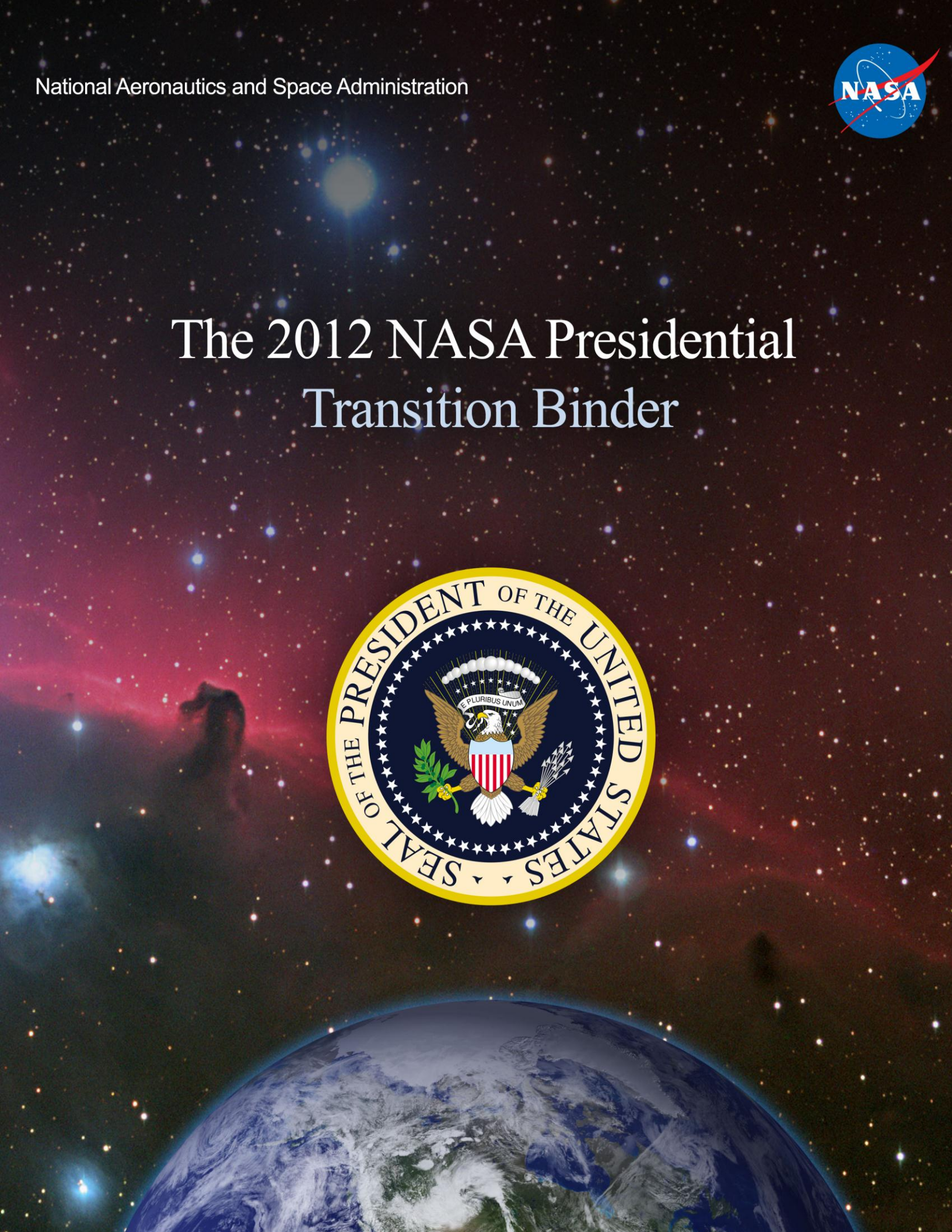
National Aeronautics and Space Administration

The 2012 NASA Presidential Transition Binder



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NASA Presidential Transition Binder Executive Summary

The NASA Presidential Transition Binder is one of three parts of the NASA documentation assembled for the benefit of the Presidential Transition Team. The first part is the Transition Library, which contains reports, documents, and other publications related to NASA. The second part is the Transition Binder, this document, which contains information specifically generated for the Transition Team by NASA. The third part is the Critical Issues book, which contains a description of major issues facing the Agency that will need to be addressed at some point in the near future. This executive summary presents an overview of the information contained in the Transition Binder.

1.0 The Space Act, Relevant Space Policies, and Other Applicable Laws

NASA was established by the National Aeronautics and Space Act of 1958. Title 51, United States Code, National and Commercial Space Programs (Public Law 111-314), revises and restates certain laws relating to national and commercial space programs as a new positive law title of the United States Code. Title 51 provides a complete compilation, restatement, and revision of the general and permanent laws related to NASA.

Over the past five decades, a substantial amount of legislation was enacted relating to national and commercial space programs. In the United States Code, some of these provisions appeared in Title 15 (Commerce and Trade), some in Title 42 (The Public Health and Welfare), and some in Title 49 (Transportation). No distinct title for national and commercial space programs existed in the United States Code because the organizational scheme for the Code was originally established in 1926, before such programs were contemplated.

2.0 NASA 2011 Strategic Plan Summary

NASA is currently operating under its 2011 Strategic Plan with the next Strategic Plan due in February of 2014. The main elements of the Strategic Plan are goals for NASA's major functions and operations, and a description of how these goals are to be achieved. This section describes the primary aspects of the 2011 Strategic Plan, a copy of which can be found in the Transition Library.

3.0 NASA Governance and Strategic Management

The purpose of NASA's governance structure is to promote mission success by fostering an integrated working relationship between programmatic and institutional managers as they fulfill their separate responsibilities. This section describes NASA's governance structure and rationale.

4.0 NASA Organization and Roles

NASA consists of the Office of the Administrator, Mission Directorates, Mission Support Offices with sub-offices, and NASA centers. This section describes each of the offices and centers.

5.0 NASA Budget and History Overview

The NASA budget has fluctuated since its inception in 1959. This section provides historical context to NASA's budget and its changes over time.

6.0 NASA Major Missions

NASA currently has numerous major missions underway or planned. This section provides

an overview of some of the missions in terms of budget and/or visibility. These flight missions are organized by the Mission Directorate.

7.0 Mishap Investigations and Contingency Plans

NASA conducts mishap investigations in accordance with NASA Procedural Requirements for Mishap Reporting, Investigating, and Recordkeeping. The objective is to improve safety by identifying what happened, where it happened, when it happened, why it happened, and what should be done to prevent recurrence and reduce the number and severity of mishaps.

8.0 The NASA Workforce

NASA's workforce consists of almost 18,000 civil servants. This workforce is supported by nearly 40,000 contractor personnel that are located on or near NASA-managed locations. This section breaks down and describes NASA's workforce in several categories. In addition, this section provides an overview of NASA's long-term workforce strategy.

9.0 NASA Interaction with Executive Office Of The President

NASA interacts with the Executive Office of the President via three primary bodies: the Office of Management and Budget, the Office of Science and Technology Policy, and the National Security Council. This section describes NASA's interactions with these organizations.

10.0 Congressional Committee Leadership as of October 10, 2012, and General Accountability Office Interaction

NASA is subject to oversight by numerous Senate and House committees, as well as by the Government Accountability Office (GAO). This section lists all of these oversight entities.

11.0 NASA Interaction with Federal Departments and Agencies

NASA routinely interacts with numerous federal departments and agencies. The Office of International and Interagency Relations at NASA Headquarters coordinates Agency-level policy interactions with U.S. executive branch departments and agencies. This section discusses NASA interaction with the Department of State, the Department of Defense, the Department of Commerce, regulatory efforts with other agencies, and provides examples of programmatic cooperation with individual federal agencies. It is important to note that interactions between NASA and other federal departments and agencies occur at multiple levels at the Agency, across all centers and Headquarters.

12.0 NASA Interaction with Foreign Entities

NASA has well-established cooperative partnerships with other foreign government space agencies. NASA currently has over 500 active international agreements in 120 countries. These partnerships include the International Space Station, Hubble Space Telescope, James Webb Space Telescope, and numerous Earth science and space science missions. It also seeks new opportunities for mutually beneficial cooperation with current partners, with emerging space programs, and with appropriate government agencies in

nations that do not have space agencies. This section describes how NASA interacts with these other organizations.

13.0 How NASA's Work is Done: In-House, Industry, Academia

NASA performs its mission using civil servants, contractors, and academic researchers, as well as international and other Agency partnerships. Work is performed at NASA Headquarters in Washington, DC, and in Mission Centers and facilities around the United States. NASA draws upon extensive support from the private sector and academia to accomplish its mission. This section provides an overview of how each of the facets of NASA's extended workforce gets its work done.

14.0 NASA Federal Advisory Committees and The National Academies

NASA, and its predecessor, the National Advisory Committee for Aeronautics (NACA), have always sought the independent judgment and guidance from scientific and technical experts in academia, industry, and other government agencies.

15.0 Timeline of Major Milestones and Events in the Budget Process

This section provides a six-month timeline of major milestones and events spanning November 2012 until April 2013. It includes such information as budget milestones, mission launch dates, and major procurement milestones

1.0 THE SPACE ACT, RELEVANT SPACE POLICIES, AND OTHER APPLICABLE LAWS

INTRODUCTION

NASA was established by the National Aeronautics and Space Act. Title 51, United States Code, National and Commercial Space Programs (Public Law 111-314), revises and restates certain laws relating to national and commercial space programs as a new positive law title of the United States Code. Title 51 provides a complete compilation, restatement, and revision of the general and permanent laws related to NASA.

Over the past five decades, a substantial amount of legislation was enacted relating to national and commercial space programs. In the United States Code, some of these provisions appeared in Title 15 (Commerce and Trade), some in Title 42 (The Public Health and Welfare), and some in Title 49 (Transportation). No distinct title for national and commercial space programs existed in the United States Code because the organizational scheme for the Code was originally established in 1926, before such programs were contemplated.

Public Law 111-314 gathers provisions relating to national and commercial space programs, and restates the provisions as title 51, United States Code, ‘‘National and Commercial Space Programs.’’

Title 51 does not provide for any new programs, nor does it modify or repeal any existing programs. Title 51 restates existing law in a manner adhering to the policy, intent, and purpose of the original enactments, while improving the organizational structure of the law and removing ambiguities, contradictions, and other imperfections.

2010 NASA AUTHORIZATION ACT

The Congress passed and the President signed the 2010 NASA Authorization Act to provide direction to NASA along with authorization for appropriations at specified levels for Fiscal Years 2011-2013. This bi-partisan legislation provided policy goals and objectives for NASA’s major programs. In particular, it directed NASA to develop the Space Launch System with an initial lift capability of 70 to 100 tons to low Earth orbit, with the capability to carry and upper stage that will bring the total lift capability to 130 tons. The Act further directed the development of a Multi-Purpose Crew Vehicle based on the Orion project. These provisions, along with others on commercial crew and cargo, continuation of ISS through at least 2020, and on science, aeronautics, and space technology are being implemented by the Agency as rapidly as appropriations allow.

1.1 POLICIES

There are several Administration policies that collectively define current U.S. National Space Policy. The most recent National Space Policy was released by President Barack Obama on June 28, 2010. It supersedes the policy issued by President George W. Bush in 2006. This June 2010 U.S. National Space Policy is the Administration’s umbrella policy, under which all U.S. space activities (national security, civil, commercial, and international) are governed. The discussion below further clarifies specific aspects of aeronautics and space policy related to NASA. A summary of the key policies are as follows:

1.1.1 U.S. National Space Policy – June 28, 2010

This is the overarching national policy that governs the conduct of U.S. space activities and supersedes the 2006 National Space Policy. The U.S. National Space Policy expresses the President's direction for the Nation's space activities, and articulates the President's commitment to reinvigorating U.S. leadership in space for the purposes of maintaining space as a stable and productive environment for the peaceful use of all nations.

The goals of the 2010 National Space Policy are:

- Energize competitive domestic industries to participate in global markets and advance the development of: satellite manufacturing; satellite-based services; space launch; terrestrial applications; and increased entrepreneurship.
- Expand international cooperation on mutually beneficial space activities to: broaden and extend the benefits of space; further the peaceful use of space; and enhance collection and partnership in sharing of space-derived information.
- Strengthen stability in space through: domestic and international measures to promote safe and responsible operations in space; improved information collection and sharing for space object collision avoidance; protection of critical space systems and supporting infrastructures, with special attention to the critical interdependence of space and information systems; and strengthening measures to mitigate orbital debris.
- Increase assurance and resilience of mission-essential functions enabled by commercial, civil, scientific, and national security spacecraft and supporting infrastructure against disruption, degradation, and destruction, whether from environmental, mechanical, electronic, or hostile causes.
- Pursue human and robotic initiatives to develop innovative technologies, foster new industries, strengthen international partnerships, inspire our Nation and the world, increase humanity's understanding of the Earth, enhance scientific discovery, and explore our solar system and the universe beyond.
- Improve space-based Earth and solar observation capabilities needed to conduct science, forecast terrestrial and near-Earth space weather, monitor climate and global change, manage natural resources, and support disaster response and recovery. And, of particular interest to NASA:
- Direction for NASA to begin crewed missions beyond the moon, including sending humans to an asteroid, by 2025. By the mid-2030s, send humans to orbit Mars and return them safely to Earth;
- Continue the operation of the International Space Station (ISS), in cooperation with its international partners, likely to 2020 or beyond, and expand efforts to: utilize the ISS for scientific, technological, commercial, diplomatic, and educational purposes; support activities requiring the unique attributes of humans in space; serve as a continuous human presence in Earth orbit; and support future objectives in human space exploration;

- Seek partnerships with the private sector to enable safe, reliable, and cost-effective commercial spaceflight capabilities and services for the transport of crew and cargo to and from the ISS;
- Implement a new space technology development and test program, working with industry, academia, and international partners to build, fly, and test several key technologies that can increase the capabilities, decrease the costs, and expand the opportunities for future space activities;
- Conduct research and development in support of next-generation launch systems, including new U.S.rocket engine technologies;
- Maintain a sustained robotic presence in the solar system to: conduct scientific investigations of other planetary bodies; demonstrate new technologies; and scout locations for future human missions;
- Continue a strong program of space science for observations, research, and analysis of our sun, solar system, and universe to enhance knowledge of the cosmos, further our understanding of fundamental natural and physical sciences, understand the conditions that may support the development of life, and search for planetary bodies and Earth-like planets in orbit around other stars; and
- Pursue capabilities, in cooperation with other departments, agencies, and commercial partners, to detect, track, catalog, and characterize near-Earth objects to reduce the risk of harm to humans.

1.1.2 U.S. Space Transportation Policy – December 21, 2004

The 2004 U.S. Space Transportation Policy is approaching the final stages of being revised by the current Administration. In general, the National Space Transportation Policy establishes goals, guidelines, and implementation actions for the full-range of U.S. space transportation-related capabilities and activities to ensure the Nation's ability to maintain access to and use of space for U.S. national and homeland security, and civil, scientific, and commercial purposes.

1.1.3 National Aeronautics Research and Development Policy – December 20, 2006

This policy and its corresponding Executive Order provide guidance for U.S. aeronautics research and development (R&D) programs through 2020. The fundamental goal of the policy is to advance U.S. technological leadership in aeronautics by fostering a vibrant and dynamic aeronautics R&D community that includes government, industry, and academia. NASA's role under this policy includes maintaining a broad foundational research effort aimed at preserving the intellectual stewardship and mastery of aeronautics core competencies, so that the Nation's world-class aeronautics expertise is retained. These core competencies also include key aeronautical capabilities that support NASA's human and robotic space activities.

1.1.4 U.S. Space-Based Positioning, Navigation, and Timing Policy – December 8, 2004

In December 2004, the President issued an important new directive for the future of the Global Positioning System (GPS), which

reflects a renewed U.S. government commitment to maintaining GPS as a global leader in satellite navigation. The policy confirms the government's intention to continue providing an uninterrupted basic service free to all on a global basis for peaceful civil and commercial use. It also acknowledges that GPS has become a global utility integral not only to our Nation's security, but also to our economic activity. Appropriately, the policy covers not just GPS, but all systems that utilize satellite-based technologies to provide enhanced positioning, navigation, or timing (PNT) services, such as the augmentation systems maintained by the Department of Transportation. NASA participates in realization of the policy through membership on the PNT Executive Committee, as well as activities such as development of requirements for the use of GPS to support civil space systems, and identifying solutions to preserve existing and evolving uses of space-based PNT services. In addition, NASA has sponsored the National Space-Based Positioning, Navigation and Timing Advisory Board since its inception in 2007, a federal advisory committee comprised of national and international PNT experts that provide guidance and recommendations to the PNT Executive Committee.

1.1.5 U.S. Commercial Remote Sensing Space Policy – April 25, 2003

This policy calls for the advancement and protection of U.S. national security and foreign policy interests by maintaining the Nation's leadership in remote sensing space activities, and by sustaining and enhancing the U.S. remote sensing industry. The purpose of this policy is to foster economic growth, contribute to environmental stewardship, and enable scientific and technological excellence. The policy sets forth that NASA and other government agencies should "rely to the maximum practical extent on U.S. commercial remote sensing space capabilities for filling imagery and geospatial needs for military, intelligence, foreign policy, homeland security and civil users and focus U.S. government remote sensing space systems on meeting needs that cannot be effectively, affordably, and reliably satisfied by commercial providers because of economic factors, civil mission needs, national security concerns, or foreign policy concerns."

1.2 Other Applicable Laws

The National Aeronautics and Space Act is NASA's legal charter. In addition, there are numerous other laws that affect NASA operations. Some primary laws in selected areas are discussed below.

1.2.1 The Environment

- The National Environmental Policy Act of 1969, as amended, 42 U.S.C. § 4331, et seq, This Act is the "basic national charter" for protecting the environment. It establishes the policies and goals for enhancing the environment and requires Federal officials to consider, in planning anddecision-making, the environmental consequences of proposed actions.
- The Clean Air Act, as amended, 42 U.S.C. § 7401 et seq. The Clean Air Act is a national comprehensive law governing Federal and State activities having any effect on the air quality. It imposes strict criteria for use oflisted hazardous air pollutants; requires phase-out of ozone-depleting chemicals, by group or class, on a specified timetable; and it includes both civil andcriminal fines and penalties for violations.
- The Comprehensive Environmental, Response, Compensation and Liability Act, as amended, 42 U.S.C. § 9601, et seq., This Act mandates compliance with

procedural and substantive requirements for hazardous waste cleanups; and provides forassessment, ranking, and evaluating facilities for listing on the National Priorities List as "superfund" sites for cleanup.

- The Solid Waste Disposal Act (SWDA), as amended particularly by the Resource Conservation and Recovery Act (RCRA), 42 U.S.C. § 6901, et seq. SWDA/RCRA mandates that all Federal agencies comply with solid and hazardous wastes handling and disposal requirements; obtain permits for releases; andproperly identify, treat, and store such wastes. The law impacts all NASA facilities. The Federal Facilities Compliance Act of 1992 provided for a waiver of sovereign immunity with respect to federal, state, and local procedural and substantive requirements relating to RCRA.

All federal, state, and local environmental laws apply to NASA either directly or through Executive Orders.

1.2.2 ETHICS/STANDARDS OF CONDUCT

This area includes the following legislation:

- Criminal statutes in Title 18, United States Code:
  - Section 201: prohibits bribery and/or gifts for or because of an official act.
  - Sections 203/205: prohibit communications on behalf of third parties before the government.
  - Section 207: post-employment restrictions; after retirement / resignation, prohibits communications with the government on behalf of third parties, such as subsequent employer or private client. In the case of the Administrator, it will likely prohibit communications with:
    - NASA on any matter for one year, because of pay rate;
    - The entire government for two years with respect to any NASA matter in existence at the time of the Administrator's separation;
    - The entire government on any matter the Administrator was personally and substantially involved in, for the lifetime of the matter.
  - Section 208: Prohibits personal and substantial involvement in any matter in which the civil servant, spouse, minor child, partner, or outside employer has a financial interest. Includes, among other things, conflicts arising from investments, as well as conflicts from employment negotiations, arrangements, or relationships.
  - Section 209: prohibits supplementation of salary as compensation for government service from a source other than the United States.
- Ethics in Government Act of 1978/Ethics Reform Act of 1989 (Pub. L. 95-521 / Pub. L. 101-194)

- Requires public financial disclosure for all Executive Schedule and SES/SL/ST employees, and confidential financial disclosure for many General Schedule employees.
- Limits outside earned income of senior, non-career employees.
- Requires annual ethics training.
- Requires the Office of Government Ethics to make ethics regulations for the entire government. OGE's regulations include conflicts of interest, gifts, seeking other employment, outside activities, and other areas.
- Stop Trading on Congressional Knowledge (STOCK) Act, Pub. L. 112-105. Requires internet access to Public Financial Disclosure forms (OGE Form 278s), which are filed by PAS, SES, ST, SL, Schedule C, and certain other employees effective December 8, 2012, with further study of the requirement.
- Requires public financial disclosure filers to file ongoing periodic transaction reports for securities transactions exceeding $1000.
- Requires public financial disclosure filers to notify their ethics office that they are negotiating for employment with an outside entity within three days of beginning negotiations and to recuse themselves in writing if a potential conflict exists.
- Requires Senate confirmed presidential appointees to report mortgage information for personal residences.
- Restricts all OGE 278 filers from buying stock through initial public offerings (IPO's) "in ways other than available to members of the public generally."
- Hatch Political Activity Act, as amended.
- The Administrator and Deputy Administrator may engage in political activity while on duty, while in government offices and in government vehicles. However, costs associated with that activity may not be paid with appropriated funds.
- Authorizes certain off-duty political activities by General Schedule employees.
- Prohibits career SES members from engaging in most political activity.

- Trade Secrets Act, as amended, 18 U.S.C. § 1905. The Trade Secrets Act requires Federal Government employees to protect proprietary/trade secret data or confidential commercial information received in the course of their employment from unauthorized release. Under the Trade Secrets Act, NASA employees are subject to criminal prosecution and removal from office for wrongful disclosure of such information. Conviction under this statute can result in fines, imprisonment, or both.

1.2.3 PERSONNEL

The following laws apply in the area of personnel. For more information, contact Veronica Marshall, Office of Human Capital Management, at (202) 358-0857.

- The Civil Service Reform Act of 1978 (Pub. L. 95-454), as amended. The Civil Service Reform Act is the legal authority for all federal personnel activities and practices. It established the Senior Executive Service, the Merit Systems Protection Board, the Office of Special Counsel, the Federal Labor Relations Authority, and a government-wide performance appraisal system.
- NASA Flexibility Act of 2004, 5 U.S.C. 9804. The Act's provisions afford NASA new flexibility with respect to recruitment, relocation, and redesignation bonuses.
- NASA Authorization & Appropriation Acts. NASA's authorization and appropriation acts frequently include specific restrictions on personnel actions, including prohibitions against reductions in force, or shifting of projects away from NASA field centers.

1.2.4 International Law and Cooperation

International law and cooperation are covered by the following legislation:

- Case-Zablocki Act, 1 U.S.C. § 1126 and the State Department's Circular 175 procedure, 22 CFR Part 181. The Act requires periodic reporting to Congress of "significant" international agreements entered into by executive branch agencies. The State Department's Circular 175 procedure is an internal process through which agencies are required to obtain State's authorization to negotiate and to conclude such agreements and involves consultation with other affected agencies—including the Office of Management and Budget.
- Iran Nonproliferation Act of 2000 – P.L.106-178, 50 U.S.C. § 1701: Effectively prohibits payments to the Russian Space Agency and entities under jurisdiction or control of the Russian government for work on the ISS or for human spaceflight. (http://www.nasa.gov/offices/ogc/commercial/18usc1905.html)
- Special Maritime & Territorial Jurisdiction of US – 18 U.S.C. § 7: Extends U.S jurisdiction to U.S. registered vehicles designed for flight or navigation in space. (http://www.nasa.gov/offices/ogc/commercial/18usc7.html)

1.2.5 Export Control

Export control legislation includes the following:

- The Arms Export Control Act of 1976, 22 U.S.C. § 2778. The Arms Export Control Act is the foundational statute for regulating trade and transfers of munitions and defense articles. The International Traffic in Arms Regulations (ITAR), 22 CFR 120.1, et seq., issued by the Department of State under the authority of the Arms Export Control Act controls the export by NASA of items on the U.S. Munitions List (USML). The USML covers launch vehicles, advanced aircraft, spacecraft, space electronics, and related equipment, including ground support equipment specifically designed or modified for spacecraft or space electronics.

NASA has been pursuing an appropriately circumscribed ITAR exemption, modeled on the Arms Export Control Act's Foreign Military Sales exemption enjoyed by the Department of Defense (DOD) and its contractors, and has engaged with the State Department and other agencies on an acceptable legislative proposal to address the ITAR-related concerns of the Agency and its contractors.

- The Export Administration Act of 1979, 50 U.S.C. App. 2401, et seq. The Export Administration Act is the basic statute that underlies the regulation of dual-use (i.e., civil/commercial and military) exports. The Export Administration Regulations (EAR), 15 CFR 730, et seq., are issued by the Department of Commerce under the authority of the Export Administration Act. The broad spectrum of dual-use items controlled on the EAR's Commerce Control List includes such items of importance to NASA as the International Space Station, developmental aircraft, navigation equipment, and sensors.

  The Administration has been consulting with Congress as it publishes a series of proposed rules to solicit public input on revised export control lists, following a DOD-chaired review, in which NASA has been participating, that is the cornerstone of the President's on-going Export Control Reform Initiative. However, the Administration will be unable to complete this process for the category of the USML that includes commercial satellites, since those items are controlled on the USML by statute. Consequently, the Administration has been working to support legislation in both the House and Senate, which would facilitate this transfer and implement the recommendations of a joint DOD and State Department national security assessment submitted to the Congress in April 2012.

1.2.6 INVENTIONS/PATENTS

Invention patents come under the jurisdiction of the following legislation:

- The Bayh-Dole Act (Pub. L. 96-517, § 6(a), 1980), as amended, 35 U.S.C. §§ 200-212. Nonprofit organizations (includes colleges and universities) and small business firms are granted the right to elect to retain title to an invention made under a "funding agreement," i.e., any contract, grant, or cooperative agreement for the performance of experimental, developmental, or research work funded in whole or in part by the Federal Government. The government retains a nonexclusive, nontransferable, irrevocable, paid-up license to practice the invention or have it practiced for or on behalf of the United States throughout the world.

- Section 20135 of the National Aeronautics and Space Act ("Space Act"), 51 U.S.C. § 20135. Section 20135 is subject to the Bayh-Dole Act. Therefore, under Section 20135, inventions by other than nonprofit organizations or small business firms that the Administrator determines were made in the manner specified by the Space Act are the exclusive property of the government. However, upon request, the Administrator may waive all or any part of the government's rights in such inventions, subject to the reservation by the Administrator of government-purpose rights in the invention, if the Administrator determines the interests of the U.S. will be served thereby.

- Executive Order 12591 issued by the President of April 10, 1987, requires executive departments and agencies, to the extent permitted by law, to adopt and implement the same or substantially the same policies for all research and development contractors as are set forth in 35 U.S.C. § 200 et seq., (Pub. L. 96-517). As a result, NASA, if requested, usually waives title to inventions made under Section 20135 of the Space Act under essentially the same circumstances, and subject to the same or similar conditions, as found in 35 U.S.C. § 200 et seq.

1.2.7 PATENT LICENSING

Patent licensing activities are regulated by the following laws:

- The Bayh-Dole Act, (Pub. L. 96-517, § 6(a), 1980) as amended, 35 U.S.C. §§ 207-209. This act authorizes each federal agency to (a) obtain and maintain patents or other forms of protection in the United States and foreign countries on inventions in which the Federal Government owns a right, title, or interest and (b) grant nonexclusive, exclusive, or partially exclusive licenses, royalty-free or for royalties or other consideration, and on such terms and conditions, including the grant to the licensee of the right of enforcement, as determined appropriate in the public interest. Provides the requirements a federal agency must meet to grant an exclusive or partially exclusive license on a federally owned invention under Section 207, and prescribes certain terms and conditions that must be included in such licenses.
- 15 U.S.C. § 3710c, Distribution of royalties received by federal agencies. This requires that each year the first $2,000, and thereafter at least 15 percent, of the royalties or other income received from licensing of federally owned inventions be distributed to the employee-inventors and any other inventors that have assigned their rights to the United States. Remaining royalties (within certain limits and under certain guidelines) are to be distributed to the laboratory where the invention was made to support activities directed to promoting the licensing of inventions.

- 51 U.S.C. § 20113(e). Under NASA's "other transactions" authority, NASA enters into reimbursable, non-reimbursable, and funded agreements (Space Act agreements) with diverse groups of people and organizations. Reimbursable Agreements are Agreements wherein NASA's costs associated with the undertaking are reimbursed by the Agreement Partner. NASA undertakes Reimbursable Agreements when it has unique goods, services, and facilities not being fully utilized to accomplish mission needs, which it can make available to others on a noninterference basis, consistent with the Agency's missions. All Reimbursable Agreements are subject to the provisions of NASA's financial management policy. Nonreimbursable Agreements involve NASA and one or more Agreement Partner(s) in a mutually beneficial activity that furthers the Agency's missions, wherein each party bears the cost of its participation, and there is no exchange of funds between the parties. Since Nonreimbursable Agreements involve the commitment of NASA resources, the respective contributions of each Agreement Partner must be fair and reasonable under the circumstances. Funded Agreements are Agreements under which appropriated funds are transferred to a domestic Agreement Partner to accomplish an Agency mission. Funded Agreements may be used only when the Agency's objective cannot be accomplished through the use of a procurement contract, grant, or cooperative agreement.
- 51 U.S.C. § 50116, National and Commercial Space Programs. This requires NASA to execute a commercial technology transfer program with the goal of facilitating the exchange of services, products, and intellectual property between NASA and the private sector. This program shall place at least as much emphasis on encouraging the transfer of NASA technology to the private sector ("spinning out") as on encouraging use of private sector technology by NASA and shall be maintained in a manner that provides clear benefits for the agency, the domestic economy, and the research community.
- Executive Order 12591 of April 10, 1987, requires agencies to take various steps to ensure that federal agencies and laboratories assist universities and the private sector in broadening the U.S. technology base by moving new knowledge from the research laboratory into the development of new products and processes.
- 15 U.S.C. § 3710a, Cooperative research and development agreements. This authorizes federal agencies to enter into Cooperative Research and Development Agreements (CRADAs) with public and private entities to transfer commercially useful technology from federal laboratories into the private sector.

1.2.8 TRADEMARKS

Trademarks and NASA Emblems are governed by the following laws and regulations:

- 15 U.S.C. Chapter 22, U.S. Trademark Law. Though NASA's name, initials, NASA Seal, Insignia, Logotype, mission patches, and other Program Identifiers are

not, technically, trademarks, their use is governed and protected by law.

Section 20141 of the Space Act (51 U.S.C. § 20141) prohibits misuse of the Agency name and initials. 14 CFR Part 1221.1 sets forth NASA's policy and procedures on use of the NASA Seal, Insignia, Logotype, and Program Identifiers.

1.2.9 Procurement Contracts, Grants and Cooperative Agreements

51 U.S.C. § 20113(e) authorizes NASA to award grants and cooperative agreements. The following legislation governs procurement contracts, grants and cooperative agreements:

- Federal Grant and Cooperative Agreement Act of 1977. The provisions of this statute are codified at 31 U.S.C. § 6301, et seq., and prescribe criteria for selecting appropriate legal instruments between federal agencies and other entities in acquiring property and services and in providing U.S. government assistance. This Act is also referred to as the "Chiles Act" after the late Senator Chiles (FL) who sponsored it. If the principal purpose of the parties is not the acquisition of property or services, but the transfer of a thing of value to a recipient to carry out a public purpose of support or stimulation authorized by law, an agency must use a grant or cooperative agreement, rather than a procurement contract.
- NASA's procurement of goods and services is governed by the following:
- Armed Services Procurement Act (ASPA) of 1947, as amended. Notable statutes amending the ASPA are the Competition in Contracting Act of 1984 and the Federal Acquisition Streamlining Act of 1994. The provisions of this statute are codified for NASA at 10 U.S.C. § 2301, et seq., and govern the procurement of supplies and services by the Agency. The competition requirement found at 12 U.S.C. § 2304 is one of the more significant provisions in the Armed Services Procurement Act. With certain defined exceptions, section 2304 of the Act requires that NASA's procurements provide for full and open competition; that is, all responsible sources must be permitted to submit bids or proposals on procurement. The Act also provides for the increased use of commercially available items, and places more emphasis on past contractor performance and best value solicitations. Although NASA derives its procurement authority from the ASPA, that does not modify its civilian agency role as established by the Space Act

1.2.10 Commercialization of Space Activities

The commercialization of space is governed by the following legislation: The Commercial Space Launch Act, as amended, codified in 51 U.S.C. § 50901 et seq. promotes commercial space launches by the private sector, through the Federal Aviation Administration (FAA) licensing of all commercial launches and reentries, including those involving space flight participants. The Act also provides FAA licensing authority for the operation of commercial launch and reentry sites. Other government agencies, including NASA, are encouraged to make facilities and services available to licensees on a direct cost reimbursable basis. In addition, the Act requires licensees to obtain insurance or

demonstrate financial responsibility to compensate third parties or the United States for possible damage resulting from their activities; and provides an indemnification mechanism for the payment by the United States of third party claims against licensees above the required insurance amounts.

- The Commercial Space Competitiveness Act, codified at 51 U.S.C. §§ 50501-506, authorizes NASA to allow non-federal entities to use NASA's space-related facilities on a reimbursable direct cost basis provided, among other things, that no equivalent commercial services are available on reasonable terms. In addition, the Act establishes a launch voucher demonstration program; multiyear anchor tenancy contracts for goods or services under certain conditions; and termination liability for the anchor tenancy contracts.
- The Commercial Space Act of 1998, codified as Chapter 501, Space Commerce, of United States Code Title 51, National and Commercial Space Programs encourages the development of a commercial space industry through a variety of mechanisms.
- Section 50111 declares that a priority goal of constructing the International Space Station is the economic development of Earth orbital space, which should be governed by free market principles. It directs NASA to enter into a funded Space Act Agreement with commercial entities for a Commercial Orbital Transportation Services crewed vehicle demonstration program, enter into an International Space Station (ISS) crew transfer and crew rescue services contract with a commercial provider who demonstrates the capability to provide such services, and generally make use of U.S. commercially provided ISS crew transfer and crew rescue services to the maximum extent practicable. (51 U.S.C. § 50111.)
- Section 50113 requires NASA to acquire space and Earth science data from commercial providers to the extent possible and, when doing so, to treat space science data as a commercial item. (51 U.S.C. § 50113.)
- Section 50115 requires NASA to acquire Earth science data from commercial providers to the extent possible and, when doing so, to treat Earth science data as a commercial item. (51 U.S.C. § 50115.)
- Section 50116 requires NASA to execute a commercial technology transfer program with the goal of facilitating the exchange of services, products, and intellectual property between NASA and the private sector. (51 U.S.C. § 50116.)
- Section 50131 mandates that the Federal Government acquire space transportation services from commercial providers, subject to certain exceptions. (51 U.S.C. § 50131.)

- Section 50132 states that the Federal Government is to treat space transportation services as commercial items when acquiring them. (51 U.S.C. § 50132.)
- Section 50134 authorizes the Federal Government to use excess intercontinental ballistic missiles as space launch vehicles only under certain conditions. (51 U.S.C. § 50134.)
- The 2003 DoD Appropriations Act of 2003, codified at 51 U.S.C. §§ 50301-302, provides loan guarantee authority, through the Secretary of Defense, for commercial reusable in-space transportation systems as a means of encouraging their production and operation by the private sector. The Act states that commercial reusable in-space transportation systems can enhance and enable U.S. space exploration by providing lower cost trajectory injection from earth orbit, transit trajectory control, and planet arrival deceleration to support NASA's missions to Mars, Pluto, and other planets.
- 51 U.S.C. § 70905 designates the U.S. segment of the ISS as a national laboratory; directs the Administrator to seek to increase the utilization of the ISS by other federal entities and the private sector through partnerships, cost-sharing agreements, and other arrangements that would supplement Administration funding of the ISS; and authorizes NASA to enter into a contract with a non-governmental entity to operate the ISS national laboratory.
- 42 U.S.C. § 18354 directs the Administrator to enter into a cooperative agreement with a not-for-profit entity to manage the activities of the ISS national laboratory. The Administrator is to provide initial financial assistance to the organization. In managing the ISS national laboratory, the organization is to, inter alia, plan and coordinate ISS national laboratory research activities; develop guidelines for non-NASA scientific utilization of ISS research capabilities and facilities in U.S.-owned modules; and cooperate with various entities to ensure the enhancement and sustained operations of non-exploration-related research payload ground support facilities. NASA, however, retains its roles and responsibilities in providing payload integration. With respect to ISS research capacity, ISS national laboratory managed experiments are to be guaranteed access to, and utilization of, not less than fifty percent (50 percent) of the U.S. research capacity allocation.
- 51 U.S.C. § 20301 requires the Administrator to carry out a balanced set of programs as delineated in the Act. NASA must also contract with the private sector for crew and cargo services, including to the ISS, to the extent practicable; use commercially available products (including software) and services to the extent practicable to support all NASA activities; and encourage commercial use and development of space.
- Land Remote Sensing Policy – 51 U.S.C. § 60101: Continuity of Landsat data acquisition.

- Title IV, "Development and Use of Commercial Crew and Cargo Transportation Capabilities," of the 2010 NASA Authorization Act (Pub. L. 111-267) addresses the ongoing commercial crew and cargo program.
- Section 401, codified at 42 U.S.C. § 18341, directs NASA to continue to support the Commercial Orbital Transportation Services program, and authorizes NASA to apply funds to support efforts to conduct a flight test, accelerate development, and develop the ground infrastructure needed for commercial cargo capability.
- Section 403, codified at 42 U.S.C. § 18342, authorizes NASA, starting in fiscal year 2012, to support follow-on commercially developed crew transportation systems, provided that specified requirements are satisfied.
- The America COMPETES Reauthorization Act of 2010 (Pub. L. 111-358) directs NASA and other Federal Government entities to carry out education programs that are designed to increase the student interest and participation in STEM, improve the literacy in STEM, and provide curriculum support and materials. This Act also gave all federal agencies, including NASA, the authority to carry out programs to award prizes competitively to stimulate innovation that has the potential to advance the mission of the respective agency.

2.0 NASA 2011 STRATEGIC PLAN SUMMARY

INTRODUCTION

NASA is operating under the 2011 Strategic Plan. Previously, NASA published Strategic Plans in 1995, 1996, 1998 (with an interim adjustment in 1999), 2000, 2003, and 2006.[1] This guiding document will be updated on a four-year cycle, starting with 2014, to better align with the beginning of each new term of an Administration.

This section discusses NASA's 2011 Strategic Plan by first presenting the plan's background and an overview. It then discusses the key components of the plan: the vision, mission, values, and strategic goals. The 2011 Strategic Plan can be found at http://www.nasa.gov/pdf/516579main_NASA2011StrategicPlan.pdf. It also provides some preliminary information on the new law and policy for agency strategic plans and NASA's forthcoming plan in development.

2.1 BACKGROUND

The law and policy determining the development and delivery of NASA's 2011 Strategic Plan are the Government Performance and Results Act (GPRA), 1993 (Section 3), and OMB Circular A-11, Part 6, Section 210, respectively. The strategic plan defines an agency's mission, long-term goals, strategies planned, and the approaches it will use to monitor its progress in addressing specific national problems, needs, challenges, and opportunities related to its mission.

The strategic plan is the cornerstone of an agency's performance framework. The strategic plan should provide the context for decisions about performance goals, priorities, and budget planning. It should provide the framework for the detail published in Agency Annual Performance Plans and Annual Performance Reports.

2.2 2011 STRATEGIC PLAN

NASA published the 2011 Strategic Plan on February 14, 2011. It reflects the laws and policies relevant to the Agency, such as the 2010 U.S. National Space Policy and the NASA Authorization Act of 2010.

NASA's strategic goals and outcomes are the basis of its performance framework.[2] They are in turn supported by objectives, performance goals, Agency Priority Goals, and annual performance goals. The objectives identify actions within a 10-year time frame that support progress toward their respective outcome. Performance goals, written to support the objectives, are published in NASA's Congressional Justification as the annual performance plan. They describe Agency activities that span the next five years and include a set of specific, measurable, annual performance goals that must align with the budget.

2.3 NASA'S VISION, MISSION, AND VALUES

NASA's Vision, Mission, and Values were updated in the 2011 Strategic Plan.

[1] Plans prior to 2003 are archived at: http://www.hq.nasa.gov/office/codez/plans/archivemenu.html. Recent Budgets, Strategic Plans, and Accountability Reports are published at http://www.nasa.gov/news/budget/index.html.

[2] An illustration of NASA's performance framework is at the end of this document.

NASA's Vision: To reach for new heights and reveal the unknown, so that what we do and learn will benefit all humankind.

NASA's Mission: Drive advances in science, technology, and exploration to enhance knowledge, education, innovation, economic vitality, and stewardship of Earth.

NASA's Values: NASA's 2011 Strategic Plan presents the agency's four core values.

- **Safety:** NASA's constant attention to safety is the cornerstone upon which we build mission success. We are committed, individually and as a team, to protecting the safety and health of the public, our team members, and those assets that the Nation entrusts to the Agency.
- **Integrity:** NASA is committed to maintaining an environment of trust, built upon honesty, ethical behavior, respect, and candor. Our leaders enable this environment by encouraging and rewarding a vigorous, open flow of communication on all issues, in all directions, and among all employees without fear of reprisal. Building trust through ethical conduct as individuals and as an organization is a necessary component of mission success.
- **Teamwork:** NASA's most powerful tool for achieving mission success is a multidisciplinary team of diverse competent people across all NASA centers. Our approach to teamwork is based on a philosophy that each team member brings unique experience and important expertise to project issues. Recognition of, and openness to, that insight improves the likelihood of identifying and resolving challenges to safety and mission success. We are committed to creating an environment that fosters teamwork and processes that support equal opportunity, collaboration, continuous learning, and openness to innovation and new ideas.
- **Excellence:** To achieve the highest standards in engineering, research, operations, and management in support of mission success, NASA is committed to nurturing an organizational culture in which individuals make full use of their time, talent, and opportunities in pursuit of excellence in both the ordinary and the extraordinary.

2.4 NASA'S STRATEGIC GOALS

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. Over 50 years later, NASA continues its work in research and exploration through its unique resources and competencies in science and engineering. The current strategic goals reflect NASA's major missions and research.

Within the Strategic Plan, each goal is supported by narrative to elaborate on the goal's relevance to the public, strategies for achievement, risks, and projections for the future. NASA's six strategic goals are listed immediately below.

- **Strategic Goal 1:** Extend and sustain human activities across the solar system.
- **Strategic Goal 2:** Expand scientific understanding of the Earth and the universe in which we live.
- **Strategic Goal 3:** Create the innovative new space technologies for our exploration, science, and economic future.

- **Strategic Goal 4:** Advance aeronautics research for societal benefit.
- **Strategic Goal 5:** Enable program and institutional capabilities to conduct NASA's aeronautics and space activities.
- **Strategic Goal 6:** Share NASA with the public, educators, and students to provide opportunities to participate in our Mission, foster innovation, and contribute to a strong national economy.

2.5 NEW LAW AND POLICY

The law and policy determining the development and delivery of federal strategic plans were overhauled in early 2011. Congress passed the Government Performance and Results Act (GPRA) Modernization Act of 2010 (GPRAMA) on January 4, 2011. OMB revised Circular A-11 in both 2011 and 2012 to reflect this new direction.

GPRAMA, (Section 2), and A-11 (2012), Part 6, Section 230, discuss several key elements required in a strategic plan. They include agency and mission information, strategic goals, strategic objectives, and Agency Priority Goals. Agencies must establish general, outcome-oriented, long-term strategic goals for the major functions and operations of the agency. Strategic goals should identify the problem or opportunity being addressed and rationale for the selection of the goals, as well as a description of consultations with Congress and other stakeholders. Strategic objectives break broader strategic goals down to a level that reflects the outcome or impact the agency is trying to achieve, as well as the specific results of an agency's contributing programs. Agency Priority Goals are selected every two years, and reflect the top implementation-focused, performance-improvement priorities of agency leadership and the Administration.

2.6 IMPLEMENTING THE 2011 STRATEGIC PLAN

NASA has been implementing the 2011 Strategic Plan in a changing policy environment. The current strategic plan was published about the same time that the GPRA Modernization Act was passed. While NASA's current strategic plan was not developed under the Modernization Act, it complies with the requirements in A-11 (2011), including Federal Priority Goals, where applicable, Agency Priority Goals, where applicable, and congressional consultation. Therefore, NASA did not have to update its strategic plan prior to 2014.

OMB guidance for strategic plans has evolved over the 2011 and 2012 versions of A-11 towards a standard strategic plan framework of strategic goals and strategic objectives. NASA's current framework has strategic goals, outcomes, and objectives, but has placed more emphasis on strategic goals and outcomes, as they align most closely with the OMB standard. Objectives are still in the strategic plan, but receive less emphasis in annual performance reporting.

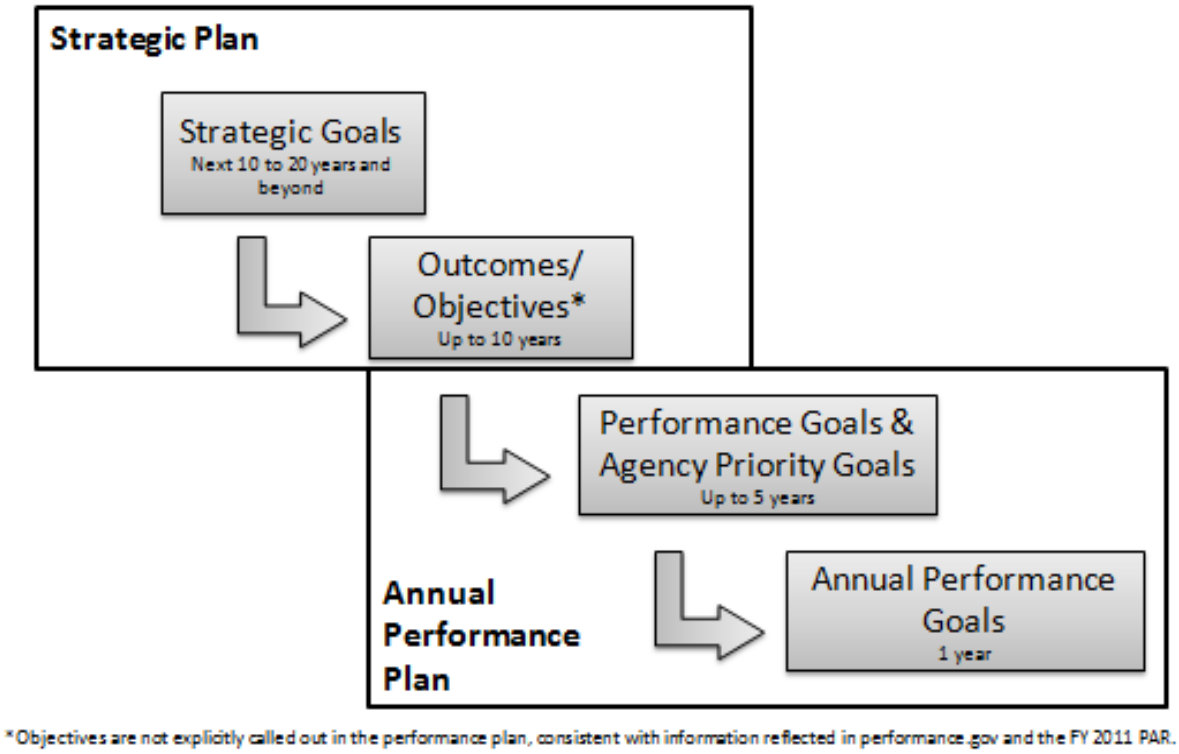
In February 2012, NASA and OMB agreed on two-year Agency Priority Goals for the FY12-13 period. A-11 directed that the goals be incorporated into the strategic plan. The 2011 Strategic Plan was amended in February 2012 to incorporate the Agency's FY12-13 Priority Goals. The Priority Goals emphasize the International Space Station, Human Exploration and Operations, Mars Science Laboratory, and Space Technology.

2.7 2014 STRATEGIC PLAN DEVELOPMENT

NASA is required to publish a new strategic plan in February 2014. As part of this timeline, OMB requests a draft strategic plan

by June 3, 2013. After a four-week review period, Agencies will incorporate OMB feedback and request input from external stakeholders. The final draft strategic plan is no later than December 20, 2013, for final clearance.

NASA began development of its 2014 Strategic Plan in spring 2012. Its development is based on the guidance in the GPRA Modernization Act and OMB Circular A-11 NASA's Performance Framework due to OMB (2012). Draft strategic goals will be provided to Control Account Managers as part of the Strategic Programming Guidance, so they can begin preparing their FY15 budgets and performance plans to align with the new plan. The plan will be published in February 2014 concurrent with the FY15 Congressional Justification.



*Objectives are not explicitly called out in the performance plan, consistent with information reflected in performance.gov and the FY 2011 PAR.

Figure 2.7-1: NASA Strategic Plan Development Process

3.0 NASA GOVERNANCE AND STRATEGIC MANAGEMENT

INTRODUCTION

NASA's primary focus is mission success for the full breadth of operational, developmental, and planned programs and projects. Institutional facilities and capabilities are maintained only because they are necessary to achieve mission success for this range of programs and projects. Similarly, Agency and center policies, requirements, standards, procedures, and practices exist only to facilitate mission success for the spectrum of programs and projects. At the same time, there is a necessary and constructive tension between organizational practices, which promote mission success in the near term and those which enable mission success in the future.

NASA's success is dependent upon a proper balance between those authorities vested in program and project managers intended to promote programmatic efficiency, and those authorities vested in institutional managers intended to assure resource availability, compliance with external requirements, compliance with applicable standards of professional practice, and efficiency across NASA's total program portfolio. The purpose of NASA's governance structure is to promote mission success by fostering an integrated working relationship between programmatic and institutional managers as they fulfill their separate responsibilities.

The Office of the Administrator, Mission Directorate Associate Administrators (AAs), Mission Support Directorate Associate and Assistant Administrators, Center Directors, and program and institutional managers each have key roles and assigned authority in executing successful missions. However, in view of their differing constraints, time frames of interest, and organizational points of view, their roles and responsibilities vary greatly as they pursue the common goals of mission safety and success. The NASA governance structure is designed to provide a system of checks and balances among these entities and their respective Authorities.

To enable Agency-wide success, NASA's governance framework is founded on the following tenets:

- Everyone in NASA has a responsibility to support the goals of its programs and projects.
- Clear roles, responsibilities, and decision making creates organizational effectiveness and efficiency.
- For major system developments, NASA generally establishes the overall architecture and manages the interfaces. Additionally, NASA must retain smart buyer/customer experience. Thus, for institutional long-term health, NASA must maintain center systems engineering, program and project management capabilities, and essential mission support capabilities.
- Programmatic and institutional perspectives can naturally differ. This creative tension must be managed constructively to provide the appropriate balance between short-term efficiency and long-term sustainability.
- While maintaining the chain of authority, information must be available to appropriate levels of management for visibility into programs, projects, and institutions.
- Each team member brings unique experience and important expertise to issues. Diversity and inclusion are integral to mission success.
- Independent reviews by respected experts are held to provide an objective measure of progress.

SOURCE: NASA Governance and Strategic Management Handbook (NPD 1000.0B draft)

3.1 ORGANIZATIONAL BALANCE

NASA's mission focus is reflected in its structure. Figure 3.1-1 is a notional representation of the NASA organization that will serve as the reference for the discussion of organizational balance. The Office of the Administrator is accountable for all Agency activities, both programmatic and institutional, and has responsibility for policy, strategic planning, budgetary resources, and oversight of NASA's overall mission. Mission Directorate AAs are responsible for managing the directorate's program portfolio and are accountable for mission safety and success for the programs and projects assigned to them. Mission Directorate AAs define, fund, evaluate, and oversee the implementation of NASA programs and projects to ensure their outcomes meet schedule and cost constraints. They establish and maintain the directorate's strategy to meet Agency goals, mission architecture, top-level requirements, schedules, and budgets. Mission Directorate AAs and program and project managers have ultimate responsibility for mission success in accordance with governing requirements.

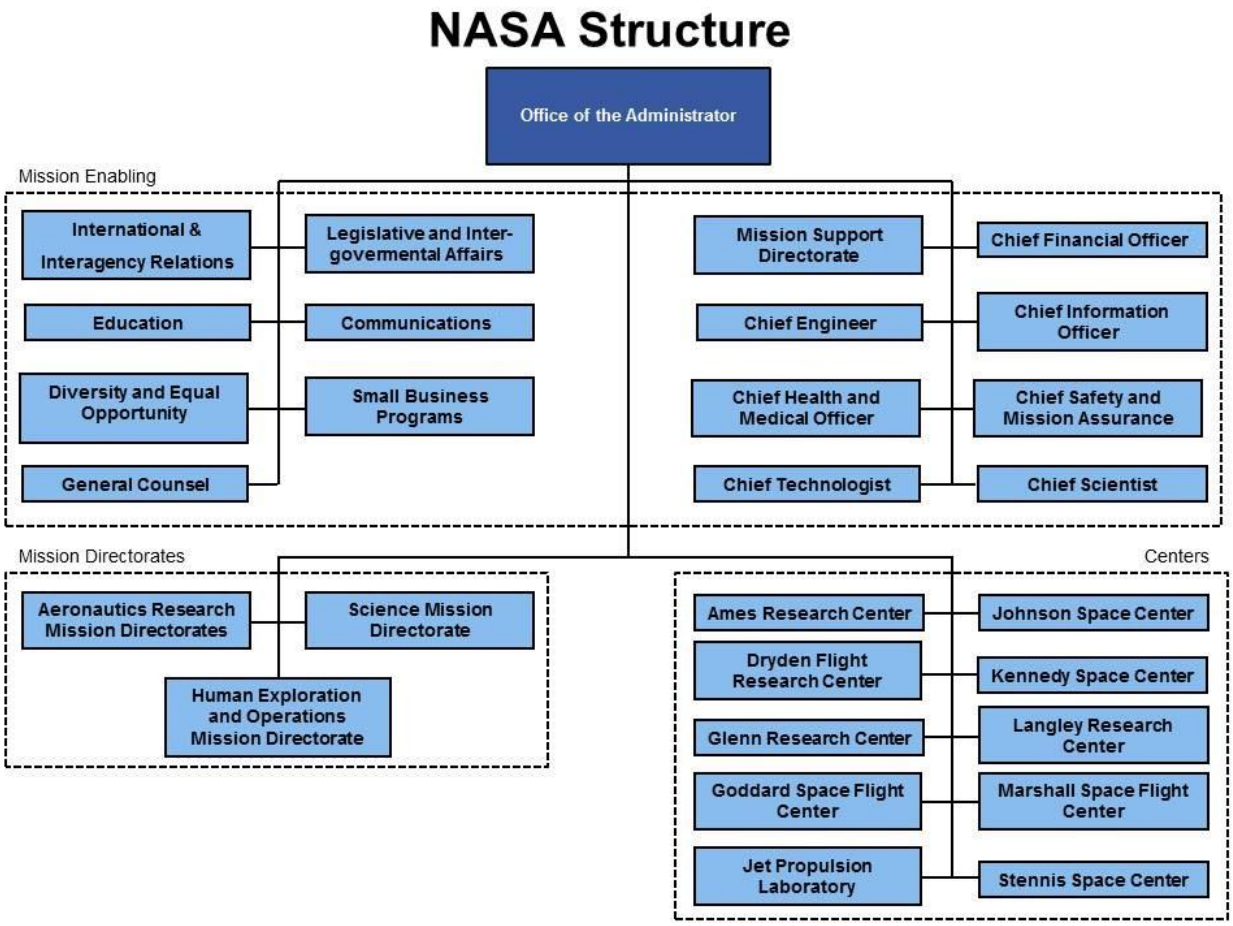


Figure 3.1-1: NASA Structure - Center functional office directors report to agency functional AA; Deputy and below report to center leadership

The Mission Support Directorate (MSD), in coordination with other Mission Support Offices, provides Agency policy and oversight and assures compliance with external and internal Agency requirements. They contribute to the decisions on strategic balance between current and future program and project needs, while ensuring the needed institutional and asset base for programs over time.

The MSD provides effective and efficient institutional support to enable the Agency to successfully accomplish its missions. The MSD focuses on reducing institutional risk to NASA's current and future missions by improving processes, stimulating efficiency, and providing consistency and uniformity across institutional capabilities and services. A key institutional role of the Mission Support Directorate AA is that of service across Mission Directorates.

Center Directors are responsible for the care of institutional assets, for establishing and maintaining the staff and their competencies, and for the facilities required by current and future programs and projects. To achieve Agency program and project objectives, Mission Directorate AAs depend on the Center Directors to execute programs in accordance with Agency priorities, and to communicate any issues to Mission Support Directorate and Mission Directorate AAs, and higher through the Agency governance process (See Figure 3.1-1). Center Directors are responsible and accountable for the proper planning and execution of programs and projects assigned to the center. Center Directors provide resources, oversee the assignment of workforce and facilities, and manage center operations to ensure the center is capable of accomplishing the programs, projects, and other activities assigned to it in accordance with Agency policy and the center's best practices and institutional policies. This includes establishing and maintaining ongoing processes and forums to monitor the status and progress of programs and projects, and performing periodic reviews to assess technical and programmatic progress.

Center Directors also serve as an important link in the Technical Authority line. By means of the Institutional (Technical and Mission Support) Authority vested in them, Center Directors are responsible and accountable for assuring that activities at their centers are implemented in accordance with accepted standards of professional practice and applicable NASA requirements (see Figure 3.1-2). They facilitate the activities of the program and project Technical Authorities as well as Mission Support Authorities.

Mission Directorate AAs and Center Directors must balance the specific needs of individual programs and projects alongside thoughtful compliance with applicable priorities, policies, procedures, and practices. To achieve this balance, Center Directors and Mission Directorate AAs report organizationally to the NASA Associate Administrator. Mission Directorate AAs do not have institutional oversight of centers. Center Directors do not provide programmatic direction but they do provide oversight of the programs and projects at their centers and they provide recommendations to the Decision Authority at key decision points throughout the life cycle of a program or project. Mission Directorate AAs and Center Directors all have a strong and vested interest in the mission of the Agency. They continually exchange information to ensure the appropriate balance and to ensure that issues and concerns are properly elevated to the AA for resolution when appropriate.

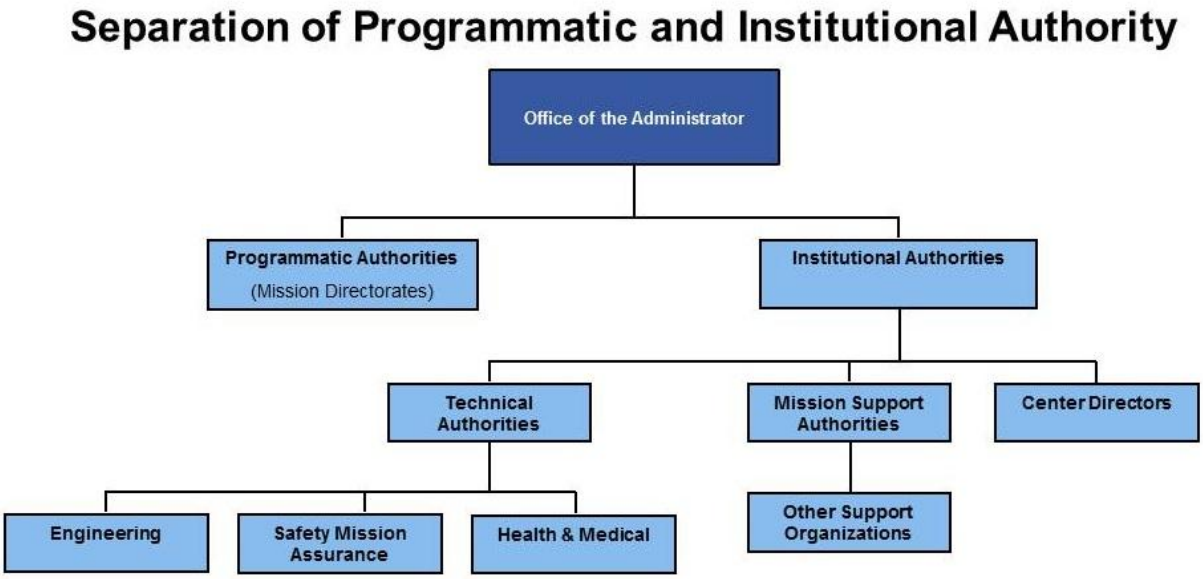


Figure 3.1-2: Separation of Programmatic and Institutional Authority

3.2 PROGRAMMATIC AND INSTITUTIONAL CHECKS AND BALANCES

An important element supporting the achievement of mission success is a management system that incorporates a robust system of checks and balances. Such a system maintains balance between organizations, promotes open communication, incorporates processes to ensure decisions benefit from different points of view, and achieves a proper balance between flexibility and formality.

The existence of a comprehensive system of checks and balances is not an expression of a lack of confidence in any organization or individual. It is recognition that NASA fulfills its overall mission through implementation of important, complex, and high-risk programs and projects for which there typically does not exist a prescribed solution or in many cases a single solution. The proper resolution of challenges to safety and mission success, and the reduction of risk to its minimum, depends on the work of teams strengthened by diverse experience and the existence of open communications. Figure 3.1-2 illustrates the separation of the Programmatic and Institutional Authorities, which is a cornerstone of NASA's system of checks and balances.

3.3 ROLES AND SEPARATION OF AUTHORITIES

NASA's separation of the roles for Programmatic and Institutional Authorities provides an organizational structure that promotes success while taking advantage of the different perspectives each Authority brings to issues.

The Office of the Administrator assigns specific responsibility and authority to the Programmatic and Institutional Authorities who report to the Administrator, Deputy Administrator, or Associate Administrator. These Authorities, who are the "official voices" for their respective areas, set, oversee, and assure conformance to applicable institutional and programmatic requirements.

The Programmatic Authority resides with the Mission Directorates and their respective programs and projects. The Institutional Authority includes respective Headquarters and center organizations. This Authority includes the Technical Authorities (individuals with specifically delegated authority in Engineering, Safety and Mission Assurance, and Health and Medical), the Mission Support Authorities consisting of MSD and remaining Headquarters Mission Support Offices, the center organizations that are aligned with these offices, and the Center Directors.

3.3.1 PROGRAMMATIC AUTHORITY

The Mission Directorates and their program and project managers are the Programmatic Authorities.

The Mission Directorate:

- Creates the high-level implementation strategies for program formulation based upon the NASA Strategic Plan.
- Defines the corresponding programmatic requirements and objectives.
- Evaluates program/project performance, provides guidance to the strategic acquisition process, and oversees implementation of decisions from the strategic acquisition process.

Program and project managers are responsible and accountable for the safe conduct and successful outcome of their program or project in conformance with governing Programmatic and Institutional Authority requirements.

3.3.2 INSTITUTIONAL—TECHNICAL AUTHORITY

In the separation of Programmatic and Institutional Authority roles (see Figure 3.1-2); the Institutional Authority encompasses all those Headquarters and center organizations not in the Programmatic Authority. The Engineering, Safety and Mission Assurance, and Health and Medical organizations are unique. They support programs and projects in two ways. They provide, support, and oversee the technical work of matrix personnel with necessary technical expertise. In addition, these organizations provide individuals who have a formally delegated Technical Authority role traceable to the Administrator and independent of Programmatic Authority. The Technical Authorities are a key part of NASA's overall system of checks and balances and provide independent oversight of programs and projects in support of safety and mission success. The individuals fulfilling Technical Authority roles have independent reporting paths from the program or project.

The responsibilities of a program or project manager have not been diminished by the implementation of a Technical Authority. The program or project manager is still ultimately responsible for the safe conduct and successful outcome of the program or project in accordance with governing requirements.

3.3.3 INSTITUTIONAL—MISSION SUPPORT AUTHORITY

Mission Support Authorities are the designated "official voices" of their institutional areas and the associated requirements established by NASA policy, law, or other external mandate.

These authorities are asserted horizontally (across Headquarters) and vertically (Headquarters to centers, and within centers) through leadership where there is not a direct line relationship. The delegated responsibilities of Mission Support Authorities vary depending on their functional

areas, such as finance, procurement, information technology, legal, facilities engineering, and environmental. The unifying organization for the Mission Support Authorities is the Office of the MSD AA. Common responsibilities of Mission Support Authorities are to:

- Oversee management of the functional areas of the Offices of Human Capital Management, Strategic Infrastructure, Procurement, Protective Services, Internal Controls and Management Systems, Headquarters Operations, the NASA Shared Services Center, and the NASA Management Office.
- Oversee the preparation, presentation, and execution of the mission support budget, which includes all Cross Agency Support (CAS) accounts, including Agency and Center Management and Operations (AMO, CMO), and Construction of Facilities and Environmental Compliance and Restoration (CoF and ECR, or CECR.).
- In concurrence with Center Directors, approves the assignment, promotion, discipline, and relief of the principal mission support official at each center.
- Ensures that personnel competencies and facility capabilities required to meet NASA's strategic needs are identified and provided.
- Provides an integrated projection of functional activities with associated costs and workload implications across the Agency.
- Ensures integration and alignment of mission support activities in support of Agency strategic needs.

3.4 Authority Roles Regarding Risk

Decisions related to technical and operational matters involving safety and mission success risk require formal concurrence by the cognizant Technical Authorities (Engineering, Safety and Mission Assurance, and Health and Medical). This concurrence is based on the technical merits of the case and includes agreement that the risk is acceptable. For matters involving human safety risk, the actual risk taker(s) (or official spokesperson[s] and his/her/their supervisory chain) must formally consent to taking the risk; and the responsible program, project, or operations manager must formally accept the risk.

3.5 Process-Related Checks and Balances

There are many process-related checks and balances built into NASA's way of doing business. These range from governance oversight, reviews and decision making by the Agency Management Councils (see Section 3.7) to peer reviews conducted at the lowest level to oversight reviews conducted by the Agency's Program Management Council. Three checks and balances of particular importance at the program or project level are: the independent life-cycle review process, the requirements tailoring process, and the dissenting opinion process.

3.5.1 Independent Life-Cycle Review Process

The independent life-cycle review process provides a comprehensive review of programs and projects at each life-cycle milestone by competent individuals who are not dependent on or affiliated with the program or project. The purpose of these reviews is to provide:

- The program/project with a credible, objective assessment.

- NASA senior management with an independent view of program/project performance according to plan, and whether externally-imposed impediments to the program/project's success are being removed.
- A credible basis for a decision to proceed into the next phase.

The independent review also provides vital assurance to external stakeholders that NASA's basis for proceeding is sound.

3.5.2 REQUIREMENTS TAILORING PROCESS

Good requirements that are properly managed are essential to any successful undertaking. Part of establishing the proper set of requirements is the adjustment of prescribed requirements to the specific task (e.g., a program or project). All authorizations are approved and concurred by the appropriate Programmatic and Institutional Authorities.

Principles that govern the process of tailoring requirements are:

1. The organization at the level that established the requirement must approve the request for tailoring of that requirement unless this authority has been formally delegated elsewhere. The organization approving the tailoring disposition consults with the other organizations that were involved in the establishment of the specific requirement and obtains the concurrence of those organizations having a material interest.
2. The involved management at the next higher level is to be informed in a timely manner of the request for tailoring of the prescribed requirement.

3.5.3 DISSENTING OPINION PROCESS

NASA supports the full and open airing of issues of any nature (e.g., programmatic, institutional), including alternative and divergent views. Diverse views are to be fostered and respected in an environment of integrity and trust with no suppression or retribution. In the team environment in which NASA operates, team members often have to determine where they stand on a decision. In assessing a decision or action, a member has three choices: agree, disagree but be willing to fully support the decision, or disagree and raise a Dissenting Opinion. For disagreements that rise to the level of importance that warrant a specific review and decision by a higher level of management, NASA has formalized the Dissenting Opinion process.

A "Dissenting Opinion" is a substantive disagreement with a decision or action that an individual judges is not in the best interest of NASA and is of sufficient importance that it warrants a timely review and decision by higher level management. A Dissenting Opinion must be supportable and based on a sound rationale (not on unyielding opposition). The individual must specifically request that the dissent be recorded and resolved by the Dissenting Opinion process.

Key steps of the Dissenting Opinion resolution process are:

1. Disagreeing parties must jointly establish the facts agreed upon and their respective positions, rationale, and recommendations;
2. The parties jointly present to the next higher level of the involved Authorities (e.g., the Programmatic and Technical Authority); and
3. If the dissenter is not satisfied with the process or outcome, the dissenter may appeal to the next higher level of management. The dissenter has the right

to take the issue upward through the organization, even to the NASA Administrator, if necessary.

3.6 AUTHORITY AND ACCOUNTABILITY

The strategic importance of ethics and values in top management cascades throughout and supports a NASA culture of accountability and transparency. Authority and accountability for any work within the Agency must be in alignment. Where there are overlaps or competing interests between a program or project and the institution, special attention is required. If authority and accountability are not directly aligned, consideration should be given to reassigning affected Agency components to the appropriate authority. Missions, programs, and projects are discouraged from creating duplicative institutional capabilities.

Note: A complete copy of NASA Policy Directive 1000.0A, from which this section was excerpted, can be found in the NASA Presidential Transition Library.

The Agency maintains active system-wide accountability processes and reporting through the Agency Office of Internal Management Control Systems and its work with each Agency organization. The governance oversight function is performed by the Senior Assessment Team (SAT), which is the Agency's Internal Control Board and reports to the Mission Support Council (MSC). The SAT provides leadership in the definition, implementation, and assessment of the Agency's internal control program and all associated activities.

3.7 AGENCY MANAGEMENT COUNCILS

NASA resolves authority and accountability issues through an active, integrated governance management system. This system is multi-pronged and utilizes a collaborative governance process.

NASA governs with three Agency-level councils with distinct charters and responsibilities: the Executive Council (EC), the Mission Support Council (MSC), and the Program Management Council (PMC). In addition, the Strategic Management Council (SMC) may be convened by the Administrator, allowing broader organization engagement on key issues and specific topics.

Governance by council is used where topics require high levels of integration, visibility, and approval. Governance by council also provides high-level oversight, sets requirements and strategic priorities, and guides key assessments of the Agency. As indicated by Figure 3.7-1, the governance structure affects all major processes.

Regardless of organizational position, senior managers are accountable to the appropriate council chair with respect to topics addressed by that council. These councils are essential components of governance; no other Agency-wide chartered governing councils are required. All internal, Agency-level sub-councils or boards report directly to the Chair of one of the three governance councils. Functional support for the three Agency level councils is provided by the Office of Agency Council Staff (OACS), which reports to the Chief of Staff. The Office of Strategy Formulation, with support of the OACS, provides functional support to the SMC.

NOTE: NASA Policy Directive (NPD) 1000.0B (in Draft as of September 2012) will describe the purpose, responsibilities, and authority of NASA's three governance councils. That text is included here until publication of NPD 1000.0B.

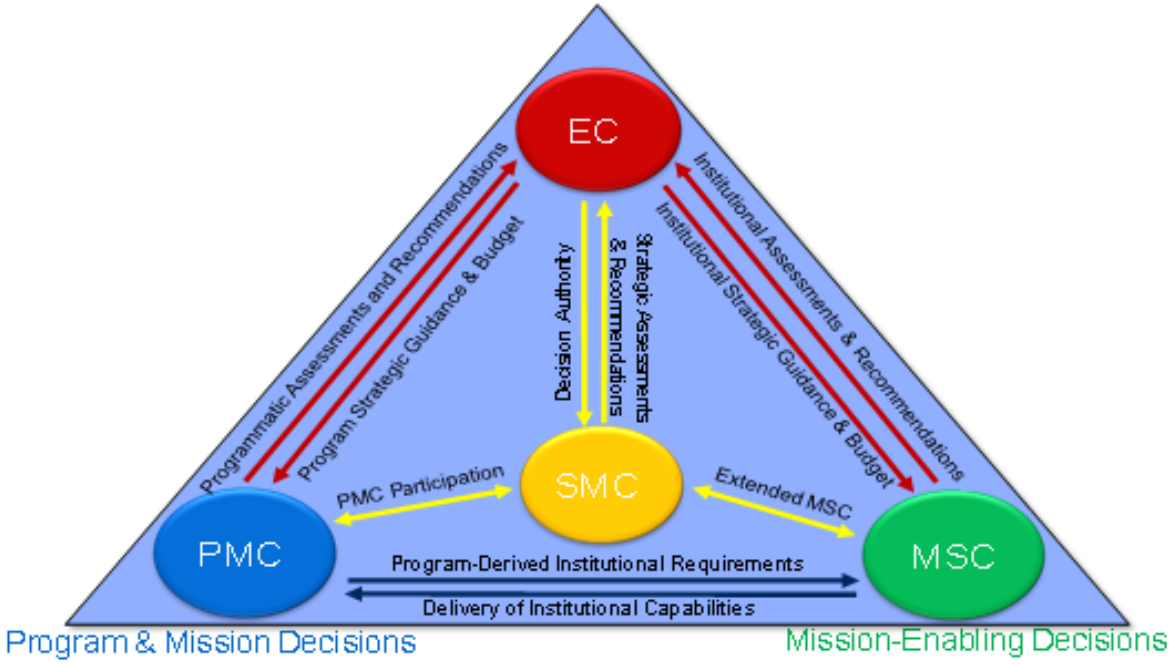


Figure 3.7-1: NASA's Management Councils

4.0 NASA ORGANIZATION AND ROLES

INTRODUCTION

NASA's organizational structure reflects the wide range of goals and missions that NASA supports. This section discusses how NASA is organized, and the role of each of NASA's component units. An organizational chart is presented with lines of authority and responsibility among NASA's units. In addition, biographical information is provided on each component unit's Official in Charge (OIC), as well as the Directors of the NASA centers.

4.1 OVERVIEW OF THE NASA ORGANIZATION

NASA's organization is shown in Figure 4.1-1 below, and consists of NASA Headquarters in Washington, DC, 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. The Headquarters is organized into an Office of the Administrator, Administrative Staff Offices, three Mission Directorates, and the Mission Support Directorate. Note: at the time this document was created, the Agency was in the process of restructuring the Office of the Chief Technologist and setting up a separate Space Technology Mission Directorate.

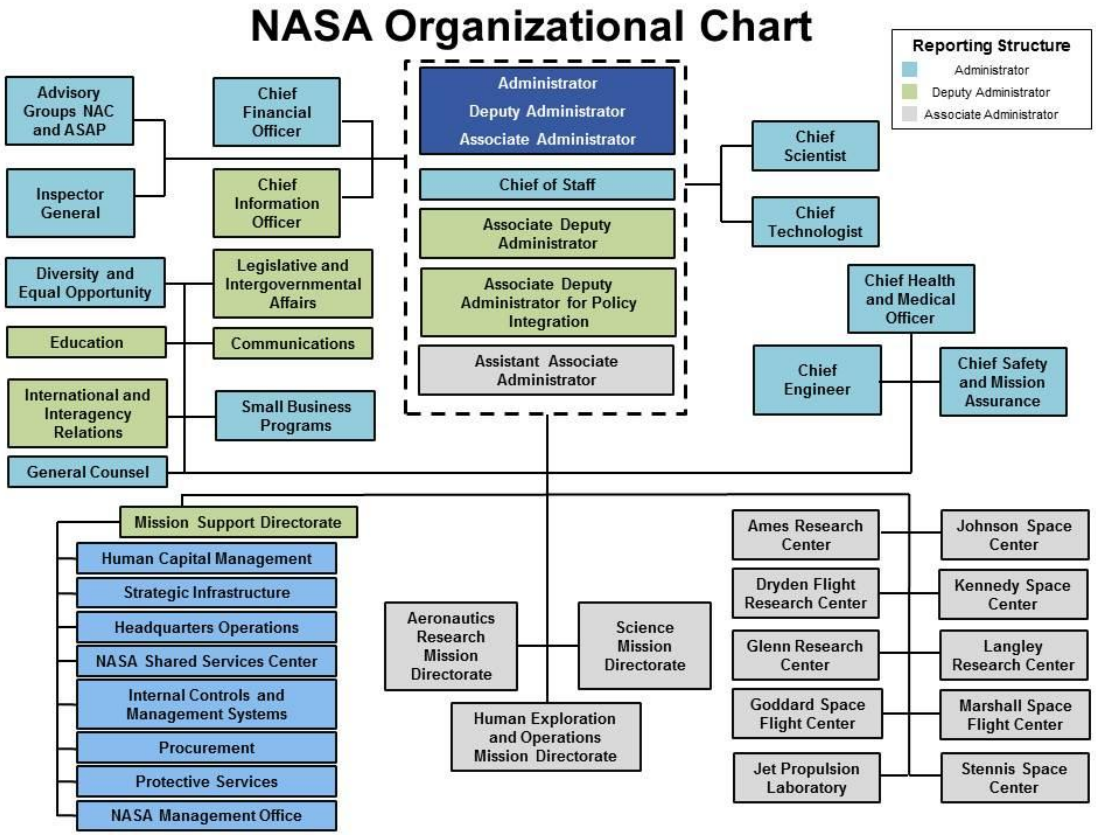


Figure 4.1-1: NASA Organizational Chart

4.1.1 NASA Office of the Administrator

This office provides overall leadership, planning, policy direction, management, and coordination for all NASA activities.

This section discusses the structure of NASA's Office of the Administrator. For each component, we present its mission statement and biographical information on the Official in Charge of that department.

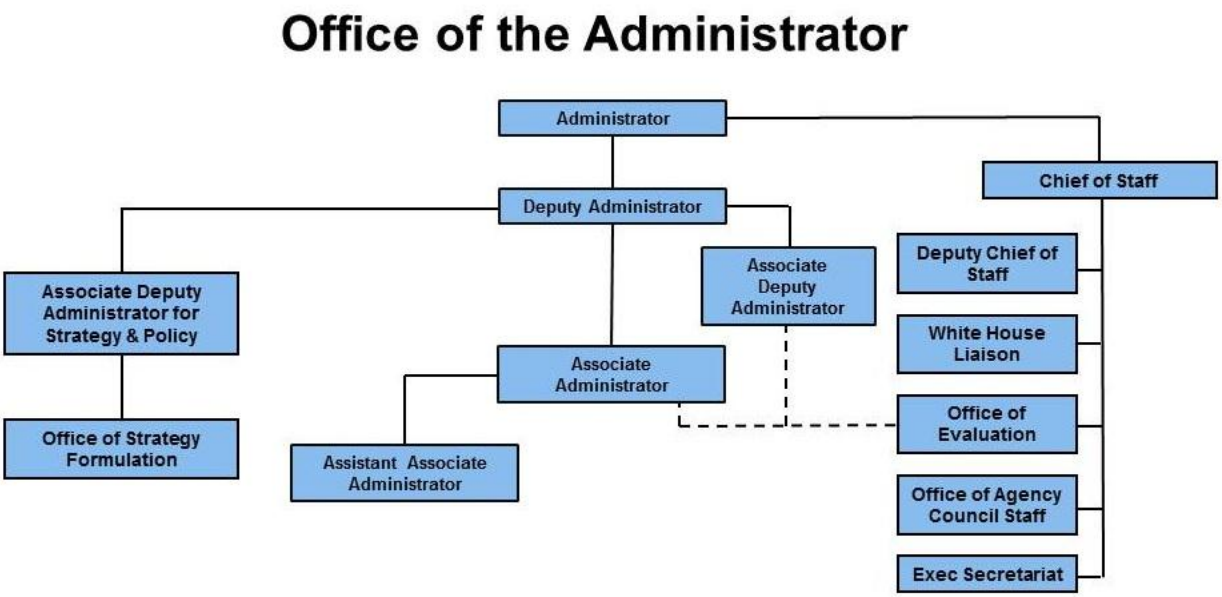


Figure 4.1.1-1: NASA Organizational Chart

4.1.2 ADMINISTRATOR

MISSION STATEMENT

The Administrator leads the Agency and is accountable to the President for all aspects of the Agency's mission, including establishing and articulating the Agency's vision and strategic priorities, ensuring successful implementation of supporting policies, programs, and performance assessments. The Administrator performs all necessary functions to govern NASA operations and exercises the powers vested in NASA by law.

OFFICIAL IN CHARGE

NASA Administrator, Charles F. Bolden, Jr.

Nominated by President Barack Obama and confirmed by the U.S. Senate, retired Marine Corps Maj. Gen. Charles Frank Bolden, Jr., began his duties as the twelfth Administrator of the National Aeronautics and Space Administration on July 17, 2009. As Administrator, he leads the NASA team and manages its resources to advance the agency's missions and goals.

Bolden's confirmation marks the beginning of his second stint with the nation's space agency. His 34-year career with the Marine Corps included 14 years as a member of NASA's Astronaut Office. After joining the office in 1980, he traveled to orbit four times aboard the space shuttle between 1986 and 1994, commanding two of the missions. His flights included deployment of the Hubble Space Telescope and the first joint U.S.-Russian shuttle mission, which featured a cosmonaut as a member of his crew. Prior to Bolden's nomination for the NASA Administrator's job, he was employed as the Chief Executive Officer of JACKandPANTHER LLC, a small business enterprise providing leadership, military and aerospace consulting, and motivational speaking.

A resident of Houston, Bolden was born Aug. 19, 1946, in Columbia, S.C. He graduated from C. A. Johnson High School in 1964 and received an appointment to the U.S. Naval Academy. Bolden earned a Bachelor of Science degree in electrical science in 1968 and was commissioned as a second lieutenant in the Marine Corps. After completing flight training in 1970, he became a naval aviator. Bolden flew more than 100 combat missions in North and South Vietnam, Laos, and Cambodia, while stationed in Namphong, Thailand, from 1972-1973.

After returning to the U.S., Bolden served in a variety of positions in the Marine Corps in California and earned a Master of Science degree in Systems Management from the University of Southern California in 1977. Following graduation, he was assigned to

the Naval Test Pilot School at Patuxent River, MD, and completed his training in 1979. While working at the Naval Air Test Center's Systems Engineering and Strike Aircraft Test Directorates, he tested a variety of ground attack aircraft until his selection as an astronaut candidate in 1980.

Bolden's NASA astronaut career included technical assignments as the Astronaut Office Safety Officer; Technical Assistant to the Director of Flight Crew Operations; Special Assistant to the Director of the Johnson Space Center; Chief of the Safety Division at Johnson (overseeing safety efforts for the return to flight after the 1986 Challenger accident); Lead Astronaut for vehicle test and checkout at the Kennedy Space Center; and Assistant Deputy Administrator at NASA Headquarters. After his final space shuttle flight in 1994, he left the agency to return to active duty with the operating forces in the Marine Corps as the Deputy Commandant of Midshipmen at the U.S. Naval Academy.

Bolden was assigned as the Deputy Commanding General of the 1st Marine Expeditionary Force in the Pacific in 1997. During the first half of 1998, he served as Commanding General of the 1st Marine Expeditionary Force Forward in support of Operation Desert Thunder in Kuwait. Bolden was promoted to his final rank of Major General in July 1998 and named Deputy Commander of U.S. Forces in Japan. He later served as the Commanding General of the 3rd Marine Aircraft Wing at Marine Corps Air Station Miramar in San Diego, CA, from 2000 until 2002, before retiring from the Marine Corps in 2003. Bolden's many military decorations include the Defense Superior Service Medal and the Distinguished Flying Cross. He was inducted into the U.S. Astronaut Hall of Fame in May 2006.

Bolden is married to the former Alexis (Jackie) Walker of Columbia, S.C. The couple has two children: Anthony Che, a lieutenant colonel in the Marine Corps who is married to the former Penelope McDougal of Sydney, Australia, and Kelly Michelle, a medical doctor now serving a fellowship in plastic surgery.

4.1.3 DEPUTY ADMINISTRATOR

MISSION STATEMENT

The Deputy Administrator is responsible to the Administrator for providing overall leadership, planning, and policy direction for the Agency. The Deputy Administrator performs the duties and exercises the powers delegated by the Administrator, assists the Administrator in making final Agency decisions, and acts for the Administrator in his or her absence by performing all necessary functions to govern NASA operations and exercise the powers vested in the Agency by law.

The Deputy Administrator articulates the Agency's vision and represents NASA to the Executive Office of the President, Congress, heads of federal and other appropriate government agencies, international organizations, and external organizations and communities.

OFFICIAL IN CHARGE

NASA Deputy Administrator, Lori B. Garver

Nominated by President Barack Obama and confirmed by the U.S. Senate, Lori Beth Garver began her duties as the Deputy Administrator of the National Aeronautics and Space Administration on July 17, 2009.

As Deputy Administrator, Garver is NASA's second in command. She works closely with the administrator to provide overall leadership, planning, and policy direction for the Agency. Together with the NASA administrator, Garver represents NASA to the Executive Office of the President, Congress, heads of government agencies, international organizations, and external organizations and communities. She also oversees the work of NASA's functional offices.

Garver's confirmation as Deputy Administrator marks the second time she has worked for NASA. Her first period of service to the agency was from 1996 to 2001. She first served as a special assistant to the NASA Administrator and senior policy analyst for the Office of Policy and Plans, before becoming Associate Administrator for the Office of Policy and Plans. Reporting to the NASA administrator, she oversaw the analysis, development and integration of policies and long-range plans, the NASA Strategic Management System, and the NASA Advisory Council.

A native of Michigan, Garver graduated from Haslett High School in Haslett, Michigan, in 1979 and four years later, in 1983, she earned a bachelor's degree in political science and economics from Colorado College. Her focus turned to space when she accepted a job working for Sen. John Glenn from 1983 to 1984. She since has served in a variety of senior roles in the nonprofit, government, and commercial sectors.

Garver worked at the newly formed National Space Society from 1984 to 1996, becoming its second executive director in 1987. She served as the society's primary spokesperson, making frequent appearances on national television and regularly testifying on Capitol Hill. She also earned a Master's degree in Science, Technology and Public Policy from George Washington University in 1989.

After working at NASA from 1996 to 2001, Garver was employed as the Vice President of DFI Corporate Services from 2001 to 2003. From January 2001 until her nomination as NASA's Deputy Administrator, she was a full-time consultant as the president of Capital Space, LLC, and Senior Advisor for space at the Avascent Group. In these roles, she provided strategic planning, technology feasibility research, and business development assistance, as well as merger, acquisition, and strategic alliance support, to financial institutions and Fortune 500 companies.

Garver was the lead civil space policy advisor for the 2008 Obama presidential campaign and led the agency review team for NASA during the post-election transition. Previously, she served as the lead space policy advisor for the Hillary Clinton and John Kerry campaigns for president and represented them at various events and conferences. Garver has held numerous senior positions in space policy. She was a member of the NASA Advisory Council, a guest lecturer at the International Space University, President and board member of Women in Aerospace, and President of the American Astronautical Society. She lives in Virginia with her husband, David Brandt, and their sons Wesley and Mitchell.

4.1.4 ASSOCIATE ADMINISTRATOR

MISSION STATEMENT

The Associate Administrator reports to the Deputy Administrator and the Administrator, and is responsible for integrating the technical and programmatic elements of the Agency. The Associate Administrator oversees the Agency's programs through the Mission Directorates, Field Centers, and Headquarters technical mission support offices, to include the Office of Safety and Mission Assurance and the Office of the Chief Engineer.

The Associate Administrator performs the duties and exercises the powers delegated by the Administrator and acts for the Administrator in the absence of the Administrator and Deputy Administrator.

The Associate Administrator oversees the planning, directing, organization, and control of the day-to-day Agency technical and programmatic operations, including establishing controls over Agency activities, providing a means for evaluating mission accomplishments, and correcting deficiencies. In addition, the Associate Administrator provides institutional management, programmatic oversight, and performance evaluation of the Mission Directorates, Field Centers, and Technical Mission Support Offices.

OFFICIAL IN CHARGE

NASA Associate Administrator, Robert M. Lightfoot, Jr.

Robert M. Lightfoot Jr. became Associate Administrator for NASA, the agency's highest-ranking civil servant position, effective Sept. 25, 2012.

He previously was director of NASA's Marshall Space Flight Center in Huntsville, AL. Named to the position in August 2009, he headed one of NASA's largest field installations, which played a critical role in NASA's space operations, exploration, and science missions. Lightfoot managed a broad range of propulsion, scientific, and space transportation activities contributing to the nation's space program. He served as acting director of the center from March 2009 until his appointment as Director.

From 2007 to 2009, Lightfoot was Deputy Director of the Marshall Center. Lightfoot served as manager of the Space Shuttle Propulsion Office at Marshall from 2005 to 2007, where he was responsible for overseeing the manufacture, assembly, and operation of the primary shuttle propulsion elements: the main engines, external tank, solid rocket boosters, and reusable solid rocket motors.

From 2003 to 2005, he served as Assistant Associate Administrator for the Space Shuttle Program in the Office of Space Operations at NASA Headquarters in Washington, DC. His responsibilities included space shuttle return to flight activities following the Columbia tragedy, technical and budgetary oversight of the $3 billion annual budget, and initial transition and retirement efforts for shuttle infrastructure.

In 2002, Lightfoot was named Director of the Propulsion Test Directorate at NASA's Stennis Space Center. He served as Deputy Director of the organization beginning in 2001, until his appointment as director.

Lightfoot began his NASA career at the Marshall Center in 1989 as a test engineer and program manager for the Space Shuttle Main Engine Technology Test Bed Program and the Russian RD-180 Engine Testing Program for the Atlas Launch Vehicle Program.

Lightfoot received a Bachelor's degree in Mechanical Engineering in 1986 from the University of Alabama. In October 2007, he was named Distinguished Departmental Fellow for the University of Alabama, Department of Mechanical Engineering. He was selected as a University of Alabama College of Engineering fellow in 2009. Lightfoot serves on the University of Alabama Mechanical Engineering Advisory Board. In 2010, he was inducted into the State of Alabama Engineering Hall of Fame.

Lightfoot has received numerous awards during his NASA career, including a NASA Outstanding Leadership medal in 2007 for exemplary leadership of the Shuttle Propulsion Office, assuring safety for the return to flight of the space shuttle. In 2006, he was awarded the Presidential Rank Award for Meritorious Executives, and in 2010 he received the Presidential Rank Award for Distinguished Executives — the highest honors attainable for federal government work. In 2000, Lightfoot received a Spaceflight Leadership Recognition Award, which recognizes leaders who exemplify characteristics necessary for success. In 1999, NASA's astronaut corps presented him with a Silver Snoopy Award, which honors individuals who have made key contributions to the success of human spaceflight missions. He also received the NASA Exceptional Achievement Medal in 1996 for significant contributions to NASA's mission.

4.1.5 CHIEF OF STAFF

MISSION STATEMENT

The Chief of Staff directs the Office of the Administrator, and oversees the Office of Evaluation and the Office of the Agency Council Staff. The Chief of Staff coordinates the management of initiatives, programs, and policies in critical areas of concern to the Administrator and Deputy Administrator, and also serves as the liaison to White House staff.

OFFICIAL IN CHARGE

Chief of Staff, David Radzanowski

David Radzanowski serves as Chief of Staff and principal advisor to NASA Administrator Charles F. Bolden, Jr., a position he has held since May 2010.

As Chief of Staff, he facilitates the management of actions in critical areas and ensures the effective flow of communications regarding the Administrator's priorities, messages, and directives. He directs the daily execution of NASA Headquarters' functions including the Office of Evaluation and the Office of Agency Council Staff.

Prior to this appointment as Chief of Staff, he was the Deputy Associate Administrator for Program Integration for the Space Operations Mission Directorate, where he had oversight responsibility for the administrative functions of the Directorate as well as Space Shuttle Transition and Retirement activities.

In February 2006, he joined NASA as Assistant Associate Administrator for the Resources Management and Analysis Office within Space Operations.

Radzanowski's NASA career included supporting the Review of U.S. Human Spaceflight Plans Committee, otherwise known as the Augustine Committee, which conducted a comprehensive review of NASA's human spaceflight plans. He provided assistance and guidance primarily in the areas of budget and program costing. He received a Meritorious Presidential Rank Award in 1999 and NASA's Outstanding Leadership Medal in 2011.

Before coming to the Agency, Radzanowski served eight years at the White House Office of Management and Budget (OMB) as Deputy Associate Director for Appropriations, Office of Legislative Affairs (October 2005 – February 2006); Chief, Science and Space Programs Branch (October 2002 – October 2005); and Program Examiner for the National Science Foundation, Science and Space Programs Branch (June 1998 – October 2002).

Prior to joining OMB, Radzanowski served eight years as an analyst in aerospace policy for the Congressional Research Service on Capitol Hill. In this position, he wrote over 30 reports on space issues and testified twice before Congress on NASA issues.

Radzanowski earned his bachelor's degree in Astronomy-Physics from the University of Wisconsin-Madison in 1988. He earned a master's degree in Public Policy and Management from Carnegie Mellon University's Heinz School of Public Policy in 1990. He is married to Jennifer Kron of New Jersey. They reside in Washington, DC.

OFFICIAL IN CHARGE

Deputy Chief of Staff, Michael French

Michael French serves as NASA's Deputy Chief of Staff and as a senior advisor to NASA Administrator Charles F. Bolden, Jr. and Chief of Staff David Radzanowski on agency activities, a position he has held since August 2011. In this position, he facilitates the expeditious consideration and management of actions in critical areas with which the administrator is concerned and ensures the effective flow of communications regarding the administrator's priorities and directives.

Prior to this appointment, French served as senior advisor to the Secretary of the Interior, as Deputy Director of Cabinet Affairs at the White House, and as Counsel to the Chairman of the Federal Election Commission. Prior to working in the federal government, French practiced law in the defense-aerospace sector as an attorney in Los Angeles. In 2008, French served as an in-house counsel to the Obama for America campaign and as an attorney to the Obama-Biden Presidential Transition Team.

French earned his bachelor's degree in business administration from the Haas School of Business at the University of California, Berkeley. He also holds a J.D. from Harvard Law School. He lives with his wife and two children in Alexandria, VA.

4.1.6 ASSOCIATE DEPUTY ADMINISTRATOR

MISSION STATEMENT

The Associate Deputy Administrator is responsible for integrating the mission support elements of the Agency. The Associate Deputy Administrator oversees the Agency's mission support functions through the Mission Support Directorate, centers, and appropriate staff offices.

OFFICIAL IN CHARGE

NASA Associate Deputy Administrator, Richard Keegan

Richard Keegan was appointed as NASA's Associate Deputy Administrator on Dec. 16, 2010. The associate deputy administrator assists and supports NASA's deputy administrator and administrator during day-to-day Agency operations, across the broad scope of institutional and workforce issues, as well as with with contingency and continuity of operations planning. Previously, Keegan served as Deputy Associate Administrator of the Mission Support Directorate at its creation in April 2010. For the prior four years he was director of NASA's Office of Program and Institutional Integration. In those roles, he served as the focal point for balancing priorities for mission directorates, mission support offices, and Agency field centers.

Since coming to NASA Headquarters in 2002, Keegan has served in senior business management positions in mission directorate and mission support offices. He also worked in a variety of jobs during 21 years at NASA's Goddard Space Flight Center in Greenbelt, MD, NASA Headquarters, and the Department of Energy. He began his federal service in June, 1980. Prior to that, he was a junior high school science teacher for two years. He has degrees in Biological Sciences and Secondary Education from the University of Maryland.

4.1.7 Associate Deputy Administrator for Strategy and Policy

Mission Statement

The Associate Deputy Administrator for Strategy and Policy directs the Office of Strategy Formulation and serves as the primary coordinator for Agency-level policy and strategy efforts. She helps implement a wide range of initiatives in support of NASA's goals, and integrates the efforts of the Agency's various strategic planning offices to ensure consistency with the White House and legislative direction, while supervising an analytic staff in the Office of Strategy Formulation.

Official in Charge

Associate Deputy Administrator for Strategy and Policy, Rebecca Spyke Keiser

Rebecca Spyke Keiser was named NASA's

Associate Deputy Administrator for Strategy and Policy in June 2012, an expansion of her duties and portfolio, which began when she was named as the NASA associate deputy administrator for policy integration in August 2010. In this position, Keiser reports directly to Deputy Administrator Lori Garver as the primary coordinator for Agency-level policy and strategy efforts. She helps implement a wide range of initiatives in support of NASA's goals, and integrates the efforts of the Agency's various strategic planning offices to ensure consistency with the White House and legislative direction, while supervising an analytic staff in the Office of Strategy Formulation.

Keiser previously served as the executive officer for the deputy administrator since 2009, a role in which she managed the office's staff, provided policy analysis and advice, and facilitated communication across the Agency. Prior to that, Keiser was chief-of-staff for the Exploration Systems Mission Directorate at NASA Headquarters, where she led the front office team responsible for communications and cross-directorate policy formulation. She also was the executive officer for former NASA Deputy Administrator Shana Dale from 2005 to 2008.

Keiser's career includes extensive international relations experience. She has served in NASA's Office of International and Interagency Relations as the lead for France, Spain, and Portugal, and the human spaceflight lead for Asia. She also was the assistant to the director for International Relations in the Office of Science and Technology Policy, where she made policy recommendations and represented the agency at U.S. and international meetings.

Keiser earned a Bachelor of Arts degree in Japanese Studies from Wellesley College, a Master of Science degree in Politics of the World Economy from the London School of Economics, and a doctorate in International Studies from the University of South Carolina. She has received numerous NASA awards for exceptional service.

The Office of Strategy Formulation supports the Associate Deputy Administrator for Strategy and Policy's efforts by:

- Performing analysis to inform the development of the Agency's overall strategy.
- Formulating and, as needed, iterating NASA's strategy options to align with national goals and the Agency's vision and mission.
- Assessing changes in the NASA internal and external environment.
- Identifying key trade-off decisions regarding goals and objectives for the Agency.
- Developing a strategic management process that aligns with the Agency's performance management system.
- Planning senior leadership meetings with a strategic agenda as determined by the Administrator.
- Facilitating the Strategic Management Council.

Overview

The Office of Strategy Formulation (OSF) supports the Administrator, Deputy Administrator, Associate Administrator, Associate Deputy Administrator and Chief of Staff. The Office of Strategy Formulation is responsible for providing, refining, and revising, when necessary, the framework to inform strategic decision making.

Mission

The Office of Strategy Formulation coordinates the long term strategy efforts for the Agency by working with mission directorates and other key offices. It supports the Administrator in setting NASA's strategic goals and objectives. It also conducts studies and analysis that inform Agency-wide strategic issues and decisions.

4.1.8 Assistant Associate Administrator

Mission Statement

The Assistant Associate Administrator supports the Associate Administrator in integrating the technical and programmatic elements of the Agency in order to ensure accomplishment of the Agency's mission. In doing so, the AAA performs oversight of the Agency's programs through the mission directorates and field centers, and headquarters technical functional support offices, to include the Office of Safety & Mission Assurance and Office of the Chief Engineer. The AAA assists in planning, directing, organizing, and controlling the day-to-day Agency technical and programmatic operations, including establishing controls over Agency activities, providing a means for evaluating mission accomplishments, and correcting deficiencies.

Official in Charge

Assistant Associate Administrator, Art Maples (Acting)

Arthur Maples serves as NASA's Assistant Associate Administrator. In this role, he assists the Associate Administrator in the oversight and integration of NASA's programmatic and technical efforts to ensure the successful accomplishment of the agency's overall mission.

Prior to coming to the Office of the Administrator, Maples was detailed to the United States Senate. There he served as the principle space advisor to Senator Bill Nelson, Chairman of the Science and Space Subcommittee.

Before his work in the U.S. Senate, Maples spent 5-years at Goddard Space Flight Center as an information technology manager. He began his career with NASA in 1985 at the Kennedy Space Center, where he served as a biomedical engineer and technical manager. He served on the prime launch team for 19 Space Shuttle missions. He was also a project manager and technical lead for life science and ecological science projects.

Maples is the recipient of NASA's prestigious Silver Snoopy Award as well as many other commendations. He holds a Bachelor's degree in Biomedical Engineering from Tulane University and a Master's degree in Business Administration from the R.H. Smith School of Business at the University of Maryland.

4.1.9 Director, Office of Evaluation

Mission Statement

The Office of Evaluation was established on December 4, 2011. It evolved from the Office of Independent Program and Cost Evaluation. It provides objective, transparent, and multidisciplinary analysis of NASA programs and projects to inform Agency decision-making.

Official in Charge

Director Office of Evaluation, Janet E. Petro (Acting)

Janet E. Petro began her professional career as a commissioned officer in the U.S. Army after graduating in 1981 from the U.S. Military Academy at West Point, NY, with a Bachelor of Science in Engineering. She served in the U.S. Army's aviation branch with various assignments overseas in Germany. She also holds a Master of Science in Business Administration from Boston University's Metropolitan College.

Petro is on detail to the Office of the Administrator from her position as the deputy director of NASA's John F. Kennedy Space Center in Florida. Appointed to that position in April 2007, she shares responsibility with the director in managing the Kennedy team of approximately 8,600 civil service and contractor employees, determining and implementing center policy and managing and executing Kennedy missions and Agency program responsibilities.

Prior to joining NASA, Petro served in various management positions for Science Applications International Corp., also known as SAIC, and McDonnell Douglas Aerospace. At SAIC, Petro held a number of positions, including program/project manager, division manager, and deputy operations manager for several entities within the corporation's operations. She interfaced with NASA, the U.S. Air Force, the U.S. Navy, and commercial entities on numerous programs. As the interface to senior-level government customers, Petro was responsible for overseeing program and project managers and providing operational guidance on various technical programs.

At McDonnell Douglas Aerospace, Petro advanced from Mechanical Engineer and Cargo Manager for processing classified payloads for space shuttle and expendable vehicles; to program manager for executing a classified, multimillion-dollar U.S. Department of Defense program, integrating payloads onto various space vehicles at U.S. Air Force and NASA facilities; to senior manager in Advance Products Division; to Senior Manager for Communications and Data Systems Division.

Originally from Detroit, MI, she now resides with her family in Indian Harbour Beach, FL.

4.2 OFFICE OF INSPECTOR GENERAL (OIG)

MISSION STATEMENT

The Office of Inspector General (OIG) conducts independent and objective audits and investigations of NASA programs and operations; promotes economy, effectiveness, and efficiency within the Agency; prevents and detects crime, fraud, waste, and abuse; reviews and makes recommendations regarding existing and proposed legislation and regulations; and keeps the Administrator and Congress fully and currently informed of problems in Agency programs and operations.

ORGANIZATIONAL STRUCTURE

As depicted in Figure 4.2-1 below, the OIG consists of an immediate office comprised of the Inspector General, the Deputy Inspector General, the Executive Officer, and the Investigative Counsel and four component offices – Audits, Investigations, Management and Planning, and Counsel. The OIG employs auditors, analysts, investigators, attorneys, and support staff at NASA Headquarters in Washington, D.C. and at 12 other locations on or near NASA centers.

The Inspector General Act of 1978 (IG Act) established Offices of Inspectors General at agencies throughout the Federal Government to promote economy, efficiency, and effectiveness and to detect fraud, waste, and abuse in federal programs and operations. In accordance with the Act, the NASA Inspector General (IG) is nominated by the President and confirmed by the Senate to conduct objective oversight of NASA programs and operations and independently report to the Administrator, Congress, and the public.

The OIG targets its resources to address NASA's most important challenges, including those identified in the annual report produced by the OIG entitled, "NASA's Top Management and Performance Challenges" and the U.S. Government Accountability Office's High Risk List. For 2012, the OIG identified the following five issues as Top Challenges facing NASA:

- Future of U.S. Human Spaceflight
- Project Management
- Infrastructure and Facilities Management
- Acquisition and Contract Management
- Information Technology Security and Governance

In accordance with the IG Act, the OIG prepares Semiannual Reports to Congress summarizing our audit and investigative activities for each 6-month period. These reports are available on the OIG's website at http://oig.nasa.gov/sar.html.

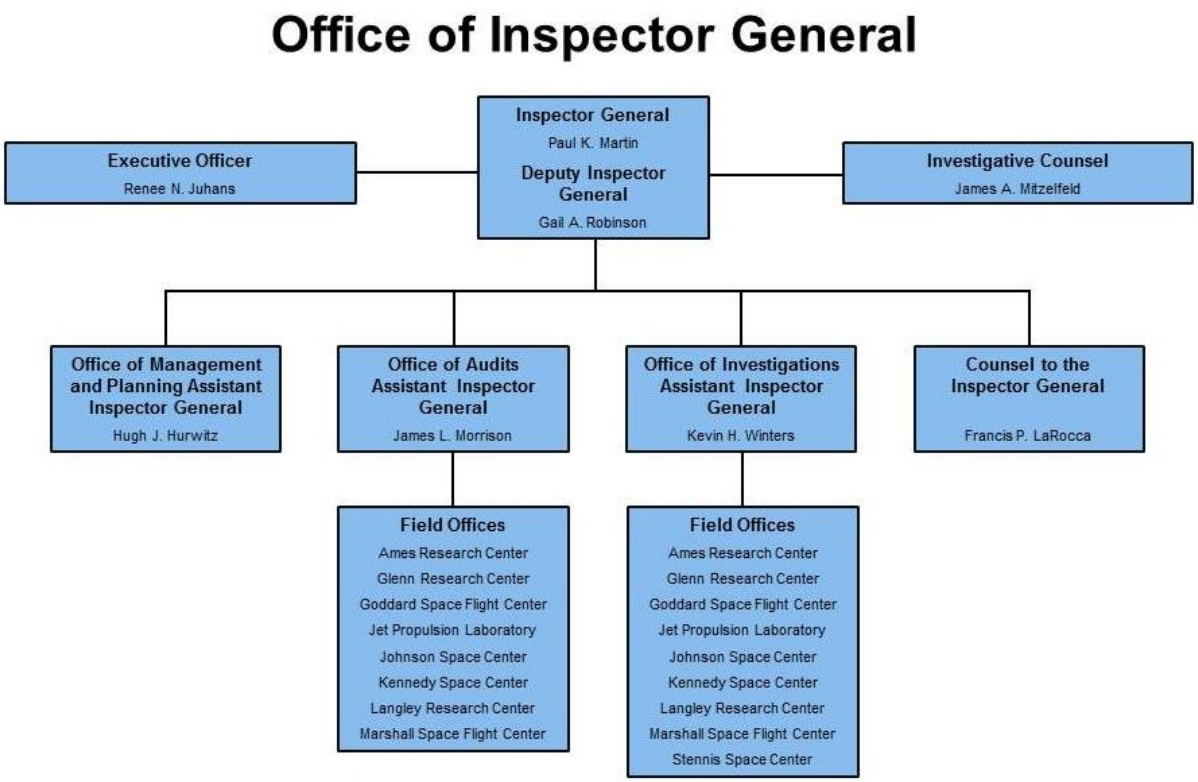


Figure 4.2-1: Organizational Structure of OIG

WORKFORCE AND BUDGET

OIG's workforce consists of approximately 200 full time permanent civil servants. The OIG's fiscal year (FY) 2012 budget was $38.8 million.[3] For FY 2013, the President's budget submission requests $37 million for the OIG.

BUDGET EST. ($M)

President's FY13 Budget Request	FY2012	FY2013	FY2014	FY2015	FY2016	FY2017
Office of Inspector General	$38.8	$37.0	$37.0	$37.0	$37.0	$37.0

Table 4.2-1: Office of Inspector General's Budget Runout

[3] This amount included a $1 million transfer from NASA to the OIG to "commission a comprehensive independent assessment of NASA's strategic direction and agency management" (Public Law 112-55). The OIG contracted with the National Research Council to conduct this study.

FUNCTIONS

The Inspector General provides policy direction and leadership for the OIG and serves as an independent voice to the Administrator and Congress by identifying opportunities and promoting solutions for improving the Agency's performance. Through reports and other means, the IG keeps the NASA Administrator and Congress informed of fraud and other serious problems, abuses, and deficiencies relating to the administration of NASA programs and operations; recommends corrective action concerning such problems, abuses, and deficiencies; and reports on the progress made in implementing such corrective action. Paul Martin currently serves as Inspector General.

The Deputy Inspector General provides overall direction to the Assistant Inspectors General and Counsel to the Inspector General in the development and implementation of diverse audit, investigative, legal, and support operations of the OIG. Gail Robinson serves as Deputy Inspector General.

The Executive Officer serves as the OIG liaison to Congress and other government entities, conducts OIG outreach both within and outside of NASA, and manages special projects. Renee Juhans serves as Executive Officer.

The Investigative Counsel serves as senior advisor for OIG investigative activities and conducts special reviews of NASA programs and personnel. James Mitzelfeld serves as Investigative Counsel.

The Office of Audits (OA) is responsible for conducting independent and objective audits, reviews, and other examinations to improve the economy, efficiency, and effectiveness of NASA programs, projects, operations, and contractor activities. In addition, OA oversees the work of the independent public accounting firm that is under contract by the OIG to conduct the annual audit of NASA's financial statements. Jim Morrison serves as Assistant Inspector General for Audits.

The Office of Investigations (OI) investigates allegations of crime, cybercrime, fraud, waste, abuse, and misconduct that could have an impact on NASA programs, projects, operations, and resources. The OI refers its findings either to the Department of Justice for criminal prosecution and civil litigation or to NASA management for administrative action. Through its investigations, the OI identifies crime indicators and recommends measures for NASA management that are designed to reduce NASA's vulnerability to criminal activity. Kevin Winters serves as Assistant Inspector General for Investigations.

The Office of Counsel to the Inspector General provides advice and assistance on a variety of legal issues and on matters relating to OIG review of NASA's programs and operations. Frank LaRocca serves as NASA OIG Counsel.

The Office of Management and Planning (OMP) provides financial, procurement, human resources, administrative, and information technology services support to the OIG staff. Hugh Hurwitz serves as Assistant Inspector General for Management and Planning.

IMPORTANT ACTIVITIES

Over the past several years, the OIG's audit and investigative resources have been focused on the major challenges facing NASA.

At any one time, the OIG has approximately 25 audits in process. Some of these audits are required by statute or by the Office of Management and Budget, such as the audit of NASA's financial statements and the audit of NASA's compliance with the Federal Information Security Management Act. However, most of our audits are self-initiated, in that we select the areas we believe are of the greatest importance to the Agency, Congress, and the public and will most help improve economy and efficiency at NASA. For example, this past year we released reports examining the challenges NASA managers face in meeting the cost and schedule goals of their projects, NASA's leasing practices for its underused facilities, and whether costs associated with various NASA grants and contracts were allowable and properly supported.

Copies of completed audit reports and information about ongoing audits are available on our website.

- For ongoing audits, see: http://www.hq.nasa.gov/office/oig/hq/audits/activeProjects.html;
- For reports on completed audits, see: http://www.hq.nasa.gov/office/oig/hq/audits/reports/FY12/index.html.

As of September 30, 2012, the Office of Investigations had 230 open investigations. Investigative resources are focused on matters involving mission safety, procurement fraud, and misconduct and mismanagement by high-level Agency employees. During FY 2012, OI's investigative efforts resulted in 36 indictments or criminal informations; 22 convictions; 26 sentencings or pretrial diversions; 4 civil settlements or judgments; 118 referrals to the Department of Justice; 39 recommendations for disciplinary action and 9 recommendations for program improvements to NASA management; and 7 suspensions or debarments. In addition, more than $22 million was recovered on behalf of the government ($10.4 million went directly to NASA).

KEY PERSONNEL

Paul K. Martin was confirmed by the United States Senate as NASA Inspector General on Nov. 20, 2009.

Prior to his NASA appointment, Martin served as the Deputy Inspector General at the U.S. Department of Justice, Office of the Inspector General. In that capacity, he assisted the Inspector General in managing the audit, inspection, and investigative activities of the office's 425 employees. From 2001 to 2003, he served as Counselor to the Inspector General, and from 1998 to 2001 he served as Special Counsel to the Inspector General.

Before joining the Department of Justice OIG, Martin spent 13 years at the U.S. Sentencing Commission in a variety of positions, including 6 years as the Commission's Deputy Staff Director. Martin was one of the Sentencing Commission's first employees when the agency was created in 1985, and helped develop the first set of federal sentencing guidelines.

Martin began his professional career as a reporter with the *Greenville News*, a daily newspaper in Greenville, S.C. He holds a B.A. in Journalism from the Pennsylvania State University and a Juris Doctor from the Georgetown University Law Center.

Gail A. Robinson has served as the Deputy Inspector General since June 2010.

Prior to her appointment, Robinson served as General Counsel for the U.S. Department of Justice OIG. In that position, she was

responsible for providing advice to the Inspector General and OIG senior managers on a wide variety of legal matters.

Prior to joining the OIG community, Robinson worked at a private law firm and as an attorney for a non-profit organization. She also served as a law clerk on the United State Court of Appeals for the District of Columbia.

Ms. Robinson holds a Bachelor of Arts in Political Science and English from Rutgers University and a Juris Doctor from the University of Pennsylvania Law School.

4.3 Staff Offices

Administrator Staff Offices

- **Chief Financial Officer:** Elizabeth Robinson
- **Chief Information Officer:** Linda Cureton
- **Chief Scientist:** Waleed Abdalati
- **Chief Technologist:** Mason Peck
- **Chief Engineer:** Michael Ryschkewitsch
- **Chief Health and Medical Officer:** Richard Williams
- **Chief, Safety and Mission Assurance:** Terrence W. Wilcutt
- **Diversity and Equal Opportunity:**
    - **Associate Administrator:** Brenda Manuel
- **Education:**
    - **Associate Administrator:** Leland Melvin
- **International and Interagency Relations:**
    - **Associate Administrator:** Michael F. O'Brien
- **General Counsel:** Michael Wholley
- **Legislative and Intergovernmental Affairs:**
    - **Associate Administrator:** L. Seth Statler
- **Office of Communications**
    - **Associate Administrator:** David Weaver
- **Small Business Programs:**
    - **Associate Administrator:** Glenn Delgado

4.3.1 Office of the Chief Financial Officer(OCFO)

Mission Statement

The Office of the Chief Financial Officer, established in accordance with the Chief Financial Officers Act of 1990 (Public Law 101-576) (CFO Act), provides leadership for strategic planning, performance reporting, budget analysis, justification, control, and reporting of all Agency fiscal resources; leads the Agency's planning, programming, budgeting, and execution process; oversees all financial management activities relating to the programs and operations of the Agency; develops the Agency's detailed strategic plan and performance reports, as well as the annual budget request; and monitors and reports the financial execution of the Agency budget.

Organizational Structure

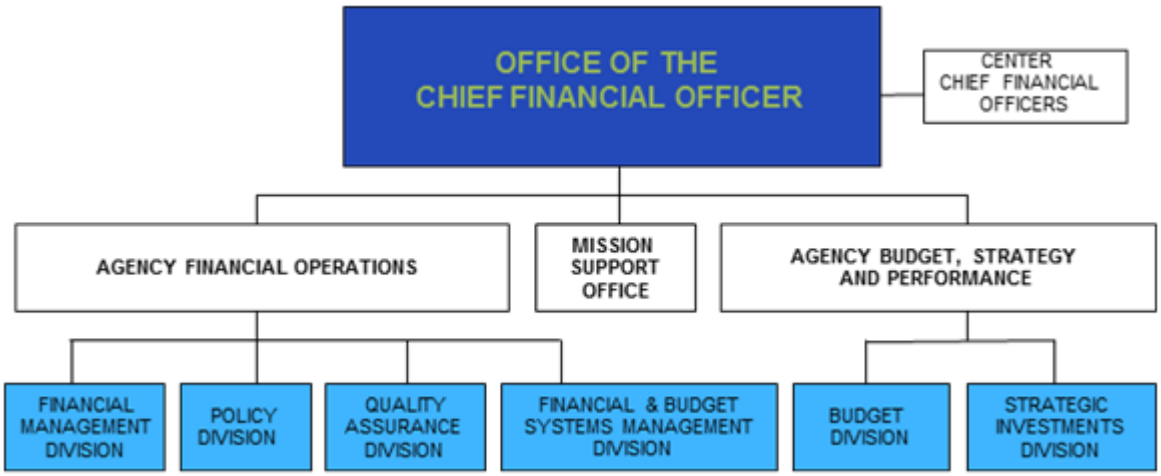


Figure 4.3.1-1: Office of the Chief Financial Officer Organizational Structure

Workforce

The OCFO has a workforce allocation of 105 Full Time Equivalent (FTE) Civil Servants.

Budget Est. ($M)

President's FY13 Budget Request	FY2012	FY2013	FY2014	FY2015	FY2016	FY2017
Office of Chief Financial Officer*	$9.4	$9.2	$9.2	$9.2	$9.2	$9.2

Table 4.3.1-1: Office of the Chief Financial Officer's Budget Runout

**Does not include Civil Service Labor*

FUNCTIONS

Office of the Chief Financial Officer. The Office of the Chief Financial Officer provides leadership for the planning, analysis, justification, control, and reporting of all Agency fiscal resources. The Office, as required under the provisions of the CFO Act, also oversees all financial management policies and activities relating to the programs and operations of the Agency. Through the operations presently within the Office itself, as well as through the OCFO Divisions and the Center Chief Financial Officers, the Office leads the Planning, Programming, Budgeting, and Execution (PPBE) process; develops the Agency's strategic plan and performance reports; drives financial and program performance improvement actions throughout the Agency; monitors and reports the financial execution of the Agency budget; and publishes monthly, quarterly, and annual agency performance and financial statements.

Financial Management Division. The Financial Management Division oversees the Agency's compliance with financial regulations and reporting requirements. The Division implements the Agency's Continuous Monitoring Program (CMP) for financial operations, ensuring funding is made available in a timely manner and monitoring funding alignment, balances, and that accounting practices are consistent with federal accounting guidelines. The Division ensures adequate controls over NASA assets, compliance with the Federal Accounting Standards Advisory Board (FASAB) standards and principles, and implementation of environmental liability standards. The Division also coordinates and executes consolidated financial reporting, data integrity analysis, and financial system improvement requirements.

Policy Division. The Policy Division develops, integrates, coordinates and maintains Agency financial management policy and requirements (FMRs, NPDs, NPRs) and coordinates the development of Agency Financial Management Operating Procedures (FMOPs). The Division provides policy interpretation, analysis, and guidance on all financial management subject matter areas; reviews and comments on all Agency Policy Directives and Procedural Requirements; and coordinates on establishing and improving Agency business process activities.

Quality Assurance Division. The Quality Assurance Division coordinates the Agency's annual financial statement audit, implements the Comprehensive Compliance Strategy (CCS) by establishing and maintaining an internal control framework and executing internal control testing, and manages the Agency's OMB Circular A-123-A Internal Control over Financial Reporting Assessment Program. The Division conducts the Agency's Improper Payment Information Act (IPIA) risk assessment, tests for improper payments, performs the Recovery Audit to ensure overpayments made are recovered, and performs assessment assurance and advisory services for financial management improvement within NASA. The Division works with responsible parties to develop corrective action plans to address financial audit recommendations, and monitors progress of the corrective actions. The Division also monitors compliance with policies, procedures, regulations, laws, etc.; areas of high risk or sensitivity, such as segregation of duties, contract closeout, etc.; and documents and provides recommendations to affected parties.

Financial & Budget Systems Management Division. The Financial & Budget Systems Management Division represents the OCFO

on all IT-related matters, both internally and externally to the Agency. The division is responsible for coordinating with the NASA Enterprise Application Competency Center (NEACC) to assess and implement systems requirements for effective and accurate collection, processing, and reporting of financial and budgetary information responding to direction from the Administration and Congress. The division promotes operational efficiency by assessing the benefits and costs of updating agency-wide financial systems and expanding capabilities; establishes internal reporting capabilities and standardized financial management systems practices; ensures timely guidance for key Agency and center financial systems matters; and ensures integration of information systems, business processes, and data with other Agency information systems, in coordination with all appropriate stakeholders.

Budget Division. The Budget Division manages the Agency's annual budget process and coordinates the development of all scheduled and ad hoc budget data deliveries to OMB (including the President's budget). The Division operates the Agency's budget systems (e-Budget), maintains the Agency Execution Plan, and controls the Agency work breakdown structure within NASA's accounting system. The Division develops Congressional operating plans for execution; is responsible for Apportionments/ Warrants/ Allotments (working with the Financial Management Division); briefs and defends annual budget requests to OMB, Congressional committees, and external stakeholders; and analyzes and sets requirements for budget execution performance.

Strategic Investments Division. The Strategic Investments Division (SID) provides key support in developing guidance, managing processes, and providing a variety of analyses during each phase of the annual Planning, Programming, Budgeting and Execution (PPBE) process. The division is responsible for NASA's performance management system, assessing trends, cross-cutting issues, risks, and program progress; and providing recommendations and input for planning and budgetary decisions. SID provides support to the Budget Division in developing the Congressional Justification, and responds to inquiries and the program reporting required by Congress, the Office of Science and Technology Policy, Office of Management and Budget, Government Accountability Office, and others. The division is also responsible for implementing strategy and performance management requirements contained in the Government Performance and Results Act Modernization Act of *2010* (*GPRAMA*), Office of Management and Budget Bulletin A-11, and other federal guidelines.

Mission Support Office. The Mission Support Office (MSO) provides support across CFO Divisions in all areas of organizational and managerial activities. The MSO collects, integrates, reports, and executes internal budget, procurement, travel, and training activities across the Headquarters OCFO. The office is responsible for managing human resource and personnel actions and for coordinating organizational change and performance initiatives. The MSO provides executive support to the OCFO front office as well as correspondence and administrative support to all OCFO divisions.

Center Chief Financial Officers. Reporting directly to Headquarters OCFO, the Center Chief Financial Officers, physically located at NASA centers, formulate and execute the center budgets and resources in close coordination with center and program management. The Center Chief Financial

Officers oversee the day-to-day financial activities needed to execute and account for operations and carryout fiscal responsibilities, including Continuous Monitoring Program (CMP) responsibilities and financial reporting requirements. The Center Chief Financial Officers coordinate with the NASA Shared Services Center (NSSC) for travel, accounts payable, accounts receivable, and payroll processing.

IMPORTANT ACTIVITIES

Improvements in NASA's Strategic Planning and Performance Reporting. The Government Performance and Results Act (GPRA) Modernization Act of *2010* (*GPRAMA*) requires agencies to adjust their processes and data collection to meet new requirements and deliverables for greater agency accountability and transparency. NASA is updating its Strategic Plan, objectives and performance goals to respond to GPRAMA, as well as assessing areas for improvement in processes, documentation, and reporting.

Implementation of Agency Financial Compliance Strategy. NASA achieved an unqualified financial audit opinion for FY 2010, the first such opinion in seven years. In 2008, NASA implemented a Comprehensive Compliance Strategy (CCS) that focuses on ensuring compliance with Generally Accepted Accounting Principles (GAAP) and other financial reporting requirements. The CCS provides the basis for implementing comprehensive proactive corrective actions required to achieve federal GAAP and auditability; and it provides the guiding principles for executing effective financial management functions and activities with internal control and compliance solutions inherently embedded in the Agency processes.

Enhancement of Agency Financial Controls and Oversight. Operating in conjunction with the CCS, the Continuous Monitoring Program (CMP) provides the overall framework for NASA financial management controls. Headquarters OCFO, in conjunction with the Center CFO communities, completed a thorough evaluation of the CMP effectiveness and will be implementing improvements for the FY 2013 reporting periods, including automation of key parts of the CMP process. Moreover, OCFO will increase its monitoring of compliance in several new areas, including incremental funding actions.

Enhancement of Agency Budget and Financial Systems. NASA's OCFO community strives to provide a positive customer experience while meeting the myriad of federal requirements applicable to budget and financial management processes. System enhancements in the areas of program/project financial and performance reporting, travel processing, and budget formulation are a priority focus for the Headquarters OCFO in FY 2013. In addition, improvements will be made to address Information Technology (IT) deficiencies related to segregation of duties, access controls, and system logging.

Reimbursable Policy and Process. NASA's mission requires increased partnering with commercial entities. To facilitate this increase in reimbursable activity, the OCFO community developed a comprehensive pricing policy to ensure compliant and consistent pricing based on the various types of agreements utilized to accomplish the mission of the Agency. In addition, an Agency-wide team was formed to capture process improvement opportunities for managing reimbursable activity across the Agency. The efforts of this team will result in more consistent and effective reimbursable processes with improved management of reimbursable funds.

Development of the FY 2014 Budget Request. NASA has not yet received passback guidance from the Office of Management and Budget (OMB) concerning the FY 2014 Budget Request. OCFO has nevertheless continued work on development of non-controversial parts of the request and stands ready to complete the request as the resolution of issues occurs.

MAJOR ISSUES

Financial Audit Opinion. NASA received an unqualified audit opinion for FY 2011. However, two significant deficiencies remain, pending the results of the FY 2012 audit:

- Unfunded Environmental Liabilities (UEL): The FY 2011 annual financial audit identified deficiencies in the effectiveness of controls associated with the remediation liability estimation process, the interpretation of accounting standards and other guidance related to the recording of environmental liabilities, and with NASA's evaluation of future Environmental Liabilities associated with Property, Plant and Equipment (PP&E). Significant improvements have been made in FY 2012 to address these items, but we anticipate this significant deficiency to remain in our FY 2012 audit report. Additional effort will be required in FY 2013 to remediate these deficiencies and also address new requirements associated with Asbestos liabilities.
- Information Technology: The FY 2011 annual financial audit identified excessive, privileged access weaknesses and inadequate logging and monitoring that, when aggregated, increase the risk that unauthorized, undetected modifications could be made to NASA's financial data and systems. We anticipate significant improvement in this area in the FY 2012 audit report with lower risk deficiencies to be worked in FY 2013 in partnership with the NEACC and GSFC for the Agency's Contractor Held Asset Tracking System (CHATS).

Implementation of New Conference Requirements. Pursuant to OMB directives that required new conference approval and reporting procedures and an internal analysis of existing NASA conference policies, the Agency recently updated its official agency policies concerning the conduct and reporting of NASA sponsored conferences and attendance by NASA personnel at conferences sponsored by other entities. These new requirements necessitated the enhancement of NASA's conference attendance tracking tools, which are set to be deployed in the Fall/Winter of FY 2013. In addition, several large data collections concerning conference sponsorship and attendance that have been requested by Members of Congress are due to be complete in the same timeframe.

KEY PERSONNEL

Dr. Elizabeth "Beth" Robinson was confirmed by the U.S. Senate on November 5, 2009, and sworn into office on November 9th as the Chief Financial Officer for NASA. Through her leadership, Dr. Robinson ensures the financial health of the organization, including responsibility for ensuring that NASA resources are effectively employed toward the achievement of NASA's strategic plan. She manages the organization's budget and financial operations, directs the preparation and submission of annual financial and budgetary reports, and coordinates agency financial and performance management policies and activities with other federal agencies.

Prior to joining NASA, Dr. Robinson was the senior-most Office of Management and Budget career official, responsible for supporting the OMB Director in developing, publishing, and enacting the President's Budget request. As Assistant Director for Budget, she provided leadership in the preparation of budget proposals, database, and documents; development and review of budget estimates; and development of budget procedures and budget accounting concepts.

Before becoming Assistant Director for Budget in September 2005, Dr. Robinson served as the Deputy Director for the Congressional Budget Office, where she assisted the Director in the overall management of the organization and represented CBO on the Federal Accounting Standards Advisory Board. Previously, she served as OMB's Deputy Assistant Director for Budget Review and Concepts. Her primary responsibilities included overseeing the development of the President's discretionary budget request and associated budget documents; revisions to agency guidance and congressional scoring rules; issues arising in the execution of the budget; proposals for and Congressional action on appropriation bills; and policy analysis projects. Prior to joining OMB's Budget Review Division, she worked as the OMB program examiner for energy issues, including the defense, intelligence, fossil energy, and science programs at the Department of Energy.

From 1994 to 1998, Dr. Robinson was a staff member on the Committee on Science in the House of Representatives. From 1989 to 1994, she worked at the Congress's Office of Technology Assessment. Before that, she was an assistant professor of geophysics at Stanford University, having graduated from the Massachusetts Institute of Technology (MIT) with a Ph.D. in geophysics in 1987. She holds an undergraduate degree in physics from Reed College.

Andrew J. Hunter was named Deputy Chief Financial Officer for Strategy, Budget, and Performance in 2010. As Deputy CFO for Strategy, Budget, and Performance, Hunter is responsible for the Agency Planning, Programming, Budgeting and Execution (PPBE) process including the requisite policies, controls, analyses and presentation for NASA's budget, strategic planning, performance management system, and reports.

From 2005 to 2010, Hunter served as Director of Resources for NASA's Exploration Systems Mission Directorate. Prior to that position, he was Budget Director for the Earth Science Program for 7 years. Hunter spent three years working in the independent assessment group within NASA's Office of the Comptroller where he co-led several Independent Annual Reviews of major agency programs whose status was briefed annually to the Deputy Administrator. Hunter also served as an analyst in the Office of Human Space Flight for several years and started with NASA as a Presidential Management Intern with the Space Shuttle Program. During this period, he also spent a year detail at the Executive Office of the President's Office of Management and Budget, and 6 months working with the Spacelab project office at Marshall Space Flight Center. Hunter joined NASA in 1988.

Hunter graduated with a Bachelor of Arts in Anthropology from the University of Colorado at Boulder. He served two years as a Peace Corps Volunteer and an additional year with the U.S. Agency for International Development, training new volunteers in West Africa. After returning to the U.S., he earned a Masters degree in Public Administration from American University in Washington, DC. While getting his Masters degree, he worked

at the Government Accountability Office and at the Department of the Treasury.

Pamela D. Hanes was named Deputy Chief Financial Officer for Finance in July 2012. As Deputy CFO for Finance, Hanes is responsible for Agency Financial Operations including the requisite policies, controls, analyses, and presentation for NASA's financial data, systems, and reports.

Prior to this, she served as CFO for NASA's Marshall Space Flight Center (MSFC) in Huntsville, AL, managing an annual budget of approximately $2.6 billion for one of NASA's largest field installations. Hanes was responsible for development, implementation, and administration of integrated resources management at MSFC, including all aspects of planning, programming, and budgeting processes, along with guidelines for distributing funds. She was also responsible for the MSFC's factual, legal, and integrated financial reporting and control system that ensures accountability of funds and other resources.

From 1991 to 2007, Hanes served in several leadership positions at MSFC and NASA Headquarters, supervising a wide variety of financial and budget operational activities and special initiatives, including an agency-wide effort to modernize NASA's financial and administrative systems by introducing new software systems and business processes.

Hanes joined NASA as an operating accountant at MSFC in 1982, and earned a Bachelor's degree in accounting in 1985 from the University of Alabama in Huntsville. Throughout her NASA career she has been recognized by many performance and service awards, including the NASA Outstanding Leadership Medal and the NASA Exceptional Service Medal. In 2007, she was honored with a Presidential Rank Award for Meritorious Executives, one of the highest honors given for government service, for her outstanding achievements at NASA.

4.3.2 OFFICE OF THE CHIEF INFORMATION OFFICER (OCIO)

MISSION STATEMENT

The Office of the Chief Information Officer provides leadership, planning, policy direction, and oversight for the management of NASA information and all NASA information technology (IT) in accordance with the responsibilities required by the Clinger-Cohen Act of 1996, the Paperwork Reduction Act of 1995, the E-Government Act of 2002, the Federal Information Security Management Act of 2002, and the Privacy Act of 1974. The Chief Information Officer (CIO) is the principal advisor to the Administrator and other senior officials on matters pertaining to information technology, the NASA Enterprise Architecture, IT security, records management, and privacy.

ORGANIZATIONAL STRUCTURE

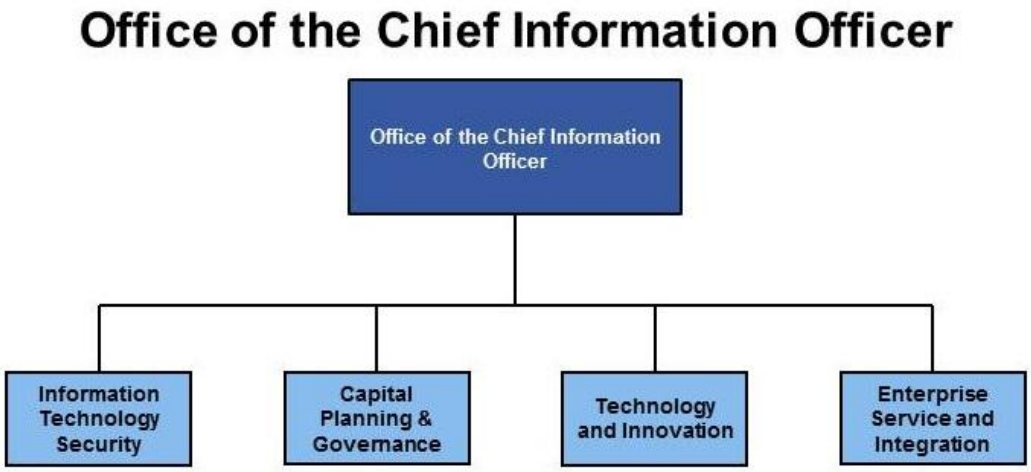


Figure 4.3.2-1: High-Level Organizational Structure of the Office of the CIO

WORKFORCE

The OCIO workforce consists of 52 Full Time Equivalent (FTE) Civil Servants and 30 contractors.

BUDGET EST. ($M)

President's FY13 Budget Request	FY2012	FY2013	FY2014	FY2015	FY2016	FY2017
Office of Chief Information Officer	$159.1	$152.0	$152.0	$152.0	$152.0	$152.0

Table 4.3.2-1: NASA Agency IT Services (AITS) Budget Runout

FUNCTIONS

INFORMATION TECHNOLOGY SECURITY (ITS)

The overall objective of the Information Technology (IT) Security Division provides requirements and direction to ensure that safeguards for IT resources (i.e., data, information, applications, and systems) are integrated into and support NASA's missions and functional lines of business. Adherence to and compliance with regulatory requirements and daily security defense of the IT environment is the responsibility of the Chief Information Security Officer (CISO). Security architectures, security designs, implementation plans, and deployments are accomplished and then followed by the combinations of operational auditing and enforcements of processes. Reporting of NASA security performance in meeting regulatory requirements is a responsibility of this office.

CAPITAL PLANNING & GOVERNANCE (CP&G)

Capital Planning and Governance Division is the central policy and business management division within the Office of the CIO. The Division develops and implements uniform and consistent information resources management policies; oversees the OCIO budget, oversees the development and use of information management principles, standards, and guidelines; evaluates agency information resources management practices; determines compliance with policies, principles, standards, and guidelines; and supports IT project governance at the Agency and center levels.

TECHNOLOGY AND INNOVATION (T&I)

Led by the Chief Technology Officer for IT (CTO-IT), the Technology and Innovation Division (T&I) fosters IT innovation, and creativity to address the IT requirements and needs of the NASA working environment. The CTO manages an IT Chief Technology Working Group comprised of Center and Mission Directorate CTOs; provides oversight to IT Enterprise Architecture construction and management; coordinates the Agency's Open Government requirements; and manages the Open Innovation and IT Lab Programs. The CTO function brings new IT innovations for analysis by the extended T&I team. These technical pilots and evaluations determine suitability for incorporation of new services, systems, and products into the NASA environment. The Enterprise Architecture functions to provide both the architectural vision for NASA's IT and the oversight protection for the IT environment regarding the diverse set of technologies in use across the Agency. They ensure new technologies are appropriately integrated into the on-going operational environment and work strategically with the Chief Technologist.

ENTERPRISE SERVICE AND INTEGRATION (ES&I)

Enterprise services provides two integrated functions: first is program and project management for bringing new or updated information technology products, systems, and services to the operational environment; and second is the agency-wide maintenance and operations services for the NASA IT environment. The program and project management functions take innovation concepts from the T&I Division and provide the necessary Agency consolidation support for planning, development, and deployment of those new or updated developments to the

Agency environment. The ES&I division ensures a robust set of infrastructure services and business applications tailored to the operational environment to enable the NASA mission. The operational functions of enterprise service management are delivered via Enterprise Service Executives and their service teams residing in the centers. They are responsible for the integration, delivery, and management of NASA's IT infrastructure services, inclusive of: networks, data centers, cloud computing, web services, desktop computers, and other end-user tools, such as e-mail and calendaring, enterprise service desk, and collaboration services. In order to integrate, efficiently manage, monitor and track all enterprise service provisioning, the NASA Shared Service Center provides a coordinated and centralized Enterprise Service Desk and automated Request System.

IMPORTANT ACTIVITIES

INFRASTRUCTURE TRANSFORMATION

Goal 1 of the NASA Information Resources Management Strategic Plan is to: "Transform NASA's IT infrastructure and application services to better meet evolving stakeholder needs and support mission success." Objectives under this goal are:

1. Ensure a positive end-to-end computing experience for stakeholders.
2. Achieve efficiencies in providing IT services, e.g., data center consolidation, help desk consolidation, cloud computing, etc.
3. Empower the mobile workforce (anytime, anywhere, securely).
4. Provide enterprise applications that support the Agency's business and information needs, with new initiatives and enhancements focused on improving business and management practices.
5. Enhance mission success by providing efficient and effective access to enterprise information and collaborative functionality.

IT FINANCE AND GOVERNANCE

The entire NASA IT budget reported to OMB is $1.4 billion, of which just 10 percent is under the NASA CIO's authority. Our goal is to increase visibility into IT budgeting and spending through improved management controls and provide funding for enterprise base IT services. IT Finance and Governance provides greater transparency into IT investments and includes business owners and stakeholders in the IT decision-making process to ensure that the Agency's most important IT requirements are being funded.

IT LABS AND OPEN INNOVATION

IT Labs identifies promising technologies and challenging problems to which IT can be applied. It does this via soliciting ideas with quick turnaround on ideation, proof of concept, prototyping, and pilots for innovation. At present, 25 such technologies are under evaluation and in various stages of the innovation life cycle.

Open Innovation challenges NASA and external collaborators to identify problems of mutual interest and explore new ways of addressing them, primarily through crowd sourcing and open source usage with global reach. Seven NASA-identified challenges were collaborated on in early 2012 via International Space Application Challenge and other engagements.

MATURING A PORTFOLIO MANAGEMENT APPROACH TO MANAGING IT INVESTMENTS

A great number of NASA's IT investment

decisions are made on an organization-by-organization basis, outside of any Agency-wide organized or disciplined processes. The result is a number of inefficiencies, including a lack of tool standardization and difficulty collaborating among like functions (e.g., earned value management), an inability to leverage Agency-wide contracts that could potentially reduce costs (e.g., enterprise software licensing), and increased and duplicative manpower for supporting multiple instances of like software. To mitigate this, the NASA CIO has instituted several changes, including (1) a new governance structure at both the Agency and center level, coupled with new processes that ensure greater visibility and decision authority over the Agency's IT investments; (2) a business application portfolio management function which maintains inventories of the Agency's applications and, working with application owners, seeks opportunities for driving efficiencies and reducing redundancies; and (3) the procurement, provision of services, and management of NASA's IT infrastructure through the implementation of more robust enterprise contracts entitled I3P.

MAJOR ISSUES

MANAGING NASA'S IT INFRASTRUCTURE CONSOLIDATION

Previously, NASA's decentralized approach lacked any cohesive strategy that ensured we received the best value from our IT investment. This was particularly evident in the management of much of its IT infrastructure, particularly for local area networks, data centers, IT security services, and Web services. Business cases prepared in 2008-2009 suggested there were significant savings to be gained through consolidation and central management of NASA's IT infrastructure.

Under the IT Infrastructure Integration Program (I3P), NASA has undertaken an extensive consolidation effort involving new contracts for (1) End-User Services, (2) Communications Services, (3) Web Services, and (4) Enterprise Applications, supported by an Enterprise Service Desk and Service Request System and I3P Business Office at NSSC. These new contracts are the cornerstone for the program but the program also offers a comprehensive plan to manage Agency enterprise services. However, transitioning to these new contracts and the enterprise service model has been very challenging.

Specifically, there have been service delivery shortcomings with some of the service providers, integration issues between some of the service providers, and some degree of resistance from customers transitioning to new service models and service request processes. With limited resources available to support the planning and to fund the costs of transition, the transition has been problematic at many centers. Currently, approximately one year into the transition, our I3P team is identifying ways to improve performance and hold the service providers accountable to their service level agreements. Another key element to improve the integration aspect of the I3P Program is utilizing ITIL processes (such as enhanced configuration management, change management, problem management, etc) and to improve the customer experience with infrastructure delivery and services. To mitigate these challenges, NASA's CIO has prioritized resources to address service integration issues and to improve surveillance of services under the Agency Consolidated End-User Services contract.

Another major issue for NASA's IT is aging infrastructure. As the telephone system has

the most likelihood of immediate failures and serious impact, it is one of the first being addressed by the department.

IT Security

Cyber threats to federal information systems and cyber-based critical infrastructures are evolving and growing. Cyber Security is the driving force that protects the intellectual property, power of invention, and natural ingenuity that is the heart and soul of NASA. In response to these intractable challenges, we have developed a strategy that continues to transform our cyber security program – moving to a proactive security posture based on detection, prevention, and prediction. The NASA Security Operations Center (SOC) provides centralized enterprise capabilities that immediately detect and react to threats and attacks. The NASA SOC is currently enhancing our mission assurance (systems, applications, and networks) posture via protection, detection, continuous monitoring and reaction mechanisms that drive adaptive configuration management that support critical mission and business operations.

Information security is an integral element of sound management. The United States Congress has instituted laws, regulations, and directives that govern creation and implementation of federal information security practices. These laws and regulations place responsibility and accountability for information security at all levels within federal agencies, from the agency head to system users. These laws and regulations provide a framework for overseeing implementation of required practices: the Privacy Act of 1974, the Paperwork Reduction Act (PRA) of 1995, the Clinger-Cohen Act of 1996, the E-Government (E-Gov.) Act of 2002, and the Federal Information Security Management Act (FISMA) of 2002.

Key Legislation

Privacy Act of 1974 – The Privacy Act sets forth extensive requirements for the management of personal information maintained in any format on individuals where such information is routinely retrieved by a name or personal identifier unique to the individual.

Electronic-Government Act of 2002 – The electronic-Gov Act reinforces existing statutory privacy provisions and adds new requirements to ensure sufficient protections for the privacy of personal information as agencies implement electronic government.

Title III of the e-Gov Act, or the Federal Information Security Management Act (FISMA), provides for development and maintenance of minimum controls required to protect federal information and information systems (including privacy information).

Section 208 of the e-Gov Act requires NASA to complete Privacy Impact Assessments (PIAs) for new or modified information systems that collect, maintain, or disseminate any Information in an Identifiable Form (IIF) from or about members of the public.

Paperwork Reduction Act of 1995 – The Paperwork Reduction Act (PRA) regulates the burden that agencies place on members of the public when collecting information from them. OMB authorization shall be obtained when NASA collects information from 10 or more members of the public through standardized fields, whether via survey (in paper or electronic form), web-enabled forms, or any method of information provisioning, regardless of format or whether the provisioning of the information is voluntary. For this NASA

Procedural Requirement (NPR), the PRA is applicable only when NASA seeks collection of IIF from members of the public.

KEY PERSONNEL

Linda Cureton is the Chief Information Officer (CIO) and provides the requisite leadership to transform the management of information technology (IT) capabilities and services to support and enable NASA's mission. Cureton was appointed as the NASA CIO in September 2009.

She ensures that the Agency's Information Resource Management (IRM) strategy is in alignment with NASA's vision, mission, and strategic goals. Accordingly, Cureton ensures the development of integrated IRM strategies, including standards, policies, NASA Enterprise Architecture, IT security, management, and operations. She has the responsibility, authority, and accountability for ensuring that NASA's information assets are selected, controlled, and evaluated consistent with federal policies, procedures, and legislation.

Prior to this appointment, Cureton served as the Chief Information Officer (CIO) of the NASA Goddard Space Flight Center (GSFC) and led the Information Technology and Communications Directorate. As the GSFC CIO, Cureton was responsible for ensuring that GSFC's information assets are acquired and managed consistent with Agency and Federal Government policies. She was responsible for ensuring that the Center's Information Technology strategy aligns with NASA's vision, mission, and strategic goals.

Prior to her arrival at GSFC, Cureton was the Deputy Chief Information Officer of the Bureau of Alcohol, Tobacco, and Firearms (ATF) and led the Office of Science and Technology as Deputy Assistant Director. The Office of Science and Technology is responsible for providing leadership in the innovative and efficient application of science and technology used to collect, clarify, and communicate information needed to reduce violent crime, collect revenue, and protect the public. As the ATF Deputy CIO, she was responsible for ensuring that the use of Information Technology for the Bureau's mission and business requirements fulfill customer and stakeholder needs. Previously, Cureton served in executive positions at the Department of Energy and the Department of Justice.

She is a strong advocate for the practical application of technology and some of her professional affiliations include the Armed Forces Communications and Electronics Association, the Gartner Group Information Technology Executive Program, and the Society for Information Management, Advanced Practices Council.

She has also received prestigious awards including:

- 2008 IT Service Management Forum (ITSMF) Heritage Award
- 2009 *InformationWeek* Government CIO 50
- 2009 *Washington Business Journal* Women Who Mean Business
- 2011 Minority Enterprise Executive Council 50 Women of Influence and Power Award
- 2011 Federal Computer Week Fed 100
- 2011 Washingtonian Magazine Tech Titans
- 2011 Womensphere Global Leadership Award for Innovation
- 2012 National Urban League of Northern Virginia for Leadership in

Science, Technology, Engineering, and Mathematics
- 2012 Business Insider 25 Powerful Women Engineers
- 2012 Government Computer News Civilian Executive of the Year

She is a published author. In addition, her work has been published in the *Journal of Sound and Vibration* and *The IT Professional*. She has also had several Op-Ed pieces published in leading government IT media outlets.

Cureton earned a Bachelor of Science Degree from Howard University in 1980 graduating *magna cum laude* with a major in Mathematics and a minor in Latin. She also received a Master of Science Degree in Applied Mathematics from Johns Hopkins University in 1994, and a Post-Master's Advanced Certificate in Applied Mathematics from Johns Hopkins University in 1996. She performed extensive research in numerical analysis and has been published in the *Journal of Sound and Vibration*. She currently resides in Maryland with her husband and mother.

Deborah Diaz is NASA's Deputy Chief Information Officer, providing leadership to manage information technology services and enhance capabilities to support and enable NASA's mission since 2009. As an experienced information technology executive, she is recognized as a top agent of change who has provided innovative business solutions and developed strong partnerships between industry and government. Diaz's strong collaborative leadership in NASA's Open Government Initiative Plan garnered a number one "Best in Government" vote for NASA for the last two years. She revitalized the planning, development, and operations of the new IT infrastructure program created to consolidate the Agency's IT and big data services.

Prior to NASA, as the CIO for Department of Homeland Security's Science and Technology Directorate, she developed and implemented $1.2 billion of high-profile, ground-breaking scientific programs and IT infrastructure. As she served to provide new and effective ways to fight the war on terrorism, she also served as the senior advisor on IT interoperability, biometrics, geospatial, and wireless technologies. As Deputy CIO at the U.S. Patent and Trademark Office (USPTO), she helped transform USPTO electronic commerce and managed complex IT initiatives to modernize business process and data exchange systems. As Deputy Associate Administrator of Citizen Services at General Services Agency, she developed the government's first electronic government-wide citizen portal and shepherded many public-private partnerships from concept to delivery. She was a pioneer creating many of the first e-Government initiatives such as USA.gov (FirstGov) and USA Services. Diaz also helped blaze a trail to sub-Saharan Africa and Asia, negotiating private sector joint ventures as an international consultant and with the U.S. Agency for International Development.

Diaz has received numerous prestigious awards, including being a three-time recipient of the *Federal Computer Week* "Fed 100" award, eGov Pioneer, Gracie Award, March of Dimes Heroines in Technology, *Washington Business Journal* Women Who Mean Business, and Harvard's Innovation in Government. She received her Master's of Science in International Business from Colorado State University and Bachelor of Business Administration from Stonehill College.

CENTER CIOS:

Ames Research Center CIO (Acting): Ray O'Brien

Dryden Flight Research Center CIO: Larry Freudinger

Glenn Research Center CIO: Randy Humphries

Goddard Space Flight Center CIO: Adrian Gardner

Headquarters CIO: Kelly Carter

Jet Propulsion Laboratory CIO: James Rinaldi

Johnson Space Center CIO: Larry Sweet

Kennedy Space Center CIO: Michael Bolger

Langley Research Center CIO: Jeff Seaton

Marshall Space Flight CenterCIO: Jonathan Pettus

NASA Shared Services Center (NSSC) CIO: Bruce O'Dell

Stennis Space Center CIO: Dinna Cottrell

4.3.3 Office of the Chief Scientist (OCS)

Mission Statement

The Chief Scientist serves as principal advisor to the NASA Administrator and other senior officials on agency science programs, strategic planning, and the evaluation of related investments. The Office of the Chief Scientist (OCS) represents all of the scientific endeavors in the agency, ensuring they are aligned with and fulfill the administration's science objectives. The OCS advocates for NASA science in the context of broader government science agendas and works closely with the White House Office of Science and Technology Policy and the Office of Management and Budget. OCS also coordinates with representatives of the NASA mission directorates, field centers, and advisory committees on the content and objectives of the agency's science research and exploration portfolio. The Chief Scientist represents the agency's strategic science objectives and accomplishments to the national and international science community, including other government agencies, scientific organizations, industry, academia, and the public.

Organizational Structure

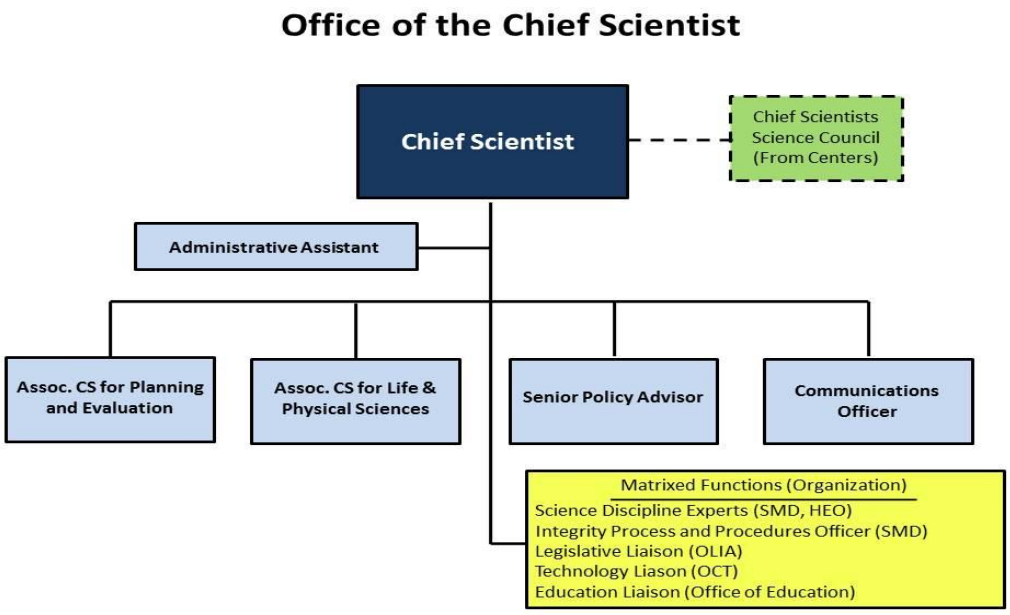


Figure 4.3.3-1: OCS Organizational Structure Workforce

Workforce

OCS has a workforce allocation of 5 Full Time Equivalent (FTE) Civil Servants

BUDGET EST. ($M)

President's FY13 Budget Request	FY2012	FY2013	FY2014	FY2015	FY2016	FY2017
Office of the Chief Scientist	$0.4	$0.5	$0.5	$0.5	$0.5	$0.5

Table 4.3.3-1: Office of the Chief Scientist's Budget Runout

FUNCTIONS

The Office of the Chief Scientist provides scientific leadership for the Agency. Its major functions are described below:

Provides Independent Assessments and Advice to the Administrator on Science Matters. The OCS serves as an independent advisor on all matters pertaining to NASA science. It performs scientific, technical, programmatic, and/or policy reviews to assure that NASA science programs are of the highest scientific and technologic merit and integrity. OCS provides independent budgetary assessment and concurrence for all NASA activities associated with the conduct of science. Finally, OCS leads the development of Agency science strategy and ensures that NASA's overarching Strategic Plan properly incorporates science issues and direction. The Chief Scientist serves as a member of NASA's Executive Council, Strategic Management Council, Program Management Council, and as an extended member of the Mission Support Council.

Serves as an External Interface Regarding Science Activities and Issues. OCS promotes, communicates, and advocates for NASA's science portfolio and strategy to the broad external community. The Chief Scientist also represents NASA in promoting and maintaining good public and community relations and providing for the widest practical and appropriate dissemination of information concerning science and space activities. In addition, the Chief Scientist seeks to understand the needs, interests, and scientific goals of the science community, and works to ensure that those interests are appropriately considered in NASA's scientific planning and pursuits.

The Chief Scientist serves as NASA's senior science representative to the Office of Science and Technology Policy, the Office of Management and Budget, and the United States Congress. He represents the Administrator to the National Advisory Council (NAC) Science Committee, the National Academy of Sciences, and other science advisory bodies, as well as the international community.

Promotes a Vital, Healthy NASA Science Community to Maximize Innovation and Productivity in NASA Research. OCS encourages and fosters science integration and cooperation across the Agency, including the Mission Directorates and the centers. One way that it carries out this function is through chairmanship of a Science Council, comprising NASA HQ and center science leaders from across the Agency. The Science Council provides a forum for discussion of cross-cutting strategic science issues, direction, and opportunities, as well as for discussing NASA-wide science policy and workforce issues.

OCS provides support and guidance to NASA science organizations in their development and implementation of plans to

address science policy, goals, objectives, metrics, and actions needed to execute the strategic goals and outcomes in the NASA Strategic Plan.

OCS works with the Center Directors to promote vitality and innovation of NASA's scientific workforce. In particular, it directs and oversees a Science Innovation Fund to promote the conduct of highly innovative, exploratory, and high-risk/high return scientific research at NASA centers.

OCS directs and oversees the Agency nomination process for Agency-wide external and internal scientific awards, including the Presidential Early Career Awards for Scientists and Engineers.

IMPORTANT ACTIVITIES

Annual Budget Review. The Chief Scientist conducts a review of the science investments prior to submission of the NASA budget to the Office of Management and Budget during the annual budget cycle. This analysis provides a review of the amounts of these investments, the rationale behind them, and their consistency with science community and Administration priorities. Following this review, the Chief Scientist makes recommendations to the Executive Council on science portfolio identifying areas of new or increased investments, and areas in which to reduce or eliminate investments. This was issued in 2012 as an action in support of the FY14 budget preparation, and should be continued annually.

Space Exploration Research. The Space Life and Physical Sciences Division, a fundamental and applied research program, resides in the Human Exploration and Operations Mission Directorate (HEOMD), a development and operations organization. Due to the close relationship between the research division and the International Space Station, the platform that the majority of research is performed on, it was determined that this was the best "fit" in the agency. To ensure that the science priorities are not over shadowed by the development and operations commitments, the Office of the Chief Scientist serves as a liaison to the NASA HEOMD to ensure alignment of agency priorities and to increase the visibility of the HEOMD research portfolio at the agency level.

Science Workforce Vitality. The OCS has several ongoing activities to enhance vitality and innovation of the scientific workforce at NASA centers. Among these is the Science Innovation Fund, which was successfully piloted at 2 centers in FY12 and has been broadened to 5 centers in FY13. This small investment provides seed funding for exploratory and high risk/high return scientific research. Additionally, OCS has led the Science Council in an effort to develop options for improving the current funding model for NASA scientists. As part of this effort, OCS is facilitating communication and understanding between center and headquarters science leaders.

Mars Program Planning. The Chief Scientist has been heavily involved in the assessment of the Mars program reformulation, including reviewing the input from the Mars Program Planning Group. In view of the fact that the Associate Administrator and the Chief Technologist have assumed their positions since the development of the President's FY13 budget, the Chief Scientist provided institutional memory in the development of this program, ensuring that the challenges it faced in the previous year were addressed in the current year.

KEY PERSONNEL

Dr. Waleed Abdalati, Chief Scientist. Dr. Waleed Abdalati serves as the principal adviser to NASA Administrator Charles Bolden, Jr., on NASA science programs, strategic planning, and the evaluation of related investments. In that capacity, he works to ensure that NASA's science activities are aligned with the goals and objectives of the scientific community and the White House. He also communicates value and rationale of these investments to Congress and the science community in order to secure broad support. He is currently on leave from his position as director of the University of Colorado's Earth Science and Observation Center, which carries out research and education activities on the use of remote sensing observations to understand the Earth. Dr. Abdalati is also a fellow of the Cooperative Institute for Research in Environmental Sciences at the University. His research has focused on the use of satellites and aircraft to understand how and why Earth's ice cover is changing, and what those changes mean for life on our planet. He also has served as leader of the Ice, Cloud, and land Elevation Satellite-2 (ICESat-2) Science Definition Team and has led or participated in nine field and airborne campaigns in the Arctic and Antarctic.

His appointment as chief scientist marks a return to NASA for Dr. Abdalati, where he worked from 1996-2008. From 1996-2000, he was a researcher at Goddard in the Oceans and Ice Branch. From 2004-2008, he was head of the Cryospheric Sciences Branch at NASA's Goddard Space Flight Center, and from 2000-2004, he managed NASA's Cryospheric Sciences Program at NASA Headquarters.

Dr. Abdalati received a Bachelor of Science degree from Syracuse University in 1986, a Master of Science degree from the University of Colorado in 1991, and a Ph.D. from University of Colorado in 1996. In the mid 1980s, before returning to graduate school, he worked as an engineer in the aerospace industry, designing, analyzing, and testing components of various spacecraft and submarine systems.

Dr. Gale Allen, Associate Chief Scientist for Life and Physical Sciences. Gale J. Allen, PhD, serves as the Associate Chief Scientist for Life and Physical Sciences Research and is responsible for the oversight of all aspects of microgravity research. She ensures investment strategies and portfolio content are aligned with the life and physical sciences decadal survey. She has over fifteen years of experience in fundamental space biology and physical sciences, and served as program manager for the Human Research Program. Dr. Allen provides leadership and advice to the Chief Scientist on matters pertaining to research in these areas and serves as interface to external agencies.

Dr. Teresa Fryberger, Associate Chief Scientist for Planning and Evaluation. Dr. Fryberger is responsible for planning and execution of both the day-to-day and longer-term functions of the OCS. She plans and manages the Science Innovation Fund and Science Council activities, and leads studies and reviews of science programs, issues, and policies. Dr. Fryberger provides leadership and advice to the Chief Scientist in the areas of research management and policy. Additionally, she oversees the organizational, financial, and administrative aspects of the office. She is an accomplished research program and policy executive in the Earth and physical sciences, with over 20 years of experience at NASA, the White House Office of Science and Technology Policy, and the Department of Energy.

4.3.4 OFFICE OF THE CHIEF TECHNOLOGIST (OCT)

MISSION STATEMENT

The Office of the Chief Technologist (OCT) coordinates NASA's technology investments across the Agency through technology portfolio tracking and technology roadmapping. OCT seeks out and initiates technology partnerships with private- and public-sector entities, manages NASA's commercialization and technology-transfer processes, houses the Emerging Space Office, and provides strategic guidance for the agency's incentive prize activities. The office is managed by NASA's Chief Technologist, who serves as the Administrator's principal advisor and advocate on matters concerning technology policy and programs. Through OCT, NASA documents and communicates the societal benefits of the Agency's technology efforts.

OCT facilitates the transfer of technology developed by NASA for commercial application and other benefits to the Nation. In this leadership role, OCT supports all Mission Directorates and has Chief Technologists and Innovative Partnership staff at each of the centers. In addition to leveraged technology investments, dual-use technology-related partnerships, and technology solutions for NASA, OCT coordinates the strategic use of prizes and challenges as a means for innovation. OCT also encourages and facilitates the pursuit of appropriate partnerships and dialogues with the emerging commercial space sector.

The office oversees Agency technology strategic planning activities, including management of the NASA Technology Executive Council (NTEC) and the Center Technology Council (CTC), and documenting and evaluating the Agency technology portfolio to facilitate coordination and understanding of all Agency technology investments. NASA's technology investments are guided by the Strategic Space Technology Investment Plan (SSTIP). OCT coordinates the Agency's overall technology portfolio to identify development needs and reduce duplication. By coordinating technology programs within NASA, OCT facilitates integration of available and new technology into operational systems that support specific human-exploration missions, science missions, and aeronautics. OCT also engages the larger aerospace community including other government agencies, and, where there are mutual interests, develops partnerships to efficiently develop breakthrough capabilities and help address significant national needs.

OCT implements its mission by cultivating and maintaining a creative and innovative culture particularly as it relates to training and workforce development. Central to this implementation is OCT's advocacy for adopting innovative technological solutions, including new paradigms for exploration and science motivated by both technology push and mission pull. This role facilitates connection to emerging technologies in external communities, enables targeted positioning of NASA's technology portfolio in selected areas, and secures NASA's intellectual property to provide fair access and to support NASA's strategic goals. Technology transfer through dual-use partnerships and licensing also creates many important socio-economic benefits for the Nation.

WORKFORCE

The OCT has a workforce allocation of 9 Full Time Equivalent (FTE) Civil Servants. OCT also funds Chief Technologists and Technology Transfer workforce at all 10 field centers.

FUNCTIONS

The Office of the Chief Technologist (OCT) provides technology leadership for NASA. OCT advises the Administrator and advocates for NASA's research and technology programs. Its functions are designed to meet the needs of NASA's Mission Directorates, to provide strategic direction for and coordination of Agency technology development efforts and to ensure that NASA technologies are transferred and commercialized for the benefit of the Nation. NASA's technology investments are guided by the Strategic Space Technology Investment Plan (SSTIP), an actionable plan that lays out the strategy for developing technologies essential to the pursuit of NASA's mission and national goals. The SSTIP prescribes a framework for NASA space technology investment and a focused approach to guide that investment over the next four years, within the context of a 20-year horizon. This plan assures NASA investments will optimize the benefits of key stakeholders, including NASA Mission Directorates, other U.S. government agencies, the private sector, and the Nation.

TECHNOLOGY TRANSFER

The NASA technology transfer program is focused on creating benefits for society through transferring the Agency's inventions and innovative knowledge to outside organizations. Managed out of NASA Headquarters, but consisting of a program office at each of the Agency's 10 centers, its activities are governed by U.S. laws and regulations as well as by NASA policies. Primary activities include intellectual property management, promoting the availability of NASA technologies for use by the U.S. public and private sectors, promoting the utilization of technological assets, and creating and communicating the societal benefits of NASA's technology transfer activities.

STRATEGIC PARTNERSHIPS

Strategic Partnerships are designed to expand and strengthen NASA's ability to execute its mission, and range from non-traditional partnerships to systematic engagements with regional, state, and local partners that accelerate technology transfer and commercialization in support of regional economic innovation and growth. Also included in this function is the coordination of NASA's participation in national technology initiatives in advanced manufacturing, nanotechnology, robotics, and materials.

PRIZES AND CHALLENGES

This function provides agency-level leadership, coordination, and guidance for NASA's use of incentive prizes to spur innovation, diversify the pool of solvers addressing NASA problems, advance technology development in a flexible, "on demand" way, and lower mission design costs to leverage government dollars for technological breakthroughs. This function also seeks to identify potential topics for NASA-led Grand Challenges, ambitious yet achievable national targets that harness and advance science, technology, and

innovation, in coordination with the Office of Strategy Formulation.

Emerging Space Office

The Emerging Space Office serves as the agency's principal advisory and advocacy function for encouraging engagement with the U.S. emerging commercial space community. With a Level 2 office managed out of ARC, this function conducts economic analysis and emerging trends assessments, and produces public reports and studies, on matters related to emerging commercial space activities including the assessment of NASA options for encouraging increased commercial space development.

Strategic Integration

This function oversees Agency technology strategic planning activities including coordination of activities related to the SSTIP, management of the NASA Technology Executive Council (NTEC), coordinating the Center Technology Council (CTC), and documenting and evaluating the Agency technology portfolio to identify and address technology gaps.

Key Personnel

Mason Peck, Chief Technologist. With more than 20 years of experience in industry and academia, Dr. Peck has worked as an engineer and consultant to NASA and in the private sector on a variety of programs, including the Tracking and Data Relay Satellite System and Geostationary Operational Environmental Satellites. He has authored 90 academic articles and holds 17 patents in the U.S. and European Union. Peck earned a doctorate in Aerospace Engineering from the University of California, Los Angeles as a Howard Hughes Fellow and a Master's degree in English Literature from the University of Chicago. Dr. Peck serves as the agency's principal advisor and advocate on matters concerning technology policy and programs.

W. James Adams, Deputy Chief Technologist. With over 30 years in industry and government, Jim Adams came to the Office of the Chief Technologist from NASA's Science Mission Directorate, where he served as the Deputy Director of the Planetary Science Division. Adams has been responsible for the development of several key technologies, including Ion Propulsion, Radioisotope Power Systems, and Pu-238 production strategies. Adams earned his Bachelor of Science in Physics from Westminster College in New Wilmington, PA and his Master of Science degree in Electrical Engineering from Villanova University.

4.3.5 OFFICE OF THE CHIEF ENGINEER (OCE)

MISSION STATEMENT

The Office of the Chief Engineer provides policy direction, oversight, and assessment for NASA engineering and program/project management. It serves as the principal advisor to the Administrator and other senior officials on matters pertaining to technical readiness in execution of NASA programs and projects. Also, it is responsible for Agency-level standards and policies as applied to engineering and program management.

ORGANIZATIONAL STRUCTURE

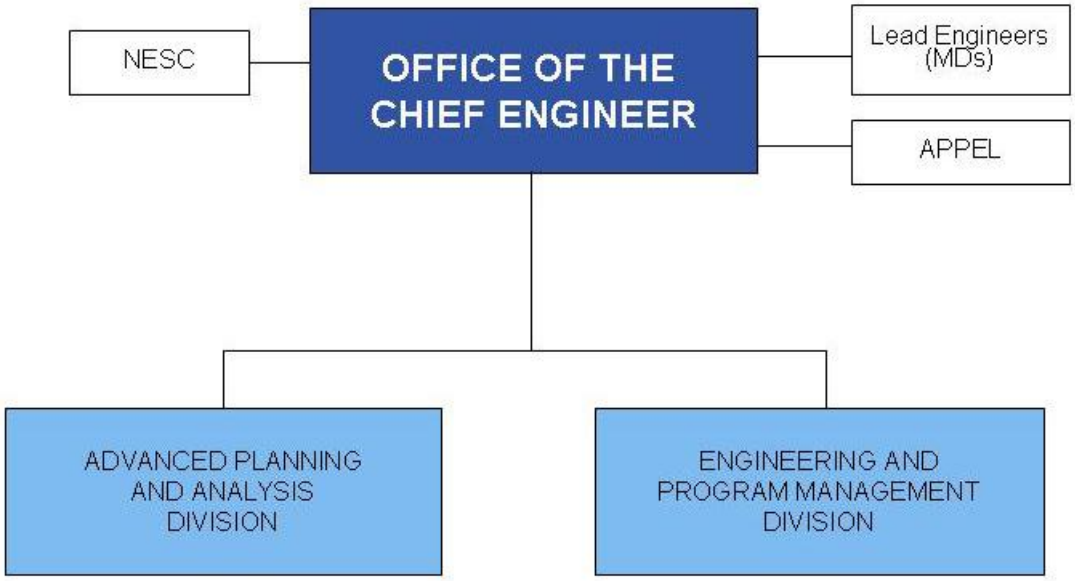


Figure 4.3.5-1: OCE Organizational Structure

WORKFORCE

OCE has a workforce allocation of 24 Full Time Equivalent (FTE) Civil Servants.

BUDGET EST. ($M)

President's FY13 Budget Request	FY2012	FY2013	FY2014	FY2015	FY2016	FY2017
Office of the Chief Engineer	$105.2	$98.6	$98.6	$98.6	$98.6	$98.6

Table 4.3.5-1: Office of the Chief Engineer's Budget Runout

FUNCTIONS

NASA ENGINEERING AND SAFETY CENTER (NESC)

The NASA Engineering and Safety Center, established in 2003 in response to the Columbia accident, is responsible for rapid, cross-Agency response to mission critical engineering issues, and for improving the state of the practice in critical engineering areas. The NESC performs value-added independent testing, analyses, and technical assessments of NASA's projects and technical activities to enhance safety and mission success. The NESC also works proactively to help NASA avoid problem recurrence and to prevent future problems. The core NESC organization is comprised of senior engineering experts from across the Agency, including the NASA Technical Fellows and their Technical Discipline Teams composed of experts from NASA, industry, and academia.

ACADEMY OF PROGRAM, PROJECT, AND ENGINEERING LEADERSHIP (APPEL)

APPEL provides leadership of, and policy for, the Agency's engineering and program/project management training. APPEL implements and manages an Agency-wide curriculum that enhances the requisite competencies for program/project managers, systems engineers, and discipline engineers, facilitates the agency's project management certification process per Office of Management and Budget requirements, and offers knowledge sharing activities to enhance mission success. This includes providing and managing curriculum at NASA centers, and offering knowledge services such as Principal Investigator Forums that are mandatory for Principal Investigator teams selected through the Science Mission Directorate's Announcement of Opportunity process. The Office of the Chief Engineer works to ensure proper alignment of curriculum with needed competencies for the future of NASA. The APPEL Director also serves as NASA's Chief Knowledge Officer, the agency's focal point for developing the policies and requirements necessary to integrate knowledge capture across programs, projects, and centers.

ADVANCED PLANNING AND ANALYSIS DIVISION

The division has four main functions:

4. Coordinate the application of technical resources to support engineering work, including lessons learned, technical standards, trend evaluation, access to technical information, technical support for specific disciplines and problems, and coordination among engineering work groups;
5. Provide leadership to define the tools, processes, facilities, and engineering resources needed to improve the Agency's technical excellence;
6. Establish and maintain Agency-wide processes, technical standards, requirements, and policies for the conduct of discipline-area engineering and systems engineering; and
7. Provide leadership and oversight for the Agency's Inventions and Contributions Board.

ENGINEERING AND PROGRAM MANAGEMENT DIVISION

This division provides leadership, policy direction, functional oversight, assessment, and coordination for two major, closely related areas:

8. Engineering and related technical disciplines, including systems engineering, software engineering, and technical integration; and

9. Program and project management, including earned value management, program integration, and program planning and control.

This division also establishes and maintains the Agency-wide process and requirements for program and project management and facilitates Agency coordination to understand the risk associated with protection of NASA's space assets (ground and on-orbit) against natural or man made activity that reduces our capacity to perform our missions. This includes maintenance and update of Policy and Requirements Documents (NPDs and NPRs) for Program and Project Management and Engineering.

IMPORTANT ACTIVITIES

TECHNICAL EXCELLENCE

It is critical that OCE develop new policies across a broad range of engineering topics that have the potential to take the agency in new directions. Focused on current and future missions, the OCE identifies critical near-, mid-, and long-term cross-cutting technical issues, any gaps/overlaps, and develops findings and recommendations for strategic considerations by the Agency to achieve its goals. OCE has identified several initiatives to address some of the high priority mid- to long-term cross-cutting technical issues driving technical readiness. Included in this list are initiatives for: Space Weather and Climatology; Entry, Descent and Landing; Advanced Propulsion Concepts; Optical Communications; and Radioisotope Power Systems.

SYSTEM ENGINEERING

Office of the Chief Engineer is working with the NASA centers to develop an Agency plan to resolve the shortage of systems engineering skills for NASA's major programs. The OCE recognizes that growing the talent pool takes time, and skill availability outside of NASA makes hiring difficult. A number of OCE activities have begun to ensure a strong systems engineering capability.

ENGINEERING SCIENCE

The Office of the Chief Engineer is responsible for leading NASA's approach to solving the engineering problems that arise throughout a flight system's lifecycle, with responsibility for technical processes and what is often called engineering science. NASA's programs and projects and technology development require a solid foundation in basic engineering science research relevant to the Agency's work. A technology is a solution that arises from applying the disciplines of engineering science to synthesize a device, process or subsystem, with the purpose of enabling a specific capability. In contrast, basic engineering science research is informed by explorations of the unknown or least understood areas of foundational science and engineering, which clearly distinguishes it from technology — it is the pacesetter for technology and the raw material for inventions and discoveries. A NASA-relevant example of basic engineering science is to provide predictive methods in fluid dynamics, structural mechanics, and spacecraft charging. Engineering science described here is done for the sake of enabling future technologies and improving the prediction and analysis of engineered systems. NASA continues to rely on tried and proven engineering capabilities such as NASA structural analysis and Finite Element Analysis (FEA) tools — NASTRAN and PATRAN, which are products of engineering science research investments made over 40 years ago. The Office of the Chief Engineer in collaboration with the Office of the Chief Technologist and the Office of the Chief Scientist is in the process of formulating an

Agency strategy that will provide coordination and direction in basic engineering science research in a way that is analogous to how the Chief Technologist currently leads and provides strategic direction for technology.

PROGRAM PLANNING AND CONTROL

Over the past two decades, NASA's Program Planning and Control (PP&C) capability and skills have been diminishing due to attrition, out-sourcing, and budget cuts. In response, OCE has implemented a number of actions to address the Agency's performance challenge. Over the past year, OCE has led a concerted effort to coordinate the revitalization of PP&C capability across the Agency under the guidance of an Agency PP&C Steering Committee and an Agencywide working group. Progress has been made at all centers but more work is required to develop a robust Agency PP&C capability.

MAJOR ISSUES

FUNDING SHORTFALL FOR MISSION SUPPORT

OCE's reduced baseline budget is barely sufficient to cover statutory regulations, required policy development, maintenance of technical standards, and essential services to engineers working on programs and projects and core agency training in support of the Office of Management and Budget (OMB) certification requirements but without the ability to reasonably address any capability shortfalls or emerging issues. This leads to a reduction in the NASA Engineering and Space Center (NESC) proactive work, knowledge sharing, the number of Tech Fellows, and discipline enhancing work. Other impacts include reduced OCE Tech Excellence Initiatives, APPEL course and knowledge sharing content, JPL TA, and several other critical areas. The challenge is to protect NASA engineering and other technical and programmatic capabilities.

KEY PERSONNEL

Dr. Michael Ryschewitsch, Chief Engineer. Since August 2007, Dr. Ryschkewitsch has served as the NASA's Chief Engineer after serving as the Deputy Center Director for NASA's Goddard Space Flight Center since 2005. He joined NASA in 1982 as a cryogenics engineer to work on the Cosmic Background Explorer mission, held a number of management positions and supported many projects such as the Hubble Space Telescope Servicing Missions and the Wilkinson Microwave Anisotropy Probe. He earned his Bachelor's degree in Physics from the University of Florida, Gainesville, in 1973 and a doctorate from Duke University, Durham, NC, in 1978. He was awarded the NASA Exceptional Service Medal, the NASA Medal for Outstanding Leadership, the Robert Baumann Award for contributions to mission success, and the NASA Engineering and Safety Center Leadership Award.

Gregory Robinson, Deputy Chief Engineer. Robinson was appointed NASA Deputy Chief Engineer in November 2005. He was previously Deputy Chief Engineer, and in that role was the primary liaison with the centers engineering organizations and the four Mission Directorates at Headquarters. Prior to coming to NASA Headquarters in 1999, he spent 11 years in various leadership posts at NASA's Goddard Space Flight Center in Greenbelt, MD. In addition to his other leadership roles, he served as Systems Assurance Manager for the Earth Observing System (Aqua) Project and the Aura spacecraft, as well as the Global Geospace Science project, which included the Wind and Polar spacecraft. Robinson earned his dual Bachelor's degrees in 1983 in Math from Virginia Union University, Electrical Engineering from Howard University, and an MBA from Averett College in 1993. He also attended Harvard University, Kennedy School

of Government, Senior Executive Fellows Program; and the Federal Executive Institute (Leadership for a Democratic Society). He has received numerous individual and group Performance Awards, and the Presidential Rank, Meritorious Senior Professionals and Executives Award.

Carrie Sorrels, Deputy for Management. Since 2005, Sorrels has served as the Deputy for Management, Office of the Chief Engineer after serving as Director of the Policy and Business Management Division in the Science Mission Directorate. She joined NASA in 1985 as a Presidential Management Intern in the Office of Space Science, where she held a number of management positions and supported many programs, including Solar System Exploration, Sun-Earth Connections, and Physics and Astronomy. She earned her Bachelor's degree in Political Science from Texas Tech University in 1983, and a Master's degree in Public Policy from Texas Tech in 1985. She was awarded the NASA Exceptional Service Medal and many performance and achievement awards throughout her career.

4.3.6 Office of the Chief Health And Medical Officer (OCHMO)

Mission Statement

The Office of the Chief Health and Medical Officer (OCHMO) serves as the focal point for policy formulation, coordination, oversight, and management of all NASA health and medical matters in all environments, and medical emergency preparedness and contingency operations and response.

Workforce

The OCHMO has a workforce allocation of 10 Full Time Equivalent (FTE) Civil Servants.

Budget Est. ($M)

President's FY13 Budget Request	FY2012	FY2013	FY2014	FY2015	FY2016	FY2017
Office of the Chief Health and Medical Officer	$4.5	$4.3	$4.3	$4.3	$4.3	$4.3

Table 4.3.6-1: Office of the Chief Health & Medical Officer's Budget Runout

Functions

Occupational Health Division

The Occupational Health (OH) Division has Agency-wide oversight for occupational medicine, environmental health (including industrial hygiene, health physics, and food sanitation), federal workers' compensation, employee assistance, physical fitness programs, and primary prevention efforts. The OH Division also represents NASA on various federal interagency panels and working groups that include the Environmental Protection Agency, Department of Labor, Federal Aviation Administration, the Office of Personnel Management, and the Department of Health and Human Services.

Medicine of Extreme Environments Division

The Medicine of Extreme Environments (MEE) Division is responsible for oversight of implementation of operational medical policy for NASA missions, with a primary focus on human space flight. MEE is also responsible for oversight of the Civilian Aerospace Medicine Residencies, and for the functions of the NASA Medical Policy Board and the Multilateral Medical Policy Board. The Division also maintains NASA's relationship with the Institute of Medicine's Committee on Aerospace Medicine and Medicine of Extreme Environments.

Medical Policy and Ethics Division

The Medical Policy and Ethics Division is responsible for formulating and implementing NASA health and medical policy pertaining to human space flight and bioethics. This includes policies, requirements, and standards related to the health and medical care of space flight and aviation crews, regulatory oversight of the use of animal and human research subjects in NASA-sponsored biomedical research, and translation of research findings into NASA medical practice.

IMPORTANT ACTIVITIES

Electronic Health Record System (EHRS)

The NASA EHRS, a project in alignment with the Federal e-Government initiative, was fully implemented in September 2012 to enhance the efficacy of Agency healthcare information management. The EHRS will enable OCHMO to track and trend health data for refinement of health programs demonstrating the highest return on investment.

HEALTH AND MEDICAL REVIEW

The Chief Health and Medical Office conducts onsite occupational health reviews of all NASA centers and facilities every three years to ensure compliance with applicable internal and external policies and regulations, and to assure the highest quality of care, support, and protection for NASA employees.

RESIDENCIES, COMMITTEE, AND BOARDS

The University of Texas Medical Branch (UTMB) and Wright State University aerospace medicine residencies train physicians for the clinical care of NASA astronauts and aviation crews. The UTMB also provides clinical currency training for NASA physicians who are trained to become NASA flight surgeons on a regular basis, as well as access to aerospace medicine continuing education. The Committee on Aerospace Medicine and Medicine of Extreme Environments of the Institute of Medicine, sponsored by OCHMO, holds regular meetings on medical issues critical to maintaining the health of NASA astronauts on missions in analog, air, and space environments. The NASA Medical Policy Board (MPB) and Aerospace Medicine Board (AMB) are responsible for guidance on aerospace medicine policy formulation and implementation, impacting astronaut healthcare before, during, and after space flight. The Multilateral Medical Policy Board (MMPB), co-chaired by the NASA and the Russian Space Agency Chief Medical Officers, establishes policies and provides oversight for International Space Station medical operations.

HEALTH AND MEDICAL TECHNICAL AUTHORITY

NASA has established the technical authority process as part of its system of checks and balances to provide independent oversight of programs and projects in support of safety and mission success. The CHMO serves as the Agency's independent Health and Medical Technical Authority (HMTA) and delegates HMTA responsibilities to the Chief Medical Officers at the NASA centers. The HMTA ensures that Agency health and medical policy, procedural requirements, and standards are addressed in program/project management when applicable and appropriate. HMTA provides independent oversight of all human health, medical, and human performance matters that either arise in association with the execution of NASA programs or projects, or are embedded in NASA programs or projects.

MAJOR ISSUES

A significant challenge for which OCHMO has been apprised by NASA Center Occupational Health representatives continues to be workforce stress. Agency budget reductions, workforce reductions, workforce reorganizations, and associated increases to employee workloads have been identified as primary contributors to the workforce's mental and physical well-being. The Chief Health and Medical Officer (CHMO), the Office of Human Capital,

NASA Employee Assistance Program Clinicians, the Office of Security and Protective Services, and the Office of General Counsel coordinate, as needed, to assess and discuss potential stress remediation methods for implementation by NASA centers. The levels of workforce stress are monitored closely to identify noteworthy trends requiring immediate attention and periodic anecdotal and utilization feedback is collected from NASA centers for analysis by the CHMO and NASA subject matter experts.

Key Personnel

Richard S. Williams, MD, **FACS**, serves as NASA's Chief Health and Medical Officer and is responsible for the oversight of all medical aspects of all national and international NASA missions involving humans. He is certified by both the American Board of Surgery and the American Board of Preventive Medicine, and has extensive medical management experience in both military and civilian settings.

Vincent J. Michaud, MD, serves as the deputy to the Chief Health and Medical Officer. He is certified by the American Board of Preventive Medicine (Aerospace and Occupational Medicine). He has over 20 years experience in a wide variety of clinical and leadership positions in aerospace and occupational medicine.

Catherine M. Angotti, RD, serves as the Director of Occupational Health and as the Administrative Deputy to the Chief Health and Medical Officer. She has over 30 years experience in the management of NASA's occupational healthcare system and has served in numerous dietetic positions at the local, state, and national levels, including election as President of the local and state dietetic associations.

David R. Liskowsky, Ph.D., serves as the Director of the Medical Policy and Ethics Division. He served on the faculty at the University of Miami from 1984-1988. In 1988, he joined the Office of Technology Assessment of the U.S. Congress as a Senior Policy Analyst. In 1992, he joined NASA's Life Sciences Division and was involved with the management of NASA's medical and biological, ground and flight research programs. In 2003, he joined the Office of the Chief Medical Officer.

4.3.7 Office of Safety and Mission Assurance

Mission Statement

The Office of Safety and Mission Assurance provides policy direction, functional oversight, and assessment for all Agency safety, reliability, maintainability, and quality engineering and assurance activities and serves as a principal advisory resource for the Administrator and other senior officials on matters pertaining to safety and mission success.

Organizational Structure

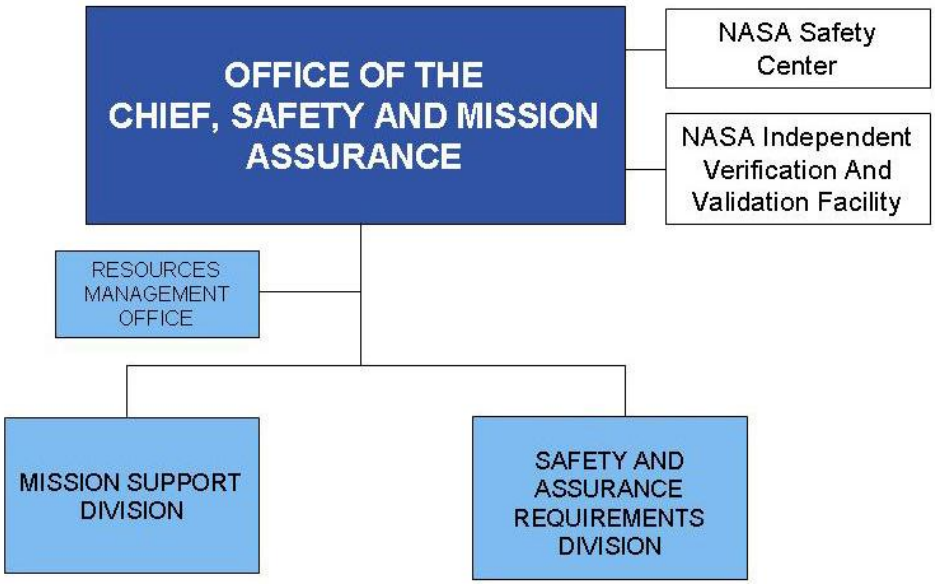


Figure 4.3.7-1: OSMA Organizational Structure

Workforce

OSMA's workforce consists of 35 Full Time Equivalent (FTE) Civil Service employees. This includes the NASA Safety Center (NSC) and the NASA Independent Verification and Validation (IV&V) Facility Director positions.

Budget Est. ($M)

President's FY13 Budget Request	FY2012	FY2013	FY2014	FY2015	FY2016	FY2017
S&MA	$49.4	$47.8	$47.8	$47.8	$47.8	$47.8
IV&V	$39.1	$31.7	$31.7	$31.7	$31.7	$31.7

Table 4.3.7-1: Office of Safety and Mission Assurance's and the Independent Verification and Validation Program Budgets

FUNCTIONS

OSMA provides the framework and guidance to assist NASA programs, projects, and centers in meeting their responsibilities to protect the public, the NASA workforce, and high value equipment and property.

MISSION SUPPORT DIVISION

The Mission Support Division provides oversight, assists with the flow of policy and procedural guidance, and provides technical Safety and Mission Assurance (SMA) support to NASA Mission Directorates and to the Center SMA organizations. The major responsibilities of the Division include (1) monitoring the compliance of Mission Directorate SMA processes with NASA policies and guidance, assuring that Mission Directorates and centers achieve their safety and mission success objectives; (2) executing the process for the approval of annual agreements between the Center SMA organization and the Center Director (called SMA Annual Operating Agreements) – these agreements drive center safety, reliability, and quality assurance implementation planning and help to identify gaps and resolve shortfalls in SMA processes; and (3) continuously overseeing, from the Headquarters-level, the development and operation of major NASA missions and programs including the International Space Station, the Exploration System Development Programs, the Commercial Cargo and Crew Programs, and aeronautics and science missions and programs.

SAFETY AND ASSURANCE REQUIREMENTS DIVISION

The Safety and Assurance Requirements Division defines and manages the Agency's comprehensive safety program. The major responsibilities of the Division include (1) providing Agency leadership in the development and implementation of NASA's safety, reliability, maintainability, quality, and risk management/assessment policies, procedures, standards, training, tools, and techniques; (2) working with NASA centers and industry to resolve technical and assurance problems that pose a threat to safety and/or mission success; (3) overseeing and supporting operational, institutional, aviation, and range safety and safety for nuclear materials for space payloads and space craft; and (4) ensuring the proper reporting, investigating, recordkeeping, and contingency planning for mishaps and close calls.

NASA SAFETY CENTER (NSC)

The NSC (Cleveland, OH) serves as an Agency-wide resource for strengthening SMA capabilities and enabling more uniform and effective SMA support for the safe and successful execution of all NASA programs and institutions. The major responsibilities of the NSC include: (1) promoting technical excellence through a balanced program for leadership development, education, training, communication, and information management in the SMA disciplines; (2) managing the audit, review, and assessment process for evaluating and assuring conformance with Agency SMA requirements; (3) providing a wide range of support for mishap investigations and mishap data analysis and trending; and (4) capturing and disseminating information of importance and usefulness to the SMA community.

NASA Independent Verification and Validation (IV&V) Facility

The NASA IV&V Facility (Fairmont, WV) serves as the Agency's sole agent for providing Agency-level prescribed independent system software validation and verification services to NASA projects. The major responsibilities of the NASA IV&V Facility include: (1) applying software engineering best practices to evaluate the correctness and quality of critical and complex NASA software systems; (2) providing the Agency with a method for the early identification of software risk elements on critical and complex system software; and (3) performing leading-edge research that improves IV&V and software assurance methods, practices, and tools.

Important Activities

In addition to the work that OSMA performs on a daily basis as described in our function summary statements above, OSMA is presently working the following important activities:

Definition/Negotiation of Agency SMA Requirements Applicable to the New Human Exploration and Operations Programs and Associated Projects – Early identification and integration of SMA requirements are essential elements of a program that is safe and successful. Working with the Programs, OSMA completed a mapping of Agency SMA requirements to Program-level requirements, identifying those SMA requirements that needed to be incorporated throughout the Programs.

Institutionalization of Safety and Mission Assurance Technical Authority Roles, Responsibilities, and Requirements – OSMA continues to refine, communicate, and implement technical authority policy and procedures that ensure clarity and accountability in responsibilities for safety and mission assurance requirements and for approving waivers to requirements that belong to the SMA technical authorities. The technical authority activities are still relatively new at NASA, and the challenge remains to assure that technical authority is understood and that its application is established and proficient for all the mission activities being pursued by the four Mission Directorates.

Oversight of the Space Shuttle Program Close-out and Transition Process to Exploration Systems – OSMA is carefully monitoring the remaining two years of Shuttle operations to assure that the focus of the work force and the integrity of the critical decision processes are maintained at a level that will assure safe fly-out of the program. OSMA is also monitoring transition activities to identify transactions that might create hazards for our current and future programs or the public.

Establishing a Fully Functional and Staffed NASA Safety Center (NSC) – In October 2006, NASA re-designated the NASA Assurance Technology Center as the NSC. The change was made after an extensive review of NASA's SMA capabilities and personal competencies in place and able to support the Vision for Space Exploration. The OSMA declared the NSC as a strategic element of the Agency's safety and mission success strategy with a responsibility to focus on supporting the development of personnel, processes, and tools needed for the safe and successful achievement of NASA's strategic goals. OSMA is continuing to stand up the NSC with a fully supported staffing plan designed to fully achieve its function.

Major Issues

Assuring the Right Selection and Focus of IV&V Funding – A recent decision by the

Agency has resulted in the reinforcement of philosophy that software independent verification and validation will be "level funded" and thus not necessarily applied to all mission critical software. This has necessitated a different approach where the software is assessed for its criticality and IV&V applied very selectively to the mission software requiring the most attention. This is a new approach, and there will be some transition concerns. Some software that might require IV&V may not receive Agency-funded coverage due to the shortage of resources.

Establishing and Maintaining a Level of Excellence in the SMA Disciplines for the Long Term Support of the Agency – OSMA is continuing to best determine how to implement the initiative to engage senior level Agency SMA Technical Discipline Fellows in the four SMA disciplines of system safety, reliability and maintainability, quality engineering, and software assurance. The positions, by virtue of the seniority of the individuals, parity with other NASA engineering peers, and the selection of the "best of the best," would be part of the Safety Center strategy for reviewing, approving, and elevating the SMA discipline curricula and testing/boarding criteria, positively influencing the NASA culture relative to the quality of SMA engineering and technical excellence.

KEY PERSONNEL

Terrence W. Wilcutt, Chief of Safety and Mission Assurance. Wilcutt is a retired Marine colonel and veteran astronaut who had served as director of safety and mission assurance at NASA's Johnson Space Center (JSC) in Houston since 2008. In that position Wilcutt was tasked with the Safety Technical Authority of the programs and projects at JSC as well as JSC's Institutional Safety program. As chief of Safety and Mission Assurance, Wilcutt is responsible for the development, implementation, and oversight of all safety and mission assurance policies and procedures for all NASA programs.

Wilcutt joined NASA in 1990 as an astronaut candidate and was accepted into the corps in 1991. He logged more than 1,007 hours in space as the pilot on two shuttle missions, STS-68 in 1994 and STS-79 in 1996, and commander of two others, STS-89 in 1998 and STS-106 in 2000. His technical assignments as an astronaut included work on space shuttle main engine and external tank issues; supporting shuttle launches and landings as a member of the astronaut support personnel team at NASA's Kennedy Space Center in Florida; and technical issues for the Astronaut Office Operations Development Branch at Johnson.

Wilcutt also served as NASA Director of Operations at the Yuri Gagarin Cosmonaut Training Center in Star City, Russia; and at Johnson as chief of the Astronaut Office Shuttle Operations Branch, manager of safety and mission assurance for the Space Shuttle Program, and deputy director of safety and mission assurance.

A native of Louisville, KY, Wilcutt earned a Bachelor of Arts degree in Math from Western Kentucky University in 1974. He taught high school math for two years before entering the Marine Corps in 1976 and earned his naval aviator wings in 1978.

From 1980 until 1983, he was stationed in Kaneohe, Hawaii, and flew F-4 Phantoms during two overseas deployments to Japan, Korea, and the Philippines. For the next three years, he served as an F/A-18 fighter weapons and air combat maneuvering instructor while assigned to Squadron VFA-125 at Lemoore Naval Air Station in California. From 1986 until his selection by NASA, Wilcutt attended

the United States Naval Test Pilot School and served as a test pilot and project officer for the Strike Aircraft Test Directorate of the Naval Aircraft Test Center in Patuxent River, MD, flying the F/A-18 Hornet, the A-7 Corsair II, the F-4 Phantom and other aircraft. He has more than 6,600 flight hours in more than 30 different aircraft.

Wilcutt has received numerous special honors, including NASA's Outstanding Leadership Medal, Distinguished Service Medal, Exceptional Service Medal, and four spaceflight medals; the Distinguished Flying Cross; the Defense Superior Service and Meritorious Service medals; and the Navy Commendation Medal. He also has received the American Astronautical Society Flight Achievement Award; the V.M. Komarov Diploma, Federation Aeronautique Internationale space award for outstanding achievements in space exploration; and distinguished alumnus recognition and an honorary doctorate degree from Western Kentucky University.

Wilcutt maintains offices in Houston and Washington.

Thomas D. Whitmeyer, Deputy Chief, Safety and Mission Assurance. Whitmeyer is responsible for executive leadership, policy direction, functional management, and coordination for Agency-wide program and institutional Safety and Mission Assurance activities.

Prior to being appointed to his current position, Whitmeyer was the Director, Mission Support Division, Office of Safety and Mission Assurance, where he orchestrated policy direction, oversight, and coordination for safety and mission assurance activities for human-rated spacecraft, payloads, expendable launch vehicles, commercial crew programs, and aeronautics programs. Before this, he was the Deputy Assistant Associate Administrator for the Space Shuttle Program in the Space Operations Mission Directorate. Earlier in his career, he was the NASA Quality Program Manager within the Office of Safety and Mission Assurance.

Whitmeyer has more than 25 years of experience in aerospace engineering and implementation of safety, mission assurance, and systems engineering disciplines in a broad range of Department of Defense and NASA robotics and human space flight systems. He has a Bachelor of Science degree in mechanical engineering from Boston University, and a Master of Science degree in mechanical engineering from George Washington University.

Alan H. Phillips, Director, NASA Safety Center. Phillips is responsible for the overall management of the NASA Safety Center, which was established in 2006 to serve as an Agency-wide resource for strengthening safety and mission assurance capabilities. He began his career as a test engineer in the commercial nuclear power industry. He joined NASA in 1987 as a facility systems safety engineer. Phillips managed LaRC's certification (and recertification) as the first federal work-site in the nation to be recognized in OSHA's Voluntary Protection Program as a STAR participant, OSHA's highest level of recognition for exemplary safety and health programs.

Gregory D. Blaney, Director, NASA Independent Verification and Validation (IV&V) Program. Blaney is responsible for the overall management of the NASA IV&V Program, which was established in 1993 as part of an Agency-wide strategy to provide the highest achievable levels of safety and cost-effectiveness for mission critical software. Blaney started his civil service career as an Air Traffic Controller for the Federal Aviation

Administration prior to joining NASA at the Goddard Space Flight Center in the Tracking and Data Relay Satellite (TDRS) Network. Blaney served as the TDRS Network Director responsible for classified operations prior to transferring to the NASA IV&V Program where he served in many capacities prior to becoming the Director of the IV&V Program.

4.3.8 OFFICE OF DIVERSITY AND EQUAL OPPORTUNITY (ODEO)

MISSION STATEMENT

The Office of Diversity and Equal Opportunity (ODEO) is responsible for developing and aligning NASA equal opportunity (EO), civil rights compliance, and diversity strategies, programs, policies, and processes consistent with the Agency's mission, strategic goals, and performance outcomes. ODEO establishes Agency-wide policies on diversity and equal opportunity and defines strategies, program objectives, and top-level requirements; ensures statutory, regulatory, and fiduciary compliance with internal and external equal opportunity laws; provides technical assistance, training, and advocacy to promote an open and inclusive workplace; ensures consistency of approach to improve functional performance across the Agency; and monitors diversity and equal opportunity program performance.

ORGANIZATIONAL STRUCTURE

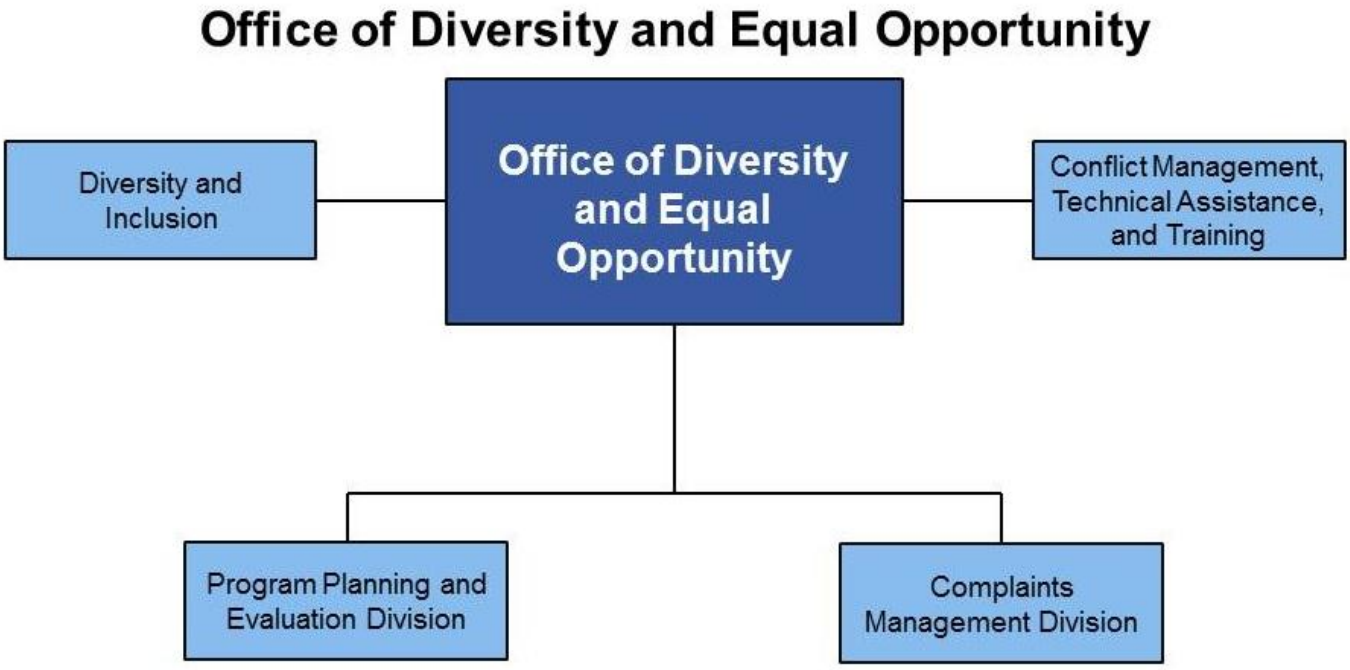


Figure 4.3.8-1: Organizational Structure

WORKFORCE

ODEO's workforce consists of 18 Full Time Permanent Civil Servants.

BUDGET EST. ($M)

President's FY13 Budget Request	FY2012	FY2013	FY2014	FY2015	FY2016	FY2017
Office of Diversity and Equal Opportunity	$1.1	$1.8	$1.8	$1.8	$1.8	$1.8

Table 4.3.8-1: Office of Diversity and Equal Opportunity's Budget Runout

FUNCTIONS

ODEO is comprised of the Office of the Associate Administrator (AA) and two Divisions: the Program Planning and Evaluation (PPE) Division, and the Complaints Management (CM) Division.

Office of the Associate Administrator. The Office of the AA provides executive leadership and oversight for the effective management of all ODEO programs, resources, Agency-wide initiatives, and external requirements for ODEO. The Office of the AA accomplishes its goals and contributes to Agency strategic goals by ensuring that the NASA workforce and grantee programs are meeting EO requirements, and engaging in diversity and inclusion (D&I) efforts to enhance organizational effectiveness.

Program Planning and Evaluation (PPE) Division. PPE manages and directs a wide range of EEO, as well as grant-related and NASA-conducted program EO requirements, through policy and program development, analysis and evaluation, outreach, and monitoring.

Complaints Management (CM) Division. CM manages and implements Agency-wide policies and systems for processing, adjudicating, and resolving individual and class discrimination complaints, including oversight of the informal complaints process conducted at the NASA centers and the Agency Alternative Dispute Resolution (ADR) program for EEO.

IMPORTANT ACTIVITIES

MODEL EEO AGENCY PLAN

Consistent with EEOC Management Directive (MD) 715, ODEO prepares multi-year plans for achieving a model EEO agency, with annual updates and progress reports. The intention of the Model EEO Agency Plan is to ensure nondiscrimination in personnel actions such as hires, promotions, awards, and performance ratings. ODEO conducts an annual self-assessment to identify deficiencies in NASA's EEO infrastructure. Workforce statistics and qualitative data gathered through surveys and focus groups are used to identify barriers and potential barriers to EEO in the NASA workforce. ODEO, in collaboration with other Agency offices, develops action plans to eliminate each of the identified deficiencies and barriers.

EEO COMPLAINTS/ADR

To ensure that the Agency more effectively meets all equal opportunity (EO) requirements, ODEO is implementing enhancements to increase the operational efficiency of the EEO complaints process. For example, ODEO has established Agency-wide procedural requirements and standards for Alternative Dispute Resolution (ADR)

implementation, designed to better ensure efficient and consistent ADR programs. In addition, ODEO has successfully sought to increase ADR utilization rates through well-disseminated communications materials and both online and classroom education and awareness opportunities.

In FY 2012, ODEO established an Agency policy for processing discrimination complaints based on sexual orientation. This process is parallel to the EEO complaints process, to the extent permitted by law.

Agency Diversity and Inclusion Strategic Implementation Plan

ODEO is also engaged in a proactive activity to enhance organizational effectiveness through a new Agency-wide Diversity and Inclusion Strategic Implementation Plan (DISIP), a strategic approach to promoting a more open and inclusive workplace. This plan is NASA's blueprint for fully leveraging our diversity. As such, it provides innovative Agency guidelines and strategies consciously designed to enhance the inclusiveness of our work environments and further broaden the reach of our education, recruitment, and small business efforts.

Plan implementation is currently focused on Agency-wide D&I communications and center technical assistance. The Agency is also moving forward with other strategic D&I efforts, such as developing guidance on utilizing employee resource groups (ERGs) to enhance D&I efforts at the local level, conducting center briefings for the Agency's lesbian, gay, bisexual, and transgender communities (LGBT) on new NASA procedures for addressing sexual orientation discrimination complaints, and implementing the Pathways Program to broaden the diversity of the NASA pipeline and new hires.

Conflict Management Program

Consistent with ODEO's focus on result-driven, customer-focused proactive initiatives, ODEO continues to implement the Agency-wide Conflict Management Program (CMP). CMP has been recognized by OPM as the most innovative and proactive program government-wide in improving complaints and civil rights programs. It is a comprehensive program to more effectively deal with workplace conflict, reduce the number of EEO complaints and alleviate the stress on NASA organizations. CMP provides practical tools to more successfully address conflict as early as possible, helping organizations to maintain focus on the mission.

Consistent and Effective Agency Anti-Harassment Procedures

NASA issued Agency Anti-Harassment Procedures (NPR 3713.3) in 2009 based on the Agency's longstanding Anti-Harassment Policy Statement. These procedures brought NASA into line with EEOC enforcement and other guidance urging employers to establish a clear set of procedures to address harassment allegations. As recommended by EEOC, these procedures are separate and apart from the Agency's EEO complaints process. The Agency anti-harassment procedures are designed to ensure that prompt, impartial, and effective action is taken in response to allegations of harassment. This includes establishing a reporting mechanism both in and out of the supervisory chain and allowing for disciplinary action up to and including removal. In addition, NASA anti-harassment policy and procedures now cover not only those classifications protected under EEO law, but other classifications protected under Executive policy, namely, sexual orientation, status as a parent, and gender identity. Overall, the procedures allow the Agency to

more effectively address allegations of harassment when they arise and to better ensure against legal liability.

EO Functional Review Program

Another means of more effectively meeting EO requirements is ODEO's Functional Review Program (FRP), a multi-year, Agency-wide program involving comprehensive center by center reviews of center EO operations. The reviews are resulting in identification of "opportunity areas" for improvement and "best practices" sharing for centers to facilitate more productive, diverse workplaces and better-managed EO resources.

External Civil Rights Compliance Activities

An additional effort to more effectively meet EO requirements concerns educational and other institutions, which promote mission-related research. NASA grants $750 million to $1.2 billion annually to approximately 650 such institutions. ODEO has developed a fully realized civil rights compliance infrastructure to ensure institutions receiving NASA funds are not discriminating against their beneficiaries, and to otherwise advance EO in these programs. This includes conducting onsite and desk-audit compliance reviews under the relevant statutes and regulations, and providing technical assistance to grantees through detailed compliance reports and negotiations to promote voluntary compliance.

In addition, NASA provides technical assistance and education and awareness opportunities through publications and brochures. We are currently taking our technical assistance efforts to the next level with a new Web site, MissionSTEM, designed to serve as a vehicle for fostering active communication between and among our grant recipient institutions and stakeholders. To this end, the Web site will showcase best practices and help to address common challenges. It will provide a variety of educational information and interactive opportunities such as webinars with institutional partners, videotaped panel presentations, and Q&A sessions between grant recipients and federal civil rights officials.

NASA's external civil rights program continues to be recognized as a leader in the field by the Department of Justice Civil Rights Division and external stakeholder organizations, such as the Society of Women Engineers and the Association of Women in Science.

Major Issues

Strategic Integration of EO and D&I

From a strategic standpoint, the biggest concern is fully integrating EO and D&I into the key decision-making processes and operations of the Agency. While we have made progress, with the Administrator making the Associate Administrator for DEO a direct report in 2010, and the Agency's current Strategic Plan incorporating specific, measurable EO and D&I performance goals, there is still much work to be done in fully institutionalizing D&I and EO at NASA.

Key Personnel

Brenda R. Manuel, Associate Administrator. Brenda Manuel assumed the role of Associate Administrator for Diversity and Equal Opportunity in October 2006. Manuel is an attorney, manager, and trainer with over 35 years experience in the field, including 33 at NASA.

4.3.9 OFFICE OF EDUCATION

MISSION STATEMENT

The Associate Administrator for Education provides Agency leadership and programmatic oversight for NASA's external education programs. The Associate Administrator for Education has the responsibility to leverage NASA's unique mission content, facilities, and workforce. Education is a cross-cutting process that engages the public in shaping and sharing the experience of exploration and discovery. The vision of NASA's education community is to advance high quality Science, Technology, Engineering, and Mathematics (STEM) education using NASA's unique capabilities.

WORKFORCE

The Headquarters Office of Education has a workforce allocation of 18 Full Time Equivalent (FTE) Civil Servants. Offices of Education are established at all NASA centers with functional accountability to the Associate Administrator for Education.

BUDGET EST. ($M)

President's FY13 Budget Request	FY2012	FY2013	FY2014	FY2015	FY2016	FY2017
Office of Education	$136.1	$100	$100	$100	$100	$100

Table 4.3.9-1: The Office of Education's Budget Runout

FUNCTIONS

Key educational functions by Division include the following:

The Planning, Policy, and Evaluation Division provides the overall management and infrastructure for planning, policy development, budget and evaluation efforts to support NASA's education projects and programs. It develops and implements plans to improve efficiencies and accountability across the Agency's education programs and provides guidance to NASA education centers. This division oversees the formulation and execution of the education budget and the integration of performance measurement and accountability tools.

The Integration Division provides oversight and guidance for the Agency's lines of business and investments in NASA Internships, Fellowships, and Scholarships; Educator Professional Development; STEM Engagement; and Institutional Engagement. The division provides coordination and integration of NASA's education programs and activities with other organizations and includes NASA centers, mission directorates, and external partners.

IMPORTANT ACTIVITIES

PORTFOLIO MANAGEMENT

The NASA Education portfolio encompasses two programs, four national projects, and numerous activities within the Mission Directorates and centers. Education has developed a structured approach, focused on objectives, to balance and manage the Education portfolio. The Education Coordinating Council (ECC), chaired by the Associate Administrator for Education, provides recommendations on the process for balancing NASA's education

investments, i.e., reducing activities, merging projects with cross-cutting purposes, identifying content gaps within the portfolio, and new models for projects. The ECC includes Center Education Directors, education leads from the Mission Directorates, and representatives from the Mission Support Offices.

EVALUATION

NASA Education has made evaluation, performance metrics and reporting data on programs a priority. All education investments support the education annual performance goals, and collect data through the Office of Education Performance Monitoring (OEPM) system. Ongoing evaluations of NASA investments and conducted by internal and external evaluators. Through formative and summative evaluations, the ECC is able to better manage, improve and make decisions about its projects and programs.

PROGRAMMATIC DIRECTION

Education efforts throughout NASA are focused on four lines of business: a) attracting and preparing students in STEM disciplines, through internships, scholarships, and fellowships; b) strengthening the academic preparation of educators to teach STEM subjects relevant to NASA's mission; c) engaging educators and youth in authentic, hands-on experiences with NASA people, resources and facilities; and d) enhancing the capacity of institutions to participate in NASA's mission or to engage the Nation in educational experiences. Multiple solicitations are scheduled for FY13, and several activities specifically strengthen the research capabilities of jurisdictions and Minority Serving Institutions. These efforts also engage students outside of school, through programs conducted at NASA visitor centers, museums, science centers, and afterschool organizations such as scouts.

MAJOR ISSUES

Major issues facing NASA Education include the following:

NATIONAL INTEREST IN STEM ISSUES

NASA is a major partner in federal STEM initiatives and makes significant use of the Agency's unique facilities, resources, and people to support education programming throughout the Nation. External reviews have validated NASA's role and importance in improving national STEM efforts. Requests for NASA Education to participate in programs at the federal, state, university, and school levels, and with community partners exceed the Office staffing and budgetary resources. Decisions are therefore based on maximizing resources and partners.

DECENTRALIZED STRUCTURE OF EDUCATION AT NASA

Education is comprised of funding from all mission directorates, centers, and the Office of Education. While this decentralized approach allows direct access to center and mission directorate expertise, it creates challenges for coordination and accountability. Risk is managed by the Associate Administrator for Education, who chairs the Education Coordination Council, an Agency-wide collaborative structure that maximizes NASA's ability to manage and implement its education portfolio.

The ECC works to ensure that the agency's education investments are focused on supporting the nation's education efforts to develop the skilled workforce necessary to achieve the agency's goals and objectives.

PORTFOLIO MANAGEMENT

Accountability and analysis of a decentralized portfolio is a significant challenge to documenting progress toward achieving Agency education goals. Risk is managed through utilization of a single agency-wide performance management database, and consistent portfolio/project measurement procedures deployed across all centers, mission directorates, and Office of Education.

KEY PERSONNEL

Leland D. Melvin is NASA's Associate Administrator for the Office of Education and leads the development and implementation of the Agency's education programs. As associate administrator for education, Melvin chairs the Education Coordinating Committee, or ECC, an Agency-wide collaborative structure that maximizes NASA's ability to manage and implement its education portfolio. The ECC works to ensure that the Agency's education investments are focused on supporting the nation's education efforts to develop the skilled workforce necessary to achieve NASA's goals and objectives. Melvin currently serves on the White House National Science and Technology Council's Committee on Science, Technology, Engineering, and Mathematics Education, or CoSTEM. CoSTEM coordinates the STEM education activities and programs for all federal agencies, encourages the teaching of innovation and entrepreneurship as part of STEM education, reviews STEM education activities and programs to ensure they are not duplicative within the federal government, and develops and implements a five-year STEM education strategy for all federal agencies. He is the United States representative on the International Space Education Board (ISEB), a global collaboration in space education between NASA, the Canadian Space Agency, the European Space Agency, the Japan Aerospace Exploration Agency, and the Centre National d'Études Spatiales. Melvin began his NASA career in 1989 as an aerospace research engineer at the agency's Langley Research Center in Hampton, Va. He entered NASA's astronaut corps in 1998 and served as a mission specialist operating the robotic arm on two space shuttle missions to the International Space Station: STS-122 in 2008 and STS-129 in 2009. Melvin earned a Bachelor of Science degree in Chemistry from the University of Richmond, and a Master of Science degree in Materials Science Engineering from the University of Virginia in Charlottesville. He holds honorary doctorates from Centre College, St Paul's College, and Campbellsville University.

Dr. Roosevelt Y. Johnson is the Deputy Associate Administrator for Education. He is responsible for infrastructure planning, budget, legislative affairs coordination, policy development, program and projects evaluation, and data collection systems. In addition to serving on the Education Coordinating Committee (ECC), an Agency-wide collaborative structure that maximizes NASA's ability to manage and implement its education portfolio, Johnson serves as one of NASA's representatives on the Cross Agency Priority (CAP) Goal team working in conjunction with the White House National Science and Technology Council's Committee on Science, Technology, Engineering, and Mathematics Education (CoSTEM). For more than 20 years he served as a Program Director for the National Science Foundation (NSF). Johnson earned a Bachelor of Science degree in Zoology from Howard University and earned his doctoral degree in Microbiology from Indiana University.

James L. Stofan is the Deputy Associate Administrator for Integration. He provides coordination and integration of NASA's education programs. He previously served as acting associate administrator for education; deputy associate administrator for planning, policy and evaluation; and director of informal education. Prior to joining NASA, he was Senior Vice President for Education Programs at the National Wildlife Federation. He was on the faculty of the Johns Hopkins University School of Public Health as Director of the Distance Education Division, and as Director of Education for SeaWorld Orlando. He holds a Master of Arts in Instructional Systems Design and Instructional Technology from the University of Central Florida, College of Education.

4.3.10 Office of International and Interagency Relations (OIIR)

Mission Statement

The Office of International and Interagency Relations (OIIR) provides executive leadership and coordination for all NASA international activities and partnerships and for policy interactions between NASA and other U.S. Executive Branch offices and agencies. OIIR serves as the principal Agency liaison with the National Security Council, the Office of Science and Technology Policy, the Department of State, the Department of Defense, and other agencies. OIIR also directs NASA's international relations; negotiates cooperative and reimbursable agreements with foreign space partners; provides management oversight and staff support of NASA's advisory committees, commissions and panels; and manages the NASA Export Control Program and policy regarding foreign travel by NASA employees.

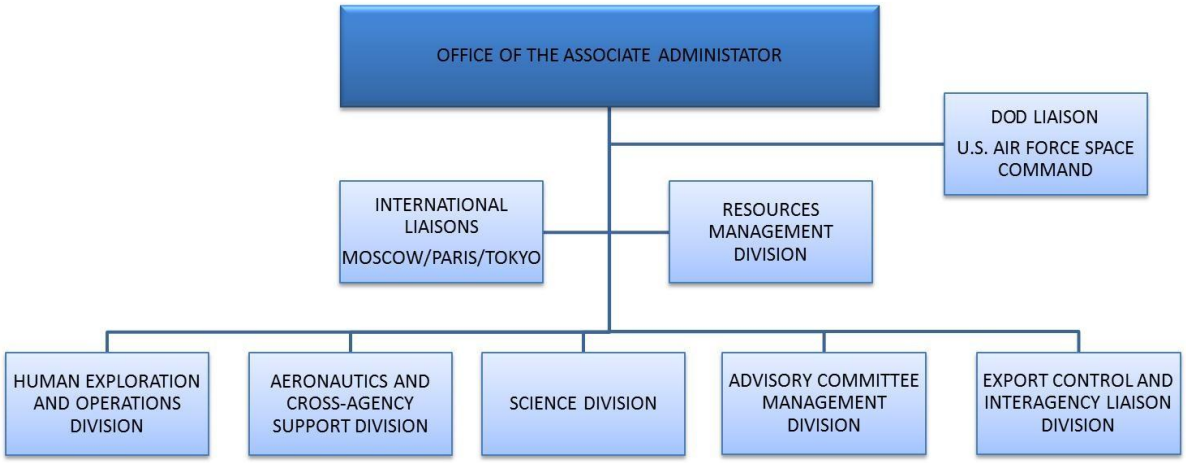


Figure 4.3.10-1: The Organizational Structure

Organizational Structure

OIIR is organized into six divisions: Human Exploration and Operations; Aeronautics and Cross-Agency Support; Science; Export Control and Interagency Liaison; Advisory Committee Management; and Resources Management.

A matrix approach within the office allows for provision of support to each of the three NASA Mission Directorates and for specific country or regional issues of interest to the Agency. In addition to its personnel at NASA Headquarters, OIIR has overseas representatives located at the U.S. Embassies in Moscow, Paris, and Tokyo, who provide support on a regional basis for NASA's overseas activities. OIIR also maintains a liaison position with the Department of Defense (Air Force Space Command) in Colorado Springs, CO.

Workforce

The OIIR has a workforce allocation of 51 Full Time Equivalent (FTE) Civil Servants.

BUDGET EST. ($M)

President's FY13 Budget Request	FY2012	FY2013	FY2014	FY2015	FY2016	FY2017
Office of International and Interagency Relations	$3.8	$4.0	$4.0	$4.0	$4.0	$4.0

Table 4.3.10-1: Office of International and Interagency Relations Budget Runout

FUNCTIONS

HUMAN EXPLORATION AND OPERATIONS DIVISION

This division supports the international activities of NASA's Human Exploration and Operations Mission Directorate (HEOMD), providing policy guidance and program support for human exploration capabilities, systems development and operations of the International Space Station (ISS) program, space communications and navigation, launch services, human spaceflight, space life and physical sciences research, commercial spaceflight, and crew issues. It also supports the Office of Safety and Mission Assurance (SMA) and the Chief Health and Medical Officer on international safety and health and medical matters. This support includes providing policy guidance and recommendations on international issues and relationships with current and prospective foreign partners, drafting and negotiating international agreements for new space cooperation, and supporting ongoing interaction with international partners for existing cooperative missions. The ISS program, for example, is a partnership of 15 nations implemented under the leadership of NASA, the European Space Agency (ESA), the Japan Ministry of Education, Culture, Sports, Science and Technology (MEXT)/Japan Aerospace Exploration Agency (JAXA), the Canadian Space Agency (CSA), and the Russian Federal Space Agency (ROSCOSMOS), and requires significant international coordination of policy and program matters. This is the lead division within OIIR for NASA's relations with Russia and countries of the former Soviet Union.

AERONAUTICS AND CROSS-AGENCY SUPPORT DIVISION

This division supports the international activities of NASA's Aeronautics Research Mission Directorate, the Office of the Chief Technologist, the Office of the Chief Scientist, and the Office of Education, fostering NASA's international engagement in aeronautics research as well as a wide range of activities in support of the Agency's mission, including the development of new space technologies and educational activities. The division oversees a diverse assortment of cooperative activities, from research aimed at improving the safety and efficiency of global aviation, to complementing U.S. space technology investments with research activities in other countries to help meet NASA goals. This is the lead division within OIIR for NASA's relations with Canada and Europe, and for coordinating all Agency interactions with international bodies such as the International Astronautical Federation and the International Academy of Astronautics.

SCIENCE DIVISION

This division supports the international activities of NASA's Science Mission Directorate, and develops and implements

policies for carrying out those activities. The Science Division works primarily in cooperation related to Earth science, solar system exploration, heliophysics (the study of the sun and its interactions with the other planets in the solar system, including its effect on human activities), and astrophysics. In addition, it is the lead division for various regions, including Asia, the Middle East, Africa, and Latin America. The division's work includes developing and negotiating international agreements with many different countries and intergovernmental organizations, and entails working with NASA's traditional partners in Europe, Asia, and Canada, as well as with non-traditional partners.

Export Control and Interagency Liaison Division

This division provides Agency-wide support for the administration of the NASA Export Control Program, the NASA J-1 Exchange Researcher Program, and the oversight of certain NASA foreign travel. In addition, this division coordinates Agency-level policy interactions with U.S. Executive Branch departments and agencies, and is the principal Agency liaison with the National Security Council, the Office of Science and Technology Policy, the Department of State, the Department of Defense, the Department of Energy, the Department of Commerce, and other agencies.

Note: International Relations is under the purview of the four OIIR Divisions mentioned above.

- **Agreements:** OIIR maintains over 50 active international agreements from organizations in over 120 countries and is drafting and negotiating about 100 international agreements at any given time. These agreements range from complex Memoranda of Understanding for major space programs, to simple letter agreements for more focused activities. OIIR prepares significant agreements for the NASA Administrator's signature, and is authorized to sign all other agreements with foreign entities.
- **International Support***:* OIIR provides policy advice and staff support for meetings by NASA senior management with foreign officials, assists the Mission Directorates in developing new international cooperative activities, serves as executive secretary for a variety of NASA multilateral groups, and monitors foreign developments and seeks opportunities for new partnership to meet Mission Directorate requirements.
- **Foreign Visits:** OIIR provides overall policy guidance for visits to NASA centers by foreign nationals or foreign representatives and manages the review and approval of requests for visits of foreign nationals from Designated Areas.

Advisory Committee Management Division

This division is responsible for providing management oversight of NASA's five external federal advisory committees, and ensuring that they operate in full compliance with the *Federal Advisory Committee Act*, the *Government in the Sunshine Act*, and related federal statutes, regulations, and policies. These five federal advisory committees are: NASA Advisory Council; Aerospace Safety Advisory Panel; National Space-Based Positioning, Navigation, and Timing Advisory Board; International Space Station Advisory Committee; and International Space Station National

Laboratory Advisory Committee. The division provides direct staff and administrative support for the two longstanding senior advisory committees to the NASA Administrator: the NASA Advisory Council and the Aerospace Safety Advisory Panel. It also serves as the designated Agency liaison with the Committee Management Secretariat of the U.S. General Services Administration (GSA). In addition, the division ensures that NASA advisory committee members and staff receive FACA training and that mandatory annual reports on NASA's advisory committee operations are submitted to GSA.

Resources Management Division

This division is responsible for OIIR's internal operations, including budget, personnel, space planning, and administrative support for NASA's overseas representatives and Department of Defense liaisons. This division also manages the Agency-wide translation service and visa processing contract, and is the Department of State liaison for issues pertaining to overseas staffing, security, facilities, the International Cooperative Administrative Support Services interagency groups, and to the Capital Security Cost Sharing group.

Important Activities

Important OIIR activities are very issue-oriented. They are contained in the NASA Transition Strategic Issues Book, under the following two topics: International Cooperation and Export Control.

Major Issues

The two major issues for OIIR are: International Cooperation and Export Control. These issues are described in detail in the NASA Transition Strategic Issues Book.

Key Personnel

Michael F. O'Brien, Associate Administrator. As Associate Administrator for International and Interagency Relations, O'Brien is responsible for NASA's interaction with Executive Branch offices and agencies; international relations for each NASA Mission Directorate; administration of export control and international technology transfer programs; and NASA advisory councils and commissions. O'Brien previously served as Deputy Assistant Administrator for External Relations (Space Flight). He was responsible for the international aspects of NASA's human spaceflight activities. He led the team that negotiated the agreements for the International Space Station with the space agencies of Europe, Japan, Canada, and Russia. O'Brien also was responsible for agreements related to space shuttle flights for international astronauts and NASA relations with over twenty other international space agencies.

O'Brien came to NASA from the United States Navy. He served as a naval aviator in command positions and in Washington on the staffs of the Chief of Naval Operations and the Chairman of the Joint Chiefs of Staff. As an advisor to the Chairman concerning political-military policy in the Middle East, Africa, and Southwest Asia, he traveled widely in the Persian Gulf area for bilateral discussions with the defense forces of Saudi Arabia, Kuwait, Bahrain, and other nations in the region. He also served as the Deputy Director for Research at the Institute for National Strategic Studies in Washington. O'Brien was Commanding Officer of U.S. Naval Station Roosevelt Roads, Puerto Rico, where he designed and

executed the $350 million repair and reconstruction program after the station was nearly destroyed by Hurricane Hugo. As a Navy combat pilot, he commanded a Navy carrier-based attack squadron, and proved that the average naval aviator has at least nine lives by surviving over 950 aircraft carrier landings in high-performance jet aircraft. O'Brien has also served as a physicist for the Department of the Navy.

O'Brien graduated with high distinction from the University of Virginia. He holds a Master of Science in Physics from Cornell University and a Master of Science in Aeronautical Systems from the University of West Florida. As an Olmsted Scholar, he performed research in International Relations and Strategic Studies at the Graduate Institute of International Relations in Geneva, Switzerland. O'Brien is also a graduate of the French Ecole Militaire in Paris, France. He speaks fluent French, some Spanish, and terrible Russian.

His awards include the Presidential Rank of Meritorious Executive, the NASA Exceptional Service Medal, the Defense Superior Service Medal, two Legions of Merit and two Air Medals for aerial combat. He is a member of Phi Beta Kappa.

Al Condes, Deputy Associate Administrator. Condes began his career at NASA in January 1984, in the NASA Headquarters Office of Procurement, as a Grants Specialist through NASA's Cooperative Education Student Program. In January 1985, he was assigned to the position of Contracting Officer conducting all major NASA foreign contract activity and assisting NASA's field centers with resolution of foreign procurement issues.

In December 1987, Condes moved to NASA's International Planning and Programs Office where he was responsible for assisting in the development, coordination, and implementation of NASA's international policy objectives. In 1993, during the U.S. Space Station program redesign, Condes served as one of NASA's primary liaisons with the U.S. Department of State and the White House Office of Science and Technology Policy and directly supported NASA's activities related to the initial involvement of the government of the Russian Federation in the International Space Station (ISS) program. In June 1994, Condes was assigned to the position of International Agreements Manager, focusing primarily on the development of appropriate legal instruments to facilitate Russian involvement in the Shuttle-Mir and ISS programs. During this period, Condes served as one of the lead negotiators and a principal author of NASA's agreements with Russia, Japan, Canada, and the European Space Agency for their respective participation in the ISS program.

In January 1999, Condes assumed the responsibility of Director for Earth Science in the Office of External Relations. In August 2002, Condes moved to Director for Human Space Flight and Research and in March 2004, Condes was selected as the Deputy Assistant Administrator for External Relations.

Condes is a member of the U.S. government's Senior Executive Service and has received numerous awards, including the Presidential Rank of Meritorious Senior Executive, the NASA Exceptional Achievement Medal, the NASA Exceptional Service Medal, the NASA Outstanding Leadership Medal. Condes has a Bachelor of Arts in Government and Politics from George Mason University and a Masters degree in Science, Technology, and Public Policy from George Washington University.

4.3.11 Office of the General Counsel (OGC)

Mission Statement

The General Counsel establishes Agency-wide legal policy, provides legal advice, assistance, and Agency-wide functional guidance, ensures the appropriateness of all legal actions and activities Agency-wide, and provides binding formal legal opinions on Agency matters. With respect to legal matters and issues, the General Counsel further ensures consistency of approach, eliminates duplication of functional support activities through collaboration, centralization, and/or consolidation of functions between and within Headquarters, the centers, and separate NASA entities.

Organizational Structure

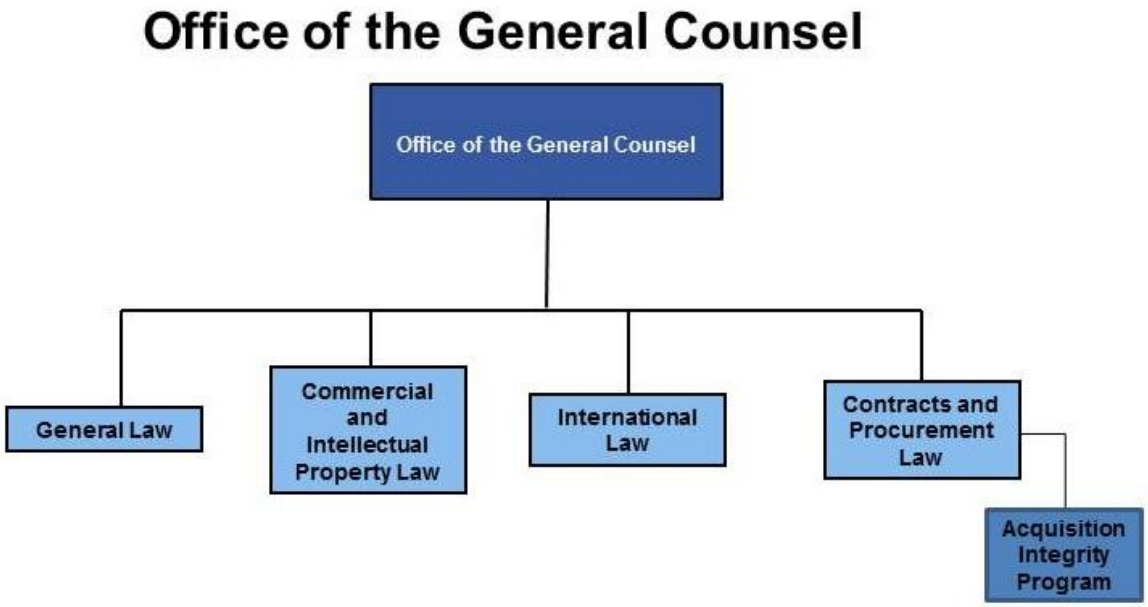


Figure 4.3.11-1: Organizational Structure

Workforce

OGC's workforce consists of 41 Full Time Permanent Civil Servants.

Budget Est. ($M)

President's FY13 Budget Request	FY2012	FY2013	FY2014	FY2015	FY2016	FY2017
Office of the General Counsel	$38.3	$37.0	$37.0	$37.0	$37.0	$37.0

Table 4.3.11-1: Office of the General Counsel's Budget Runout

FUNCTIONS

The Office of the General Counsel is organized into a front office (General Counsel and Deputy), four legal practice groups, each headed by an Associate General Counsel, and one legal program.

Commercial & Intellectual Property: This Practice Group has primary responsibility for intellectual property issues in domestic and international agreements, technical data issues, patent and copyright licensing, and the distribution of computer software, as well as non-procurement (Space Act) agreements with commercial and international entities.

Contracts & Procurement: This Practice Group has primary responsibility for contracts, grants, and cooperative agreements. They also coordinate the defense of acquisition protests filed at GAO, the ASBCA, or federal court.

General Law: This Practice Group has primary responsibility for a myriad of areas, including ethics, employment and labor law, fiscal and appropriations law, environmental and real property, safety and security law, legislation and other areas not specifically assigned to one of the other divisions.

International Law: This Practice Group has primary responsibility over legal issues regarding export control, Freedom of Information Act appeals, and general matters of international law.

Acquisition Integrity Program: The Acquisition Integrity Program (AIP) has primary responsibility for legal issues regarding procurement fraud and other related irregularities, remedies coordination, and suspension and debarment. The Program is responsible for preventing, detecting, and deterring procurement fraud through education and training of the NASA workforce as well as for supporting the investigation and prosecution of fraud and corruption related to the acquisition process.

IMPORTANT ACTIVITIES

OGC has functional responsibility for the Acquisition Integrity Program, the NASA Ethics Program, and the NASA patent program. In addition, OGC is the Agency's representative before courts and administrative bodies. It is also the principal Agency liaison with the following organizations: Department of Justice (except for those matters under the purview of the Inspector General or the Office of Security and Program Protection), the Office of Government Ethics, the Office of Special Counsel, and, for coordination of Executive Orders, the Executive Office of the President. The General Counsel personally serves as the statutory Designated Agency Ethics Official.

MAJOR ISSUES

INDEMNIFICATION FOR UNUSUALLY HAZARDOUS AND NUCLEAR RISK

NASA is seeking limited authority to indemnify companies for unusually hazardous risks associated with their participation in NASA programs. Although there are existing indemnification authorities, they are either inapplicable to foreseeable missions or are inadequate. Companies have expressed concerns to NASA that involvement in these activities as developers or operators will expose them to risks of liability and loss that are uninsurable or, at best, insurable only at an exorbitant cost to NASA. In the absence of suitable financial protection, these companies will decline to support these programs, jeopardizing the accomplishment of the program objectives. Indemnification would only be available where the risks of liability

cannot be covered by reasonably obtainable commercial insurance.

Standing Review Boards

NASA relies on independent life-cycle review teams called Standing Review Boards (SRBs) to ensure that programs, projects, and other agency officials benefit from consistent, efficient, and value-added independent life-cycle reviews and products. An OIG review of the SRB process revealed a number of vulnerabilities in the implementation of the SRB process, including compliance with the Federal Advisory Committee Act, personal conflict of interest screening for external members, and organizational conflicts of interest for contractors supporting the SRBs. It is imperative that a solution to these problems be found that ensures compliance with legal requirements, freedom from bias, and the continued delivery of technically competent external reviews of NASA programs and projects.

Support for Development of Crew Transportation Systems

NASA is working to ensure an end to its reliance on foreign crew transportation and that it utilizes safe, cost-effective U.S. crew transportation capabilities. NASA is using a two-fold strategy to support the development of commercial crew transportation systems. First, NASA is using Space Act Agreements (SAAs) under its "other transaction" authority under the Space Act to support the development of commercial crew transportation capabilities that NASA could eventually buy. Second, NASA will use FAR-based contracts for the certification of those capabilities and for the procurement of crew transportation services to and from the ISS. Significant legal issues are presented by the use of these two distinct authorities. NASA is limited in its ability to impose requirements under the Federal Acquisition Regulations and technical requirements when using SAAs. This has raised concerns as to whether NASA is accepting unwarranted risk by foregoing its traditional oversight role and whether NASA is misusing its "other transactions" authority to avoid legal requirements that would otherwise be applicable to development efforts of this type.

Key Personnel

General Counsel Michael Wholley came to NASA in June 2004, after a distinguished career of public service in the Marine Corps. He was commissioned through the Naval ROTC program at Harvard University, after receiving his Bachelor of Arts degree, *magna cum laude*, in History and Literature. He holds a Juris Doctorate degree from the University of Virginia Law School, an LL.M degree from George Washington University in Environmental Law and Land Use, and a master's degree in National Security and Strategic Studies from the College of Naval Warfare. Wholley was designated a Naval Aviator in June 1968 and flew combat missions in Vietnam.

Deputy General Counsel Sumara M. Thompson-King has more than 28 years of government and legal experience in the Government Procurement and Contract area. Thompson-King began her NASA career in 1986, when she joined the Office of Chief Counsel at NASA's Goddard Space Flight Center in Greenbelt, MD.

Thompson-King received a Bachelor's degree in Government from Smith College in Northampton, MA, and she earned a Juris Doctorate from Georgetown University Law Center in Washington, DC. Thompson-King is a member of the Pennsylvania Bar.

4.3.12 OFFICE OF LEGISLATIVE & INTERGOVERNMENTAL AFFAIRS (OLIA)

MISSION STATEMENT

The office provides executive leadership, direction, and coordination of all communications and relationships related to legislative issues between NASA and the U.S. Congress, state and local government, as well as industry, space-related associations, and citizen's groups.

ORGANIZATIONAL STRUCTURE

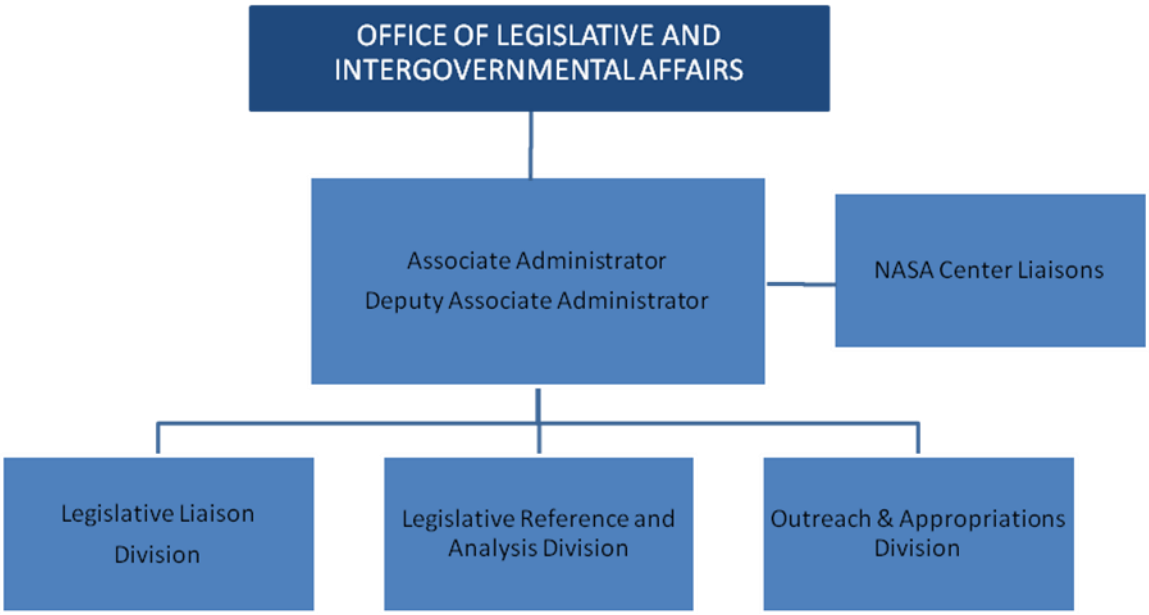


Figure 4.3.12-1: Organizational Chart for the Office of Legislative and Intergovernmental Affairs

WORKFORCE

The Office of Legislative & Intergovernmental Affairs has a workforce allocation of 25 Full Time Equivalent (FTE) Civil Servants. In addition, each center has legislative affairs staff that report directly to the Associate Administrator for Legislative and Intergovernmental Affairs.

BUDGET EST. ($M)

President's FY13 Budget Request	FY2012	FY2013	FY2014	FY2015	FY2016	FY2017
Office of Legislative & Intergovernmental Affairs	$0.1	$0.1	$0.1	$0.1	$0.1	$0.1

Table 4.3.12-1: Office of Legislative & Intergovernmental Affairs Budget Runout

FUNCTIONS

The Office is comprised of three Divisions with the following roles and responsibilities.

The Legislative Liaison Division is the primary liaison to the Members and staff of NASA's House and Senate Authorization Committees, House and Senate leadership offices, as well as the Congressional Budget Office and the Congressional Research Service. LLD is responsible for arranging NASA representation at Congressional hearings, briefings, and/or meetings. This includes briefing Agency officials on the legislative aspects of their appearances, as well as reviewing and clearing statements and other materials to be presented to Congress. This Division also serves as the primary liaison within OLIA to the Mission Directorates and Mission Support Offices and is responsible for managing the communication of Agency program and activity status to the Congress.

The Legislative Reference and Analysis Division is responsible for monitoring and analyzing legislation of interest to NASA, including Committee markups and monitoring floor activity of key legislation. LRAD is responsible for development of NASA's legislative proposals to Congress. This Division manages the Congressional hearing record process, including questions for the record and transcripts, as well as Office of Management and Budget legislative referrals. They also are the principal day-to-day interface with OLIA staff at the NASA centers. The Division also manages OLIA's records management process.

The Outreach and Appropriations Division is responsible for legislative outreach with "rank and file" (i.e., no committee or center interest in NASA) Members of Congress, Members of the House and Senate Committees on Appropriations and Committees on Budget, and with state and local governments. The Division manages a variety of Agency-level legislative outreach events, including Congressional requests for the Administrator and astronaut speaking engagements, and serves as the principal liaison within OLIA with industry, non-government organizations, trade associations, interest groups, think tanks, and coalitions. This Division also has the lead within OLIA for NASA contract and grant notifications to the Congress.

IMPORTANT ACTIVITIES

- Strengthen existing Congressional relationships.
- Reach every Member of Congress.
- Work with Mission Directorates and Mission Support Offices to ensure accurate, complete, and timely responses to key Congressional inquiries and Congressionally directed reporting requirements.

MAJOR ISSUES

- **Enactment of FY 2013 appropriation** to secure optimal funding of the President's request and a balanced overall NASA program, including funding for key priorities, including development of the Space Launch System and Orion Multipurpose Crew Vehicle to carry American astronauts beyond low-Earth orbit and into deep space within the next decade; sustainment of the International Space Station at least through 2020 as a National resource available to the broader scientific and commercial research community; establishment of a U.S. commercial crew and cargo delivery capability as soon as possible; continued

development of the James Webb Space Telescope, the world's most advanced telescope, for launch in 2018; and continued advances in new space technologies needed for future U.S. leadership in space.

- Reinforce with Congress that NASA has a comprehensive vision for a bright future and a plan to reach multiple destinations on the way to our ultimate destination, Mars.
- Enactment of other NASA legislative priorities.

KEY PERSONNEL

L. Seth Statler was appointed as Associate Administrator for Legislative and Intergovernmental Affairs in September 2009. Statler manages relations with the United States Senate, the U.S. House of Representatives, governors, state legislatures, and local governments for NASA with approximately 18,400 federal employees and 40,000 contractors. In this capacity, he provides executive leadership, direction, and coordination of communications between NASA and all of these important officials. Prior to this appointment, Statler was a career civil servant who served as Deputy Assistant Commissioner for Congressional Affairs at U.S. Customs and Border Protection (CBP), the nation's largest law enforcement agency. He played a key role in winning Congressional support for the 2003 creation of CBP and the Department of Homeland Security following the attacks of 9/11. Prior to the merger, Statler managed communications for the legacy U.S. Customs Service, Department of Treasury, as Assistant Commissioner for Congressional and Public Affairs. He previously worked for the House Committee on Appropriations as associate staff for Congressman Steny Hoyer of Maryland and as a senior legislative aide to former Senator Paul Sarbanes of Maryland. Statler earned a Bachelor's degree from Gettysburg College and a Masters in Business Administration from the University of Maryland, where he serves as an Adjunct Assistant Professor. He has completed the Program for Senior Managers in Government at Harvard's Kennedy School and the Duke Leadership Program, and serves as treasurer and as a director of the National Fallen Firefighters Foundation.

Mary D. Kerwin has served as Deputy Associate Administrator for Legislative and Intergovernmental Affairs continuously since 1999, except as Deputy Comptroller for Appropriations from 2004 to 2005. During her career, Kerwin has served a total of 12 NASA Administrators. Prior to her appointment as Deputy Associate Administrator for Legislative and Intergovernmental Affairs, she served as Deputy Associate Administrator for Legislative Affairs (Programs) and as Director, Congressional Liaison Division. As the senior career official in the Office, she has served as Acting Associate Administrator for Legislative and Intergovernmental Affairs on three occasions during Presidential transitions. Kerwin has been recognized with a Presidential Rank Award for Distinguished Service in 2009 and three Presidential Rank Awards for Meritorious Service, in 2006, 2003, and 1993. She has been awarded NASA Medals for Exceptional Achievement, Exceptional Service, and Outstanding Leadership. She completed the Senior Executive Fellowship Program at the Kennedy School of Government, Harvard University. Kerwin attended the University of Georgia, and is a graduate of Georgia State University, with a Bachelor's degree, with honors, in Political Science. She is a member of Phi Kappa Phi honor society. She also completed two years of graduate study in Political Theory at the University of Chicago.

4.3.13 OFFICE OF COMMUNICATIONS

MISSION STATEMENT

The Office works to promote effective internal and external NASA communications by working to create strategic focus among the various offices that disseminate and provide information regarding the Agency's projects and programs. The office provides for the widest practicable and appropriate dissemination of information to news media, the general public, and other appropriate external and internal constituents concerning the objectives, methods, and results of NASA programs.

The Office of Communications engages offices across NASA to better create a dialogue that helps shape and share the Agency's missions of exploration and discovery.

WORKFORCE

The Office of Communications has a workforce allocation of 51 Full Time Equivalent (FTE) Civil Servants.

BUDGET EST. ($M)

President's FY13 Budget Request	FY2012	FY2013	FY2014	FY2015	FY2016	FY2017
Office of Communications	$5.8	$5.1	$5.1	$5.1	$5.1	$5.1

Table 4.3.13-1: The Office of Communications Budget Runout

FUNCTIONS

Key communications functions by Division include the following:

PUBLIC OUTREACH

This division is primarily responsible for those Agency programs and activities that engage the general public and other targeted internal and external audiences. These programs include special events, NASA launch and landing activities, guest operations, astronaut appearances, and public communications. The Public Outreach Division is responsible for managing and administering the following programs:

Exhibits provides the overall management and infrastructure for planning and executing exhibits across the Agency. Primary activities include management of the cooperative Space Act Agreement with National Air and Space Museum, managing NASA external exhibits, serving as custodian of the exhibits website, managing the Agency's aerospace artifacts program, working to identify additional outreach activities, and managing the consortium of NASA visitor centers.

Speakers Bureau provides leadership and direction for the Agency's Speakers Bureau Program, including all field centers and mission directorates. It serves as custodian of the Speakers Bureau website and web-based toolkit, which provides information for all individuals who publicly represent the Agency. It also functions as property management custodian for visual aids, such as space suits, and other material that could be used to help illustrate NASA's missions and activities.

Guest Operations provides management and oversight of Guest Operations for launches and other activities at the Kennedy Space Center, Wallops Flight Facility, and for Agency missions at Vandenberg Air Force Base. It is also responsible for the management and execution of special events, such as anniversaries, receptions, memorial services, etc. This office also serves as the primary contact for NASA protocol.

Astronaut Appearances provides the direction and coordination for astronaut post-flight tours, speaking engagements, Capitol Hill visits, and other external and internal outreach activities. The office also maintains and manages Agency events and activities that involve former astronauts.

Strategic Alliances provides the direction and serves as the subject-matter experts for collaborations between NASA and other organizations at low or no cost to the Agency. It also acts as program manager for individual and organizational Space Act Agreements, and negotiates partnerships with both domestic and international stakeholders in coordination with the Office of International and Interagency Relations.

History Office serves two key functions: (1) Fulfilling the mandate of the 1958 National Aeronautics and Space Act calling for NASA to disseminate aerospace information as widely as possible; and (2) Helping NASA managers understand and thus benefit from the study of past accomplishment and difficulties. The NASA History Program was first established in 1959 (a year after NASA itself was formed) and has continued to document and preserve the Agency's remarkable history through a variety of products. In addition to serving internal NASA customers, the NASA History Program is of great interest to a variety of people who follow aerospace activities, including scholars, journalists, and students. While most NASA History Division products are scholarly in nature, they are also largely accessible to interested audiences.

Public Inquiries responds to all external inquiries to NASA about its activities and programs, including those received by email, telephone calls, and letters. It prepares educational materials for public dissemination and manages the system that tracks and responds to inquiries to the Office of Administrator. It also manages a special program that provides certificates of acknowledgement to Boy Scouts and Girl Scouts: the Eagle and Gold awards.

Industry Affairs serves as the Agency's primary contact and interface with public and private aerospace companies and individuals.

Participatory Engagement provides oversight, management, and active involvement of individuals as contributors to and collaborators in NASA's research, science, and exploration activities. Participatory exploration embodies far more than simply exposing people to or educating them about NASA's discoveries and exploration activities. It encourages individuals to contribute their creativity and capabilities to NASA's mission of discovery and invites them to share in the excitement of building our future.

News and Multimedia

This division is responsible for planning, organizing, directing, and coordinating the release of programmatic information on NASA missions, activities, and functions to the media and the public. Public Affairs Officers develop and implement plans to communicate NASA's activities in a manner that supports the Agency's communications goals. The division directs and coordinates

the production of an integrated suite of news products, including print, video, Internet, imagery, animation, audio, and background information intended to capture and communicate NASA's activities to a variety of news media, readers, and viewers through the following offices:

Newsroom coordinates the flow of national-level news releases through the review and editing cycle in the Headquarters Newsroom. It works with responsible Headquarters public affairs officers to set a date and time of releases, and coordinates the release of accompanying video, photographs, or Internet offerings. The Newsroom also coordinates other forms of information release, including Notes-to-Editors and Video Advisories. It assists public affairs officers in editing and producing mission press kits, and coordinates reproduction of hard copies and posts electronic versions to the NASA Home Page. It maintains extensive electronic mail and Internet lists for reaching news media and the general public. These include media electronic-mail lists for text and television products and a large general public subscriber list. It also maintains a comprehensive Internet distribution capability for national and local media organized by region for specific delivery of news and information.

NASA Television provides overall policy guidance and direction for content and operation of NASA TV. It maintains close interaction with public affairs offices at agency field center installations and with coordinating bodies such as the NASA TV Working Group and the NASA Digital TV Working Group. It provides overall direction and scheduling for airing Video File – b-roll packages and provides Agency guidance on production values and contemporary broadcast techniques. It also provides overall direction and scheduling of live shots – live satellite interviews on NASA TV originating from NASA Headquarters and NASA Field Installations with agency spokespersons and television stations around the country.

Internet/New Media directs and manages the Internet portal for NASA on the World Wide Web (www.nasa.gov). It develops and maintains highly interactive content regarding the Agency's missions and policies and provides links to all major NASA programs and organizations from this main address. It provides frequent updates on NASA activities and programs and advocates new technologies for reaching the general public through the Internet. It uses social media platforms including Facebook and Twitter to engage the public in a dialogue and disseminate information on NASA's activities.

Multimedia serves as the liaison for film and television communities, providing unique expertise and guidance for NASA's participation in all entertainment-oriented film and television projects, including major motion picture and television productions and documentaries. It plans and directs the artistic documentation of significant NASA projects and activities. This involves identifying and commissioning qualified artists to record their impressions of agency events.

Freedom of Information Act (FOIA) manages and directs agency responses to public requests for access to NASA records, and ensures that any person has a right, enforceable in court, to obtain access to federal agency records, except to the extent that such records (or portions of them) are protected from public disclosure by one of nine exemptions or by one of three special law enforcement record exclusions.

KEY PERSONNEL

David Weaver is NASA's Assistant Administrator for the Office of

Communications and is a senior public administration professional with 25 years of experience in government, politics, media relations and public policy.

At NASA, Weaver directs internal and external communications for the agency and serves as a senior advisor to NASA leadership. He is responsible for managing an agency-wide staff of 350 that implements all aspects of NASA's external and internal communications.

The Office of Communications organizes news conferences and other media briefings, public ceremonies, and special exhibits, and oversees the activities of NASA's speaker's bureau, Public Inquiries Management Office, Freedom of Information Act Office, fine arts program, public tours, and visitor centers.

Under Weaver's direction, NASA's Office of Communications also produces content for the agency's Internet homepage, www.nasa.gov, and NASA Television; prepares and distributes print and broadcast news releases, brochures, and speeches for the NASA administrator and deputy administrator; makes video and photographic records of NASA mission activities and special events; and drafts internal publications.

Immediately prior to coming to NASA, Weaver was the chief of staff to U.S. Rep. Chris Van Hollen, D-MD, where he oversaw the office's legislative, communications, scheduling and constituent services operations and served as a senior adviser to Van Hollen, who was a member of the House's leadership.

Previously, Weaver served as the chief of staff to Maryland Comptroller Peter Franchot, helping to manage a 1,100 person, $120 million agency, and serving as a senior adviser and was responsible for the office's communications, personnel, scheduling, and intergovernmental relations operations, and the comptroller's personal staff.

For 12 years, Weaver served as the director of the Office of Public Information for Maryland's most populous jurisdiction, Montgomery County. He was the principal spokesman for County Executive Douglas M. Duncan and two dozen departments and agencies. He also was responsible for the development and implementation of the county's overall communications strategy.

Weaver also served as press secretary to former U.S. Rep. Robert Torricelli. He worked for former White House Press Secretary James S. Brady and his wife Sarah at the Brady Center to Prevent Gun Violence (formerly Handgun Control, Inc.), where he served as the assistant director for state legislation. Weaver also served as a legislative aide for Vice President Joseph R. Biden, Jr., when Biden served as a U.S. Senator. He also worked with the polling firm of Garin-Hart Research.

Alan Ladwig is the Deputy Associate Administrator for Public Outreach. His office manages Industry Affairs, Strategic Alliances, Participatory Engagement, Speakers Bureau, Exhibits, Guest Operations, the History Program, and Public Inquiries.

Prior to returning to NASA Ladwig was the Manager of Space Systems for Whitney, Bradley and Brown, Inc. (WBB Consulting) and had been Sector Lead Executive for NASA business development at Northrop Grumman Integrated Systems. He served as Chief Operating Officer during the start-up phase of the Zero Gravity Corporation, a privately held space tourism and entertainment company. As Vice President of Washington Operations and Assistant to the Chairman of the Board, he established and managed the Space.com's Washington Bureau and was

responsible for business development, NASA relations, and strategic planning.

Ladwig completed two previous tours at NASA. As a political appointee of the Clinton Administration from 1993 to 1994, Ladwig established and was the Associate Administrator of the Office of Policy and Plans at NASA Headquarters. From 1981 to 1989 he was a civil servant at NASA Headquarters and managed a variety of programs for the Office of Education, the Office of Space Flight, and the Office of Exploration.

NASA awarded Ladwig the Distinguished Service Medal, the Exceptional Achievement Medal, and two Exceptional Service Medals. He is a Fellow of the American Astronautical Society.

Ladwig served in the U.S. Army with the 558th USA Artillery Corps in Athens, Greece. He received his Master of Science degree in Higher Education and a Bachelor of Science in Speech from Southern Illinois University.

Bob Jacobs is the Deputy Associate Administrator for News and Multimedia offices. He has served in this capacity since January 2007. Jacobs joined NASA in July 2000 as news chief, and was selected into the federal government's Senior Executive Service in July 2002 as the Agency's news and multimedia director.

Awarded NASA's Outstanding Leadership, Exceptional Service and Exceptional Achievement medals, he has served as a communications advisor, strategist, writer, and emerging technology consultant for the Agency's top leadership. Jacobs has been recognized for his crisis communications leadership and is a strong advocate for incorporating emerging communications technologies into the Agency's public outreach activities He initiated and moderates many of NASA's social media activities, many of which have been recognized as the best in federal government.

Jacobs directed the digital conversion of NASA's multimedia assets, including NASA Television and two major redesigns of www.nasa.gov, both of which have been honored with national Emmy and Webby awards. He developed and co-authored books commemorating NASA's 50th anniversary, the Apollo lunar landings, and the Hubble Space Telescope.

Before joining NASA, Jacobs was projects manager for the Broadcast Technology Division of *The Associated Press*, responsible for the development and implementation of news and information multimedia technology for major broadcast news organizations around the world. He began his career as a broadcast journalist, working his way through the ranks of several radio and television stations as announcer, reporter, producer, and eventually news director.

4.3.14 Office of Small Business Programs (OSBP)

Mission Statement

The office provides advice to the Administrator on all matters related to small business; promotes the development of all categories of small business and provides small businesses the maximum practicable opportunities to participate in NASA prime contracts and subcontracts.

Workforce

The OSBP has a workforce allocation of five Full Time Equivalent (FTE) Civil Servants.

Budget Est. ($M)

President's FY13 Budget Request	FY2012	FY2013	FY2014	FY2015	FY2016	FY2017
Office of Small Business Programs	$0.8	$0.9	$0.9	$0.9	$0.9	$0.9

Table 4.3.14-1: Office of Small Business Program's Budget Runout

Functions

The Small Business Act requires all federal agencies with contracting authority to establish an Office of Small and Disadvantaged Business Utilization (OSDBU). At NASA, the OSDBU has been re-named the Office of Small Business Programs (OSBP) to reflect the inclusion of all categories of small business in the Agency's activities. Headed by the Associate Administrator, OSBP develops and implements NASA's small business initiatives in compliance with federal laws, regulations, and policies.

Important Activities

The following are three cross-cutting initiatives that are in process:

Small Business Specialists Council

NASA's Small Business Specialists Council is comprised of the centers' small business specialists and small business technical advisors. The council meets quarterly to discuss issues and initiatives that pertain to the centers' small business programs as well as to the overarching Agency program. The meetings provide a forum for exchanging information and sharing best practices and lessons learned.

Small Business Improvement Plan

OSBP holds bi-annual Small Business Improvement Plan meetings, the objective of which is to involve center, mission directorate, and procurement representatives in a joint effort to strengthen NASA's small business program. At each meeting, participants develop three cross-cutting initiatives to be implemented at the center level throughout the following fiscal years. Implementation is monitored in the centers' semiannual Small Business Program Report.

Procurement Management Reviews

OSBP works with the NASA Office of Procurement in conducting procurement management surveys at the various centers. The purpose of the reviews is to ensure that procurement regulations are followed and are properly documented. OSBP is

responsible for evaluating each center's small business program, which entails conducting interviews with NASA personnel (e.g., the center Procurement Director) and personnel external to the Agency (e.g., the SBA Procurement Center Representative), examining documents, reviewing each center's subcontracting program, and collecting metrics on the centers' achievements in meeting its small business goals.

MAJOR ISSUES

MEETING MANDATED SOCIOECONOMIC GOALS

NASA was able to meet or exceed its negotiated FY-11 and FY-12 small business and the small disadvantaged business (SDB) goal. This was possible due to several Agency initiatives implemented during this timeframe such as the ones listed above and a robust training program that targets the Agency's acquisition community, which includes the small business specialists, procurement personnel, and technical staff. However, NASA did not meet the mandated goals in three of the five categories, which are women-owned, service-disabled veteran owned, and HubZone small business. In order to improve in these categories OSBP is conducting focused outreach at various centers to locate small businesses in these categories.

DETERMINING PROCUREMENTS APPROPRIATE FOR SMALL BUSINESSES

The nature of NASA's "business" is a major consideration in the Agency's acquisition strategy. With objectives like building the next crew exploration vehicle, procurements tend to be very large, and with large contractors already engaged in the preliminary design and development work, procurements tend to be non-competitive. Developing small business set-aside contracts as well as determining small business subcontracting goals on large full-and-open contracts is a major challenge. OSBP is addressing these challenges by requiring that the center small business technical advisor assist the small business specialists and contracting specialists in determining aspects of the statements of work that could be performed by small businesses. OSBP also requires that NPD 5000.2C, Small Business Subcontracting Goals, be used to ascertain small business subcontracting goals on large procurements.

KEY PERSONNEL

Glenn A. Delgado, Associate Administrator. Glenn Delgado provides executive leadership and policy direction for developing and implementing policies and initiatives throughout NASA to ensure all categories of small business are provided the maximum practicable opportunities to participate in NASA prime contracts and subcontracts Since Delgado's arrival at NASA in fiscal year 2007, the dollars awarded to small businesses have increased every year. In fiscal year 2006, NASA awarded $1.94 billion directly to small businesses. At the end of fiscal year 2012, NASA awarded $2.5 billion directly to small businesses without comprising NASA's mission. That amounts to approximately a 29 percent increase in direct awards made to small businesses, which equates to approximately $560 million. Delgado received his MBA from Marymount University and he is Level III certified in the Acquisition Professional field of Contracting. He is a member of the Acquisition Professional Community. In May 2010, Delgado was awarded the NASA Outstanding Leadership Medal for his exceptional leadership of the NASA Small Business Programs Office.

4.4 AERONAUTICS RESEARCH MISSION DIRECTORATE

MISSION STATEMENT

The Aeronautics Research Mission Directorate (ARMD) conducts research and technology development activities to solve critical national level challenges for increasing the capacity, efficiency, and flexibility of our national air spaceeconomic growth and jobs. ARMD addresses these challenges by conducting fundamental and integrated systems research to significantly increase efficiency, performance, and safety while substantially reducing fuel consumption, emissions, and noise, which are all critically important to enable Next Generation Air Transportation System (NextGen).

ORGANIZATIONAL STRUCTURE

Figure 4.4-1: Organizational Structure of ARMD

WORKFORCE

ARMD has an allocation of 38 Full Time Equivalent (FTE) Civil Servants at Headquarters.

BUDGET EST. ($M)

President's FY13 Budget Request	FY2012	FY2013	FY2014	FY2015	FY2016	FY2017
Aeronautics	$569.4	$551.5	$551.5	$551.5	$551.5	$551.5

Table 4.4-1: ARMD HQ Budget Runout

This budget represents the Aeronautics Research Mission Directorate portion of the Headquarters Agency Management and Operations budget. It includes all of the salaries and travel budgets for Headquarters employees, as well as procurement funding for any Headquarters support contractors. ARMD Mission Budget Runout: This budget supports the Aeronautics Research Mission Directorate portfolio of programs and mission activities.

FUNCTIONS

The Fundamental Aeronautics Program (FAP) Office is responsible for management oversight of the Fundamental Aeronautics Program. The FAP conducts fundamental research to generate innovative concepts, tools, technologies, and knowledge to enable revolutionary advances for a wide range of air vehicles.

The Aviation Safety Program (AvSP) Office is responsible for management oversight of the Aviation Safety Program. The AvSP conducts cutting-edge research to produce innovative concepts, tools, and technologies to improve the intrinsic safety attributes of current and future aircraft and air traffic management systems.

The Airspace Systems Program (ASP) Office is responsible for the management oversight of the Airspace Systems Program. The ASP directly addresses the fundamental air traffic management research needs for the NextGen by developing revolutionary concepts, capabilities, and technologies that will enable significant increases in the capacity, efficiency, and flexibility of the national airspace.

The Integrated Systems Research Program (ISRP) Office is responsible for management oversight of the Integrated Systems Research Program. The ISRP conducts research at an integrated system-level on promising concepts and technologies, and explores, assesses, and demonstrates the benefits in a relevant environment.

The Aeronautics Test Program (ATP) Office is responsible for management oversight of the Aeronautics Test Program. The ATP preserves and promotes the testing capabilities of one of the United States' largest, most versatile and comprehensive set of flight and ground-based testing facilities.

The Strategy, Architecture, and Analysis (SAA) Office provides executive support to the ARMD Associate Administrator through the development of analytically sound Mission Directorate strategies and maintaining configuration management of key enterprise information, such as program goals, metrics, interdependencies, technical challenges, and risks. SAA focuses on portfolio analysis of current program investments, cross-program strategic integration, and the development and execution of cross-cutting transportation architecture and systems analyses.

The Resources Management Office (RMO) focuses on resources management, program and budget integration, and is responsible for all Aeronautics Program resources planning, authorization, and review. Resources management includes budget formulation and execution, financial management, program resources status analysis, Office of Management and Budget (OMB) and Congressional budget preparation, quality control over all budget submittals, and independent budget cost estimate and profile validation.

The Integration and Management Office (IMO) is responsible for key directorate processes and activities, including strategic communications, education and outreach,

integration of ARMD and agency strategic planning and performance reporting, internal program review execution, and ARMD policy development.

IMPORTANT ACTIVITIES

Each of the NASA Aeronautics Programs will be treated in a separate section below.

Fundamental Aeronautics Program (FAP): NASA's Fundamental Aeronautics Program (FAP) conducts long-term, cutting-edge research in all flight regimes to address the major challenges of modern air transportation: public concern over noise and emissions, the affordability of air travel given concerns about jet fuel supplies and costs, the need for increasing mobility to meet the growth of air transportation, and the need for progress toward faster transportation. FAP focuses on tools and technologies to enable revolutionary changes for vehicles. From the most basic knowledge of underlying phenomena through experimentation into advanced concepts and technologies at the component and systems level, new technological capabilities are being developed.

The FAP is comprised of four projects. The Fixed Wing Project research includes exploring and developing tools, technologies, and concepts for vastly improved energy efficiency and environmental compatibility necessary for the sustained growth of commercial aviation vital to the U.S. economy and quality of life. The objective is to develop concepts and technologies for dramatic improvements in the noise, emissions, and performance of transport aircraft. The resulting scientific knowledge, in the form of experiments, data, calculations, and analyses, is critical for conceiving and designing future generations of transport aircraft. The Rotary Wing Project research includes exploring and developing tools, technologies, and knowledge to enable radical improvements in rotary wing vehicles that can greatly enhance the air transportation system. The research efforts advance technologies that increase rotorcraft speed, range, and payload, and decrease noise, vibration, and emissions. This research will enable improved computer-based prediction methods and technologies for designing future high-speed, efficient rotorcraft of various sizes and configurations that will be viable as commercial vehicles operating in the National Airspace System (NAS). High-speed vehicle research includes developing advanced computer-based prediction methods for supersonic aircraft shape and performance and developing technologies that will aim to eliminate today's technical barriers preventing practical, commercial supersonic flight. These barriers include sonic boom, supersonic aircraft fuel efficiency, prediction of vehicle control, operation and performance, and the ability to design future vehicles in an integrated, multidisciplinary manner. The high-speed research also includes expansion of foundational knowledge necessary for pushing the capabilities for controlled, air-breathing hypersonic flight. The Aeronautical Sciences Project will start to develop computer-based tools and models as well as scientific knowledge that will lead to significant advances in our ability to understand and predict flight performance for a wide variety of air vehicles. Examples of this research include the development of new computational tools that are used to predict the flow around vehicles. Another area of research that is pervasive across a number of vehicle types is improving the understanding and development of new types of strong and lightweight materials that are important for aviation.

Aviation Safety Program (AvSP): Public benefits derived from continued growth in the transport of passengers and cargo are dependent on the improvement of the intrinsic safety attributes of current and future air vehicles that will operate in NextGen. AvSP's contributions to meeting this challenge range from providing fundamental research and technologies on known or emerging safety concerns, to working with partners in addressing new safety challenges for NextGen. The program has three primary objectives: continue to improve aviation system-wide safety, advance the state-of-the-art of aircraft systems and flight crew operations, and address the inherent presence of atmospheric risks to aviation. Research in all areas emphasizes innovative methods and uses a systems analysis approach for identifying key issues and maintaining a research portfolio that addresses national aviation safety needs.

The AvSP is comprised of three projects. The goal of the System-Wide Safety and Assurance Technologies Project is to provide knowledge, concepts and methods to proactively manage increasing complexity in the design and operation of vehicles and air transportation systems, including advanced approaches to enable improved and cost-effective verification and validation of flight-critical systems. The project addresses challenges in the areas of assurance of flight critical systems, discovery of safety incidents, automation design tools, and prognostic algorithm design for safety assurance. Each of these areas supports the project goal of ensuring system safety and developing proactive technologies to enable a successful transition to NextGen. The Vehicle Systems Safety Technologies Project research identifies risks and provides knowledge needed to avoid, detect, mitigate, and recover from hazardous flight conditions, and to maintain vehicle airworthiness and health. Project research focuses on the study of safety improvements related to vehicle systems, including guidance-and-control capabilities and appropriate crew response that can detect, avoid, prevent, and recover from hazards experienced in flight or within the vehicle itself. The goal of Atmospheric Environment Safety Technologies Project research is to investigate sources of risk and provide technology needed to help ensure safe flight in and around atmospheric hazards. A substantial portion of research within the project focuses on how icing affects both airframes and propulsion systems, and investigates potential technologies for ice detection and icing reduction or elimination. The project also performs research on how to sense and mitigate risks associated with other atmospheric hazards that pose serious threats to aviation (such as lightning strikes).

Airspace Systems Program (ASP): The Airspace Systems Program (ASP) performs foundational research to enable the development of revolutionary improvements to, and modernization of, the National Airspace System. A major goal of the Airspace Systems Program is to transition key technologies from the laboratory to the field by integrating surface, terminal, transitional airspace, and en route capabilities to enable operational enhancements envisioned by NextGen. The Program is comprised of two projects: NextGen Concepts and Technology Development Project; and NextGen Systems Analysis, Integration & Evaluation Project. Both projects are, much like the airspace system itself, highly integrated, and pay close attention to information management at critical transition interfaces in the National Airspace System.

The NextGen Concepts and Technology Development Project will develop and explore fundamental concepts and integrated solutions that can improve the efficiency of all stages of air travel, from gate to gate. Researchers are developing advances in the science and applications of flight trajectories while taking into account weather and forecast uncertainties across the entire flight path. The project also conducts research into efficient ways to dynamically modify flight paths in real time to allow for the constantly changing environment within NAS. To be successful, the project must develop technologies that achieve the maximum possible productivity out of the entire airspace system, including the use of gates, taxiways, runways, terminal and en route airspace, and other airport services.

The high-level goal of the NextGen Systems Analysis, Integration, and Evaluation Project research is to identify, mature, and test key concepts and technologies based on their potential benefit towards increasing system efficiency. One of the challenges to achieving NextGen is the difficulty of introducing new concepts into a complex NAS. ASP verifies the relevance of its research and implications when included in a complex system by investigating not only the benefits achievable by single concepts, but taking this research one step further to study the implications and improvements achievable when multiple new concepts are integrated into the NAS. These investigations mature in concept and fidelity from fast time modeling and simulation through human-in-the-loop simulations and, for the most promising areas of research, to demonstrations using field trials. These most promising areas are those that enable increases in capacity and efficiency while maintaining safety and environmental conditions.

Integrated Systems Research Program (ISRP): The Integrated Systems Research Program (ISRP) conducts integrated system-level research on promising concepts and technologies to explore, assess, and demonstrate their benefits in an operationally relevant environment. The research in this program is coordinated with ongoing, long-term fundamental research within the other three research programs, as well as efforts of other government agencies. This helps to ensure the most promising research is transitioned between the programs and avoid duplicative efforts. ISRP's focus on system-level research differentiates it from other NASA aeronautics fundamental research programs, as its goals are to demonstrate integrated concepts and technologies to a level sufficient to reduce risk of implementation for stakeholders in the aviation community.

The ISRP is comprised of two projects. The Environmentally Responsible Aviation Project is addressing vehicle related environmental concerns through system-level research and experiments of promising vehicle concepts and technologies that simultaneously reduce fuel burn, noise, and emissions. Research and development efforts are focused on understanding how advanced environmental technologies can best work in an integrated vehicle/aviation operations system. Through system-level analysis, promising advanced vehicle and propulsion concepts and technologies can be down-selected based on their potential benefit towards the stated national goals. The Unmanned Aircraft Systems (UAS) Project also focuses on technologies to enable routine civil operations for UAS of all sizes and capabilities in NAS. Current Federal Aviation Regulations are built upon the condition of a pilot being in the aircraft; therefore few of those regulations specifically address UAS. To date, the

primary user of UAS has been the military. Because of this, the technologies and procedures to enable seamless operation and integration of UAS in NAS need to be developed, validated, and employed by FAA through rule making and policy development. Specifically, NASA is addressing technology development in several areas to reduce the technical barriers related to the safety and operational challenges.

Aeronautics Test Program (ATP): The Aeronautics Test Program (ATP) was created to set the strategic direction for NASA's versatile and comprehensive portfolio of ground and flight test aeronautics research capabilities. ATP makes targeted investments in its capabilities so that the nation's aeronautics community has the tools to deliver the technology innovations and breakthroughs necessary to address the increasingly complex research and development challenges associated with safe and effective real-world flight. The ATP is a long-term, funded commitment by NASA to retain and invest in test capabilities that are utilized by all three Mission Directorates and the Nation. The ATP reviews the status of its assets annually and ensures that decisions are considered from a national point of view.

ATP is responsible for the major wind tunnels/ground test facilities at Ames, Glenn, and Langley Research Centers, the Western Aeronautical Test Range (WATR), Support Aircraft, Test Bed Aircraft, and the Simulation and Loads Laboratories at Dryden Flight Research Center. In order to meet its objectives, the ATP provides for partial to full funding of the fixed costs for those ATP facilities that have significant projected NASA program usage, are considered to be national assets for which NASA accepts stewardship responsibilities, and/or for which there are present or future requirements by other government agencies or the U.S. aerospace industry. In addition, for those assets that are considered to be unique, but for which there is no projected current or future usage, the ATP provides funds to mothball these facilities. Significant maintenance activities, beyond routine maintenance, are performed to improve productivity and reduce operational cost. The Program also invests in test technology and facility upgrades (new capabilities).

MAJOR ISSUES

NASA's Role in the Nation's Hypersonics Research and Development Effort: This issue is described in more detail in the NASA Transition Strategic Issues Book.

KEY PERSONNEL

Dr. Jaiwon Shin is the Associate Administrator for the Aeronautics Research Mission Directorate at NASA Headquarters. He manages NASA's aeronautics research portfolio, guiding its strategic direction including research in the fundamental aeronautics of flight, aviation safety, and the nation's airspace system. Dr. Shin co-chairs the National Science & Technology Council's Aeronautics Science & Technology Subcommittee, which wrote the nation's first presidential policy for aeronautics Research and Development (R&D). Between May 2004 and January 2008, he served as deputy associate administrator for the directorate, where he was instrumental in restructuring NASA's Aeronautics Program to focus on fundamental research and better align with the nation's Next Generation Air Transportation System (NextGen). Prior to coming to work at NASA Headquarters, he served as chief of the Aeronautics Projects Office at NASA's Glenn Research Center. Shin received his doctorate in mechanical

engineering from the Virginia Polytechnic Institute and State University, Blacksburg, VA. He has a Bachelor's degree from Yonsei University in Korea and a Master's degree in Mechanical Engineering from California State University, Long Beach.

Thomas Irvine is the Deputy Associate Administrator for the Aeronautics Research Mission Directorate at NASA Headquarters. Previously, Irvine was director of the mission support office. He also served as the deputy director of the directorate's Aeronautics Test Program. Irvine came to NASA Headquarters in 2004 to head the Aeronautics Research Mission Support Division, where he was responsible for ensuring the availability of mission support-related capabilities. From 1999 to 2004, he was the chief of the Facility Management and Planning Office at NASA's Glenn Research Center, where he was responsible for strategic planning, improvements and upgrades, and test project scheduling and planning of all of the center's major ground test facilities. In 1982, he joined the staff of the then NASA Lewis Research Center, where he held management, program management and research engineering positions in the Engineering and Technical Services Directorate, in the Space Station Program Office and in the Aeronautics Directorate. Irvine has a Bachelor of Science degree in Civil Engineering and a Master's of Science degree in Engineering Mechanics, both from Ohio State University.

4.5 HUMAN EXPLORATION & OPERATIONS MISSION DIRECTORATE (HEOMD)

MISSION STATEMENT

The mission of the Human Exploration and Operations Mission Directorate (HEOMD) is to ensure the success of human space exploration in low Earth orbit and beyond, and to provide launch and communication support services that enhance space operations for all users.

ORGANIZATIONAL STRUCTURE

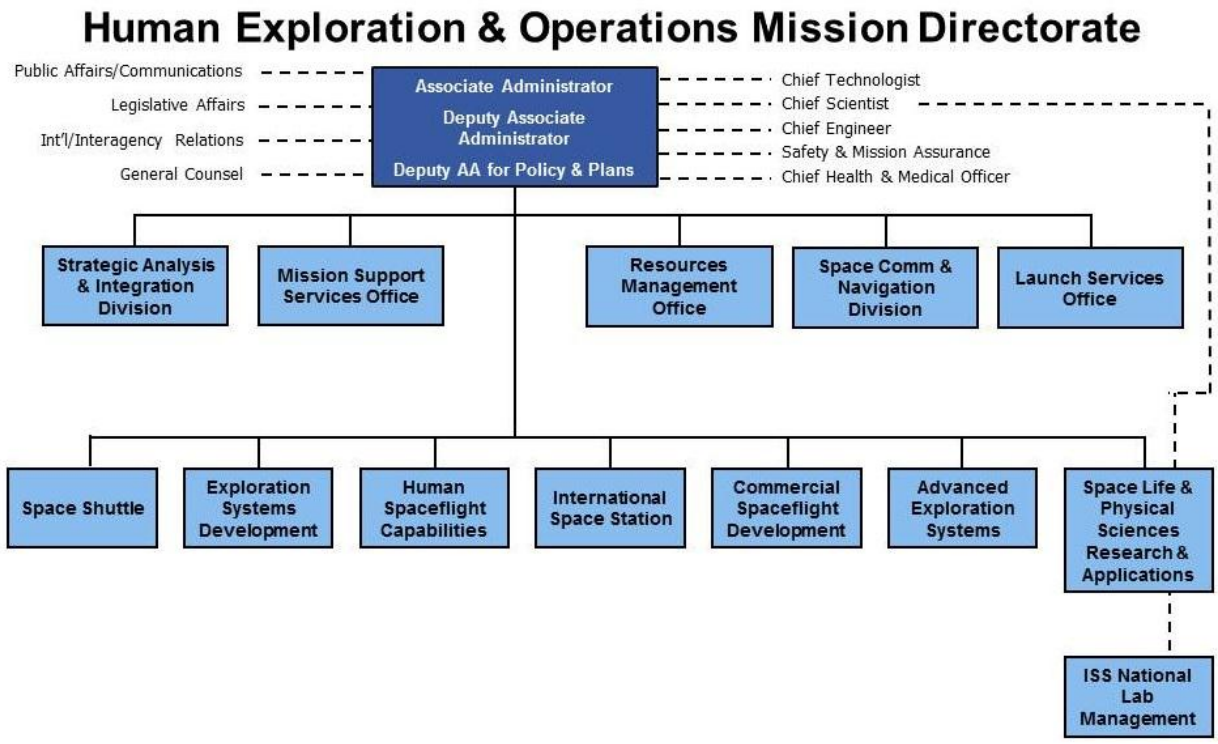


Figure 4.5-1: HEOMD Organizational Structure

WORKFORCE

HEOMD has an allocation of 151 Full Time Equivalent (FTE) Civil Servants.

BUDGET EST. ($M)

President's FY13 Budget Request	FY2012	FY2013	FY2014	FY2015	FY2016	FY2017
Human Exploration & Operations MD (HQ)	$7.9	$7.7	7.7	7.7	7.7	7.7
Human Exploration & Operations (Mission)	$7891.9	$7938.3	$8103.9	$8103.9	$8103.9	$8103.9

Table 4.5-1: HEOMD HQ Budget Runout

This budget represents the Human Exploration and Operations Mission Directorate portion of the Headquarters Agency Management and Operations budget. It includes all of the salaries and travel budgets for Headquarters employees, as well as procurement funding for any Headquarters support contractors. The HEOMD Mission Budget Runout supports the HEOMD portfolio of programs and mission activities.

FUNCTIONS

The International Space Station (ISS) Division provides insight and oversight of the ISS program as it transitions from assembly to long-term operations. A collaborative product of five space agencies representing 15 nations, the ISS has been continuously inhabited since November 2000 and is a world-class laboratory for research in an array of disciplines. The ISS also provides a test bed for learning how to live and work in space over extended periods of time, and a stable destination to facilitate the growth and evolution of new commercial opportunities, including crew and cargo transportation to low Earth orbit. The ISS Division is responsible for providing ongoing situational awareness products to agency leadership regarding ISS operations, research, and technology development activities. Headquarters ISS personnel manage the HEOMD Space Operations Center (SOC), where they monitor critical events (e.g., visiting vehicle launches, dockings, landings, spacewalks), in real-time from the Space Operations Center (SOC).

The Space Life and Physical Sciences Research and Applications (SLPSRA) Division manages NASA's fundamental science activities that realize the benefits of the space environment for research and that promote advanced, long-duration human exploration. This includes all ground based and spaceflight based science programs. SLPSRA oversees basic research in the life and physical sciences as well as mission-driven scientific research in support of human spaceflight and crew health and safety. SLPSRA programs – Fundamental Space Biology, Physical Sciences, and Human Research – seek to advance breakthroughs and discoveries in fundamental life sciences, physical sciences, and biomedical sciences that leverage the unique qualities of the space environment. The programs also ensure that ISS is used for high priority research and applications that reduce risks for long-duration human space exploration, and current and former crew health and medical data is available for research and application purposes.

The Exploration Systems Development (ESD) Division is responsible for controlling and managing the interfaces across the Orion Multi-Purpose Crew Vehicle (Orion MPCV), the Space Launch System (SLS), and the Ground Systems Development and Operations (GSDO) Programs. ESD performs cross-program systems and programmatic integration functions to successfully deliver the capabilities required for human spaceflight beyond low Earth orbit (LEO). ESD leadership establishes requirements and develops portfolio plans for governance, configuration management, reserve strategy, risk management, program performance reporting, schedule, and milestone control. The ESD Implementation Plan (ESD 10001) provides the details about how ESD manages the Programs and the cross-program integration.

The Commercial Spaceflight Development (CSD) Division oversees NASA's financial investments and technical resources dedicated to the development of safe, reliable, and cost-effective U.S. commercial space transportation systems. During development and demonstration

phases, NASA partners with U.S. industry, providing technical and financial support. In services phases, NASA becomes a customer, purchasing transportation for the U.S. and U.S.-designated crew and cargo to ISS. It is envisioned that CSD activities stimulate development of new industries that will be available to all potential customers, including the U.S. government. A secondary goal of these efforts is to help the United States expand into new markets and become more globally competitive.

The Launch Services Office (LSO) oversees the Launch Services Program (LSP) based at Kennedy Space Center (KSC) in Florida. The LSO is the NASA Headquarters Interface to NASA's expendable launch service customers, including the Science Mission Directorate (SMD), HEOMD, and STMD. The LSO also partners with other government agencies and the commercial launch industry regarding expendable launch policy and acquisition matters in addition to the expendable launch of unmanned robotic payload missions.

The Space Communications and Navigation (SCaN) Division provides communications and navigation services for all of NASA's spaceflight missions, and represents the agency in global forums that coordinate space communication requirements and standards. SCaN operates and upgrades NASA's Space Network, Deep Space Network, and Near Earth Network. As NASA's spectrum manager, SCaN coordinates closely with the U.S. government and international space communications community to ensure that the critical radiofrequency spectrum allocations are protected and new assignments are obtained through long-term studies and negotiation. SCaN also leads NASA's participation in multinational organizations that coordinate space communication requirements and standards, enabling compatibility and interoperability. SCaN also provides policy guidance and advocacy for all positioning, navigation, and timing (PNT) issues, both domestically and internationally. This primarily involves ensuring that NASA's Global Positioning System (GPS) requirements are protected for its missions, as well as developing new capabilities, such as Satellite Laser Retroreflectors, for NASA's science and exploration programs.

The Human Spaceflight Capabilities (HSC) Division provides oversight and resource allocation for HEOMD capability programs and supports the integration of strategies and capabilities that fulfill HEO program objectives and mission requirements. The HSC Program Executives manage and conduct integrated assessments on a portfolio of HEOMD-funded technical capabilities, including rocket propulsion testing and crew health and safety. By defining and implementing a strategic capability management framework, HSC provides the agency with comprehensive technical capability planning and ensures that technical issues are coordinated across the NASA centers and relevant headquarters stakeholders, including Microgravity Science Division (MSD) and the Office of the Chief Engineer (OCE). The HSC also provides comprehensive facility management support and analysis, in addition to processes and products for HEO programmatic Construction of Facilities (CoF) projects and HEO program-related environmental issues.

The Advanced Exploration Systems (AES) Division is pioneering new approaches for rapidly developing prototype systems, demonstrating key capabilities, and validating operational concepts for future

human missions beyond Earth orbit. AES activities focus on crew safety and mission operations in deep space, and are strongly coupled with future vehicle development. The AES portfolio consists of small, focused activities that target high-priority capabilities needed for human exploration such as advanced life support, deep space habitation, crew mobility, and extra-vehicular activity (EVA) systems. Early integration and testing of prototype systems reduces risk and improves affordability of exploration mission elements. The prototype systems developed in the AES portfolio are demonstrated in ground-based test beds, field tests, underwater tests, and ISS flight experiments. AES is the primary HEOMD interface to NASA's Space Technology Mission Directorate, and coordinates with SMD on the Joint Robotic Precursor Activities.

The Strategic Analysis and Integration Division (SAID) provides the agency and HEOMD leadership with strategic analysis across the human spaceflight architecture framework. SAID also leads the directorate's efforts in enterprise security, integrated risk and knowledge management, industrial base/supply chain management, science coordination, and partnership development.

The Mission Support Services Office (MSSO) is responsible for management of HEO human resources, education and public outreach, management processes and internal controls, information technology, and administrative support activities. MSSO develops and implements approaches for education and outreach that align HEO requirements and direction with Agency strategy. MSSO also ensures Directorate information technology needs are met both tactically and strategically.

The Resources Management Office (RMO) ensures efficient and productive use of agency resources necessary to achieve HEO's mission, goals, and objectives. The RMO provides this support by advocating HEOMD programs and budgets to internal and external stakeholders; analyzing program status, progress, and crosscutting issues; responsibly managing program resources; developing and promulgating HEOMD, Agency, Administration, and Congressional policy; and assuring compliance with federal laws and regulations. The RMO carries out its mission with three teams that provide crosscutting support to HEO, with focus on independent analysis and assessment; budget formulation, including management of NASA's Program Planning Budgeting and Execution (PPBE) process, and all associated deliverables; and daily financial operations, including funds control and distribution, policies and processes, phasing/operating plans. In addition, four RMO teams provide direct support to HEO technical divisions with a program/project focus.

IMPORTANT ACTIVITIES

The NASA Authorization Act of 2010 directs the NASA Administrator to achieve the following for which HEOMD is responsible:

- Develop a Space Launch System with an initial capability of lifting payloads weighing between 70 and 100 tons into low Earth orbit in preparation for transit beyond low Earth orbit, and develop the capability to carry an integrated upper Earth departure stage bringing the total lift capability of the SLS to 130 tons;

- Develop a multi-purpose crew vehicle to serve as the primary crew vehicle for mission beyond low Earth orbit and to serve as an alternate means to deliver crew and cargo to the ISS in the event other vehicles are unable to perform that function;
- Continue commercial crew and cargo development programs as guided by the Act;
- Operate and utilize the ISS through at least 2020.

Specifically, HEOMD is focusing on the following:

Building Toward the First Crewed Flights of Orion-MPCV/SLS

NASA plans a first engineering flight test (EFT-1) of the Orion-Multi-Purpose Crew Vehicle (MPCV) in 2014. This will be an uncrewed flight and will provide orbital systems and re-entry test data needed to finalize the MPCV design. The first flight of the combined MPCV/SLS system, Exploration Mission-1 (EM-1) is planned for 2017. This uncrewed mission will be the first deep space voyage of the Orion-MPCV and will include a lunar fly-by. These lead up to the first crewed flight of MPCV/SLS, EM-2, in 2021. EM-2 will send humans around the moon and back to Earth for the first time since Apollo.

Partnerships with the Emerging Commercial Space Sector for Cargo and Crew Transporation Services

NASA engaged with two companies in their development of systems to provide cargo delivery systems for the ISS. SpaceX successfully completed its Space Act Agreement (SAA) for development of Falcon 9/Dragon lab delivery system, and in October 2012 launched its first contracted delivery to the ISS, with the Dragon capsule docking to the ISS on October 10. Orbital Science Corporation erected its Antares launch vehicle on a commercial pad at NASA's Wallops Flight Facility in that same month of October, and is working toward a test flight of its rocket and then a demonstration flight of its Cygnus capsule to the ISS in the months ahead.

NASA has a two-fold strategy to end the United States' sole reliance on foreign crew transportation to the ISS and utilize a safe, cost-effective U.S. Crew Transportation System (CTS) as soon as the agency is able to certify those systems to carry NASA astronauts. First, NASA is using SAAs under the Commercial Crew Integrated Capability (CCiCap) phase to support the design and development of commercial crew transportation capabilities, as outlined above. Second, NASA will use Federal Acquisition Regulation (FAR)-based contracts for the certification of commercially developed capabilities and for the procurement of crew transportation services to and from the ISS to meet NASA requirements. NASA has already secured SAAs for the first step, and has issued the certification contracts that begin the second step.

Effective Use of the ISS for Research and Enabling of Future Exploration

The ISS has now entered its intensive research utilization phase, and will continue in this mode through at least 2020. The 2005 NASA Authorization Act designated the U.S. segment of the ISS as a National Laboratory. The 2010 NASA Authorization Act directed NASA to enter into a cooperative agreement with a not-for-profit organization to manage this National Laboratory's activities. On August 31, 2011, NASA finalized a cooperative agreement

with the Center for the Advancement of Science in Space (CASIS) to manage these activities. CASIS will help ensure the ISS's unique capabilities are available to the broadest possible cross-section of U.S. scientific, technological, and industrial communities.

ISS will continue to meet NASA's objective to prepare for the next steps in human exploration beyond low Earth orbit. The ISS is NASA's only long-duration flight analog for future human deep space exploration, and it provides an invaluable laboratory for research with direct application to the requirements that address human risks associated with deep space missions. In October 2012, NASA and its ISS partners announced that one NASA astronaut and one Russian cosmonaut will be selected to serve together in a one-year duration stay (increment) on the ISS to further these ends.

MAJOR ISSUES

The issues that significantly impact SMD are included in the NASA Presidential Transition Strategic Issues Book.

KEY PERSONNEL

William H. Gerstenmaier, Associate Administrator. Gerstenmaier is the Associate Administrator for the Human Exploration and Operations Mission Directorate at NASA Headquarters in Washington, DC. In this position, Gerstenmaier provides strategic direction for all aspects of NASA's human exploration of space and cross-agency space support functions of space communications and space launch vehicles. He provides programmatic direction for the continued operation and utilization of the International Space Station (ISS), development of the Space Launch System and Orion spacecraft, and development and operation of Space Communications and Navigation capabilities. He provides strategic guidance and direction for the commercial crew and cargo programs that will provide logistics and crew transportation for the ISS. Previously, Gerstenmaier was Associate Administrator for the Space Operations Mission Directorate. Prior to this assignment, he was the Space Station Program Manager, and before that, the Space Shuttle Integration Manager at the Johnson Space Center. Gerstenmaier began his NASA career at the then-Lewis Research Center, performing aeronautical research. He received a Bachelor of Science in aeronautical engineering from Purdue University in 1977 and a Master of Science degree in mechanical engineering from the University of Toledo in 1981. In 1992 and 1993, he completed course work for a doctorate in dynamics and control with emphasis in propulsion at Purdue University.

Gregory J. Williams, Deputy Associate Administrator for Policy and Plans. As the DAA for Policy and Plans, Williams provides advice and counsel on a wide variety of crosscutting issues affecting HEOMD. With the AA, the Deputy for Policy and Plans manages HEOMD's relations with external groups (Congressional, educational, intergovernmental, international, advisory-based, and industry based) in consultation and coordination with relevant Headquarters Mission Support Offices. Williams previously served as the Deputy Director for Strategic Integration and Management in the Science Mission Directorate. Prior to that assignment, he was the Senior Policy Advisor to the Associate Administrator for Earth Science. Williams began his NASA career as a Presidential Management Intern

in the NASA Office of Space Station in 1985. He holds a Master of Science in Public Administration and Policy Analysis from Carnegie-Mellon University in 1985 and a Bachelor of Science in Economics from the University of Washington in 1981.

Daniel L. Dumbacher, Deputy Associate Administrator for Exploration Systems Development Division. Dumbacher provides leadership and management for the HEOMD with a special focus as the Program Director for Exploration Systems Development encompassing SLS, Orion, and Ground Systems Development and Operations (GSDO) development and integration efforts. Prior to his current assignment, Dumbacher served as the Director of the Engineering Directorate at NASA's Marshall Space Flight Center. Previously, he was Deputy Director of the Ares Projects Office and, prior to that, was Deputy Director for Product Assurance in the Safety and Mission Assurance Office, focusing on space shuttle return-to-flight efforts. Other assignments included Manager of the X-37 Flight Demonstrator, Deputy Manager of the Space Launch Initiative Program, and Program Manager of the Second Generation Reusable Launch Vehicle Program. Dumbacher joined NASA in 1979.

He earned a bachelor's degree in Mechanical Engineering from Purdue University in 1981 and a Master's in Business Administration from the University of Alabama in Huntsville in 1984. He has completed the Senior Managers in Government study program at Harvard University.

Altonell L. Mumford, Director for Resources Management Office (RMO). In her role as Director for RMO, for the HEOMD, Mumford provides budget formulation and execution, systems management, and program analysis consistent with Administration policies and guidance, Agency strategic plans, and Congressional authorizations and appropriations. She provides critical strategic leadership in establishing program controls, integrating and developing the budget perspective for the HEOMD Associate Administrator (AA). Previously, Mumford was Assistant Associate Administrator for RMO, Space Operations Mission Directorate. She has worked in the federal government for 34-plus years and with NASA for over 32 of those years. Mumford has 26-plus years of professional experience and specialized training in resources management, program analysis, procurement, financial controls, budgeting, leadership, and is a graduate of the Federal Executive Institute.

Badri A. Younes, Deputy Associate Administrator for Space Communications and Navigation (SCaN). Younes is responsible for NASA's space communications and navigation infrastructure and services, as well as data standards and spectrum. He manages the SCaN Program at NASA Headquarters and oversees all NASA telecommunications and navigation projects and networks, including NASA's Space Network (SN), Near-Earth Network (NEN), and Deep Space Network (DSN). Mr. Younes is also responsible for the development of enabling technology and capabilities critical to meeting the Agency's vision for an integrated SCaN architecture aligned with NASA's future space exploration needs. Prior to returning to NASA in 2007, Mr. Younes was the Department of Defense (DoD) Director for Spectrum Management with responsibility for spectrum policy and strategic planning and implementation for the DoD. Under his leadership, the Department has successfully

negotiated major win-win agreements with the Federal Communications Commission (FCC), National Telecommunications & Information Administration (NTIA), and US private sector. Younes' experience spans 28 years of leadership in microwave and RF systems engineering and technology. He holds a Masters in Electronics Engineering from Catholic University of America, and in 1995, he completed all his PhD requirements except for the dissertation.

4.6 SCIENCE MISSION DIRECTORATE

MISSION STATEMENT

The Science Mission Directorate (SMD) carries out the scientific exploration of Earth and space to expand the frontiers of Earth science, heliophysics, planetary science, and astrophysics. Through a variety of robotic observatory and explorer craft and through sponsored research, the Directorate provides virtual human access to the farthest reaches of space and time, as well as practical information about changes on our home planet. SMD also has responsibility for developing, on a reimbursable basis, the nation's next generation of polar-orbiting operation environmental satellites for the National Oceanic and Atmospheric Administration (NOAA) and for developing the James Webb Space Telescope (JWST).

ORGANIZATIONAL STRUCTURE

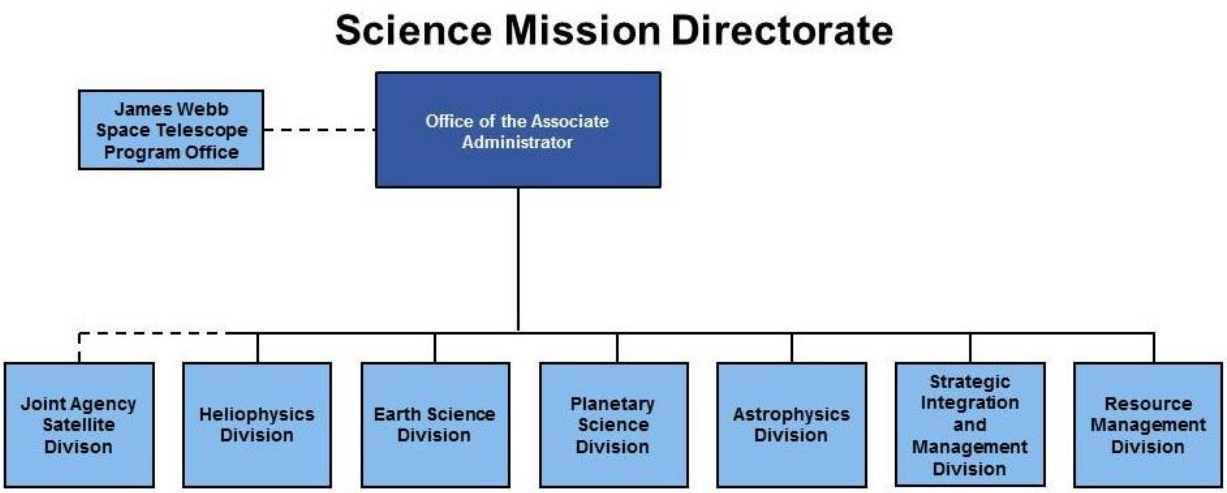


Figure 4.6-1: SMD Organizational Structure

Across SMD's four research divisions, over 95 space missions are in the portfolio, with more than 70 in operation and over 25 in development. Within these divisions, each has supporting Research and Technology programs to enable missions, and Data Analysis programs and Interdisciplinary cSience programs to exploit their data to generate new scientific results. Collectively, these additional elements are termed Research and Analysis (R&A) programs. Suborbital flight programs, including sounding rockets, aircraft, and balloon programs, make scientific measurements complementary to the space-based measurements to calibrate, validate, and extend their scientific utility, and provide opportunities to test new measurement approaches and train young scientists and engineers.

The four research divisions represent four major space-based research endeavors, each with a sub-goal in the NASA Strategic Plan.

- **Earth Science:** Advance Earth system science to meet the challenges of climate and environmental change.

- **Planetary Science:** Ascertain the content, origin, and evolution of the solar system and the potential for life elsewhere.
- **Heliophysics:** Understand the sun and its interactions with Earth and the solar system.
- **Astrophysics:** Discover how the universe works, explore how it began and evolved, and search for Earth-like planets.

In planning its science programs, NASA is guided by the priorities defined by the U.S. scientific community as presented by the National Research Council (NRC) in its decadal surveys and other reports. These reports represent the broad consensus of the Nation's scientific communities in their respective areas. As such, NRC decadal surveys and related reports provide the starting point for NASA's strategic planning process in the arenas of Earth and space sciences. NASA now has decadal surveys in hand for each of its four major science areas.

SMD enhances its scientific return on the nation's investment through productive partnerships with other federal agencies and with the space agencies of other nations. These partnerships range from basic data sharing agreements to collaboration on flight missions where each partner may provide scientific instruments, spacecraft, or launch services. SMD also collaborates with other NASA Directorates and Offices to further shared goals.

WORKFORCE

SMD has an allocation of 150 Full Time Equivalent (FTE) Civil Servants.

BUDGET EST. ($M)

President's FY13 Budget Request	FY2012	FY2013	FY2014	FY2015	FY2016	FY2017
Science Mission Directorate (HQ)	$23.9	$26.6	$27.7	$29.0	$30.6	$32.2
Science (Mission Budget)	$5049.1	$4884.6	$4886.7	$4885.4	$4884.1	$4882.2

Table 4.6-1: SMD HQ Budget Runout

This budget represents the Science Mission Directorate portion of the Headquarters Agency Management and Operations budget. It includes all of the salaries and travel budgets for Headquarters employees, as well as procurement funding for any Headquarters support contractors. SMD Mission Budget Runout: This budget supports the Science Mission Directorate portfolio of programs and mission activities.

IMPORTANT ACTIVITIES

Each of the science divisions, the JWST Program Office, and the Joint Agency Satellite Division for weather satellites will be treated in a separate section below.

MAJOR ISSUES

The issues that significantly impact SMD are included in the NASA Presidential Transition Strategic Issues Book.

EARTH SCIENCE DESCRIPTION

The overarching objective of NASA's Earth science program is to observe and understand the processes that shape the environment in which we live, learn how they are changing,

and use that information to improve the quality of life on Earth. To achieve this objective, NASA's Earth Science program advances scientific knowledge of the Earth as a complex integrated system, and provides direct societal benefit by developing and testing new user-driven applications that combine satellite data with research-based understanding. The Earth Science program designs, builds, and operates a constellation of research satellites (many developed in collaboration with other U.S. and international agencies); conducts a broad program of competitively selected research covering the oceans, atmosphere, land, and cryosphere and their interactions; creates and demonstrates new, science-based application products that are then used by other federal mission agencies; develops enabling technology and the next generation of space-borne instruments through a dedicated Earth Science Technology program; and plays key roles in interagency and international research, capacity building, and disaster monitoring/response coordination efforts .

In addition to supporting NASA's Earth system science research objectives, NASA's Earth science and observations activities help inform and support operational programs carried out by other national agencies. Therefore, the overall balance, science and applications foci, and flight mission portfolio for the program combines recommendations from the research communities presented in the National Research Council's inaugural 2007 "Earth Science and Applications from Space" Decadal Survey, with non-research inputs related to national needs and realistic budget constraints. The overall program is specified and guided by the interagency-approved 2010 "NASA Climate-Centric Architecture for Earth Observations." In its May, 2012 Mid-Term Assessment, the NRC found that "NASA responded favorably and aggressively to the 2007 decadal survey, embracing its overall recommendations… As a consequence, the science and applications communities have made significant progress over the past 5 years."

Advancing knowledge of the integrated Earth system requires comprehensive, global, sustained observations of many important quantities, which can best be accomplished through satellite missions. SMD's Earth Science research constellation is presently composed of 16 satellites; five satellites (four NASA research missions, with international contributions) are flying in close formation – called the "A-Train" – creating a virtual observatory far more capable than any individual spacecraft. The program has an additional 11 missions in formulation or development to launch before the end of 2020 (five of these missions will launch before the end of 2014).

Measurements from piloted and unmanned aircraft, as well as from surface-based networks, are acquired by NASA and used both to advance the research and to help calibrate the satellite sensors. The Earth Science program also supports the world's most extensive, searchable Earth observation data system, archiving and freely distributing virtually all historical and contemporary NASA and sister-agency satellite measurements and related information products. NASA observations, computing facilities, and research findings contribute directly to improved Earth-system models. These models codify our scientific knowledge and – when coupled with global satellite measurements – can be used to predict future evolution on many time scales.

BUDGET EST. ($M)

President's FY13 Budget Request	FY2012	FY2013	FY2014	FY2015	FY2016	FY2017
Earth Science (Mission)	$1760.5	$1784.9	$1775.5	$1835.6	$1826.2	$1772.8

Table 4.6-2: Earth Science Budget Runout

This budget supports the Earth Science portfolio of programs and mission activities. It is a subset of the total Science Mission Directorate budget.

FUNCTIONS

Within SMD, the Earth Science Division is responsible for strategic planning and implementation of NASA's wide range of Earth-focused strategic/systematic and innovative/competed mission, research, applications, technology development, data system/ modeling activities, and programs.

- **Earth Science Strategic Missions:** Facility (NASA-led) satellite missions to acquire key measurements required for advancement of Earth system science, applications development, and provision of direct societal benefit. Mission objectives and capabilities are guided by the NRC's 2007 Earth Decadal Survey and the 2010 NASA Climate Architecture documents.

- **Earth System Science Pathfinder (ESSP)/Venture Class Missions:** Low-cost, rapidly developed, competitively selected, research and applications missions to foster revolutionary innovation and train future leaders of space-based Earth science and applications. Venture class includes small satellite, instrument (for orbital flight on missions of opportunity), and suborbital investigations.

- **Research and Analysis:** Competitively selected research to broadly advance Earth system science in NASA's identified Science Focus Areas (Atmospheric Composition, Water and Energy Cycle, Climate Variability and Change, Carbon Cycle and Ecosystem, Weather and Meteorology, and Solid Earth) and their component disciplinary programs. This includes necessary science-based airborne and in-situ data acquisition activities.

- **Applied Science Program:** This program addresses development and testing of new applications of Earth science research and missions and provision of direct societal benefits (including interagency and international capacity-building) — primarily via partnerships with other federal and non-federal agencies — to extend the utility and benefit of NASA observations and science results by incorporating them into those agencies' decision support systems.

- **Earth Science Technology Program:** A focused program of competed technology research and development projects that advances Earth observing instrumentation and data management to make future missions feasible and affordable.

IMPORTANT ACTIVITIES

(expected launch dates in parentheses):

Landsat Data Continuity Mission (2013) Strategic mission	Continue the 40-year, global, moderate (15 m – 120 m, depending on wavelength) resolution time series of multispectral land cover used by researchers, state and local governments, and the private sector. Also acquires thermal infrared data used extensively by crop monitoring and water management. Joint mission with USGS.
Global Precipitation Measurement (2014) Strategic mission	Provide accurate, extensive (near-global), frequent (every 4 hours) measurements of precipitation via a core satellite and a constellation of smaller satellites. International collaboration with JAXA.
Stratospheric Aerosol and Gas Experiment III - International Space Station (2014) Continuity mission	From its position on the International Space Station, extend the time series of precision, near-global measurements of atmospheric ozone, water vapor, and aerosol profiles for research and operational prediction uses. Joint with NASA/HEOMD and the European Space Agency.
Orbiting Carbon Observatory-2 (2014) Competed mission	Provide first-ever global measurements of atmospheric carbon dioxide with accuracy and precision necessary to determine the roles of extended natural oceanic and terrestrial sources/sinks in the global carbon cycle. Recovery for 2009 mission lost due to a launch vehicle failure.
Soil Moisture Active-Passive (2014) Strategic mission	Soil moisture and freeze-thaw for weather and hydrological cycle research; SMAP soil moisture measurements will improve weather forecasts as well.
Ice, Cloud and land Elevation Satellite-2 (2016) Strategic mission	Precision, extensive, frequent, satellite laser measurements of polar ice topography/extent, and mid-latitude vegetation heights for land carbon standing stock research.
Cyclone Global Navigation Satellite System (2017) Venture class competed small satellite	First Venture-class competitive orbital mission to use a constellation of small satellites measuring GPS signals reflected from the ocean surface to make first-ever, frequent measurements of winds and air-sea dynamics under extreme and dynamic hurricane/tropical cyclone conditions. CYGNSS data will advance research and improve hurricane intensity forecast accuracy.
Gravity Recovery and Climate Experiment Follow-on (2017) Continuity mission	Precision gravity measurements to extend the ongoing GRACE time series; data used to monitor polar ice mass changes, and continental water resources including sub-surface aquifers. Joint with with Germany's Research Centre for Geosciences (GFZ).
Operation Ice Bridge (2009-2018) Airborne Campaigns	Innovative, semi-annual, sustained airborne campaigns in both the Arctic and the Antarctic, utilizing advanced instrumentation to measure ice topography and dynamics, bridging between the ICESat-1 mission (which ended in 2009) and the 2016 launch of ICESat-2.

Table 4.6-3: Important Activities

PLANETARY SCIENCE DESCRIPTION

Solar system exploration is a grand human enterprise that seeks to discover the nature, origin, and history of the celestial bodies among which we live, and to explore whether life exists beyond Earth. Underlying this science element is the theme of habitability—the capacity of an environment (which could cover an entire planet) to harbor life, be it life arising on that planet or visiting from Earth, including identifying the hazards and resources present as humans explore space. The Planetary Science program pursues a strategy of surveying planetary bodies of interest, and targeting for return visits to those most likely to enable greatest progress toward the National Research Council's (NRC)

decadal survey. The current scientific foundation is described in the NRC's *"Visions and Voyages for Planetary Science 2013 – 2022"* publication. The Planetary Science Division lays out its programs along three major classes of destinations:

- Inner planets: Earth's moon, Mars and its satellites, Venus, and Mercury
- Outer planets: Jupiter and its satellites, especially Europa; Saturn and its satellites, especially Titan and Enceladus; Uranus and its satellites; Neptune and its satellites, including Triton; Pluto and its satellites; and Kuiper Belt Objects
- Small bodies: Comets and asteroids

BUDGET EST. ($M)

President's FY13 Budget Request	FY2012	FY2013	FY2014	FY2015	FY2016	FY2017
Planetary Science (Mission)	1501.4	1192.3	1133.7	1102.0	1119.4	1198.8

Table 4.6-4: Planetary Science Budget Runout

This budget supports the Planetary Science portfolio of programs and mission activities. It is a subset of the total Science Mission Directorate budget.

FUNCTIONS

The Planetary Science Division is responsible for strategic planning and implementation of its portfolio of missions and programs.

- **Discovery Program:** a series of small Principal Investigator (PI)-led planetary missions solicited from the community as complete scientific investigations via an open, competitive Announcement of Opportunity.
- **New Frontiers Program:** a series of PI-led medium planetary missions solicited from the community as complete scientific investigations via an open, competitive Announcement of Opportunity.
- **The Mars Exploration Program:** SMD, working with the Human Exploration and Operations Directorate (HEOMD), the NASA Chief Technologist (OCT), the Space Technology Mission Directorate, and the NASA Chief Scientist (OCS), is leading efforts to reformulate NASA's Mars program activities. Our goal is to design a cross-Directorate Mars Exploration Program that is consistent with both available resources and the science objectives contained in the National Research Council's decadal surveys.

- **Operational Missions:** The Planetary Science Division's highly successful operating missions are providing a steady stream of exciting and scientifically vital results. Cassini is in an extended mission around Saturn. The Dawn spacecraft has completed its study of the asteroid Vesta and is on its way to its next target, Ceres. The Opportunity and Curiosity rovers are alive and well on the surface of Mars, with the Mars Reconnaissance Orbiter, Odyssey, and Mars Express orbiting above. The Lunar Reconnaissance Orbiter is in its extended science mission at the moon, while the twin Gravity Recovery and Interior Laboratory spacecraft are completing their extended mission to study the lunar interior. The Mercury Surface, Space Environment, Geochemistry, and Ranging or MESSENGER mission is completing its extended mission orbiting Mercury. The New Horizons spacecraft is scheduled to provide the first close flyby of Pluto in July 2015, and the Juno spacecraft will begin polar orbiting Jupiter in August 2016, opening new vistas on our solar system.

- **Research & Analysis**: Discoveries and concepts in the R&A program are the genesis of scientific priorities, new mission concepts and science instruments, and scientific investigations exploiting mission data.

IMPORTANT ACTIVITIES

(expected launch dates in parentheses)

Lunar Atmosphere and Dust Environment Explorer or LADEE (2013) Strategic Mission	Implements one of the eight science goals in the NRC's Scientific Context for Exploration of the Moon report.
Mars Atmosphere and Volatile Evolution Mission (MAVEN) (2013) Competed	A medium-sized Mars aeronomy mission to capitalize on new science, and to address science objectives from the previous planetary science decadal survey.
Discovery Program (2015) Competed	Opportunity for a small planetary mission; more than one mission may be selected.
Interior Exploration using Seismic Investigations, Geodesy and Heat Transport or InSight (2016) Competed	A geophysical lander on Mars to study its deep interior and help understand the processes that shaped the rocky planets of the inner solar system (including Earth).
OSIRIS-REx (2016) Competed	An asteroid rendezvous and sample return mission that will provide a wealth of knowledge about C-type asteroids and early solar system materials.
New Frontiers (2016) Competed	Opportunity for a medium planetary mission; more than one mission may be selected.

Table 4.6-5: Important Activities

HELIOPHYSICS DESCRIPTION

We now know that the sun, the solar system, and the region of the galaxy just outside the solar system present us with a complex, interacting set of physical processes. It is the one part of the cosmos accessible to *in situ* scientific investigation, our only hands-on

astrophysical laboratory. The NRC decadal survey, *Solar and Space Physics: A Science for a Technological Society* (NRC, 2012*),* articulated the scientific challenges of this field and recommended missions and research programs to meet them to culminate in the achievement of a space weather predictive capability to aid endeavors on Earth and in space.

As reflected in the 2009 NASA Heliophysics Roadmap (*Note: The Roadmap is in the process of being updated to account for the 2012 Decadal Survey*), three Heliophysics science and exploration objectives guide the selection of mission concepts and related investigations:

- **Open the Frontier to Space Environment Prediction:** Understand the fundamental physical processes of the space environment from the sun to Earth, to other planets, and beyond to the interstellar medium.
- **Understand the Nature of Our Home in Space:** Understand how human society, technological systems, and the habitability of planets are affected by solar variability and planetary magnetic fields.
- **Safeguard the Journey of Exploration:** Maximize the safety and productivity of human and robotic explorers by enabling the capability to predict the extreme and dynamic conditions in space.

The Heliophysics spaceflight strategy is to deploy modest-sized missions as frequently as possible to form a small fleet of spacecraft that operate simultaneously to understand the sun, heliosphere, and planetary environments as a single connected system. Heliophysics spacecraft are used collectively as a single observatory (the Heliophysics System Observatory), which provides measurements across distributed spatial scales that can be linked with a variety of models to enable predictions of tomorrow's space environment. Continuing and evolving this distributed asset allows Heliophysics to better understand the space environment, safeguard the journey of exploration, and meet national needs for predicting space weather and its impact on Earth.

BUDGET EST. ($M)

President's FY13 Budget Request	FY2012	FY2013	FY2014	FY2015	FY2016	FY2017
Heliophysics (Mission)	620.5	647.0	643.0	636.7	638.3	661.6

Table 4.6-6: Heliophysics Budget Runout

This budget supports the Heliophysics portfolio of programs and mission activities. It is a subset of the total Science Mission Directorate budget.

FUNCTIONS

The Heliophysics Division is responsible for strategic planning and implementation of its portfolio of missions and programs.

- **Solar Terrestrial Probes** provide understanding of the fundamental plasma processes inherent in all astrophysical systems.
- **Living with a Star** consists of missions targeted toward those aspects of the sun and space environment that most directly affect life and society.
- **Explorer program** complements the two strategic mission programs described above through smaller, competitive PI-led missions.
- **Heliophysics Research Program:** Physics-based modeling has played an increasingly important role both in defining the missions and in interpreting their observations. Working with universities, other government facilities, and industrial labs, the research program conducts several competitive grant programs for theory, modeling, and research and analysis efforts.
- **Sounding Rockets and Management of the Wallops Rocket Range:** Opportunities to test instruments prior to flight on orbital missions, to provide scientific and mission management experience to new investigators, to provide training for graduate students, and to make measurements that enhance the total scientific return. Heliophysics also manages the Wallops range for the benefit of NASA and other agencies.
- **Partnerships with the Department of Defense, NOAA, Department of Energy, and National Science Foundation** to provide science payloads on missions that fulfill objectives of participating government agencies and to conduct collaborative research projects that advance the understanding and mitigation of the space environment and its effects on national assets.

IMPORTANT ACTIVITIES.

(expected launch dates in parentheses):

Interface Region Imaging Spectrograph (IRIS)(2013) Competed, PI-led	Trace the flow of energy and plasma into the corona and heliosphere.
Magnetospheric Multiscale (MMS) (2015) Strategic Mission	Study microphysics of fundamental plasma processes.
Explorer (NET 2016) Competed, PI-led	PI-led mission, and potentially a mission of opportunity to be selected in Spring 2013.
Solar Orbiter (2017) Strategic Collaboration	Partnership with ESA to measure properties and dynamics of solar wind.
Solar Probe Plus (2018) Strategic Mission	Study the processes controlling heating of the solar corona.

Table 4.6-7: Important Activities

ASTROPHYSICS DESCRIPTION

The Astrophysics Division science spans the vast reaches of the cosmos throughout space and time, from exploration of the beginning of time in the universe, through the development of galaxies and stars, to the search for life on planets outside our solar system. The science goals of astrophysics are breathtaking. We are starting to investigate the very moment of creation of the universe and are working to construct the full history of stars and galaxies. We are discovering how planetary systems form and how environments hospitable for life develop. And we will search for the signatures of life on other worlds, perhaps to learn that we are not alone. This is the broad sweep of science articulated in the NRC decadal survey *New Worlds, New Horizons in Astronomy and Astrophysics* (NRC, 2010). The decadal survey identifies national scientific goals in this arena and identifies priority missions for both NASA and the National Science Foundation, which has the lead for ground-based astronomy.

BUDGET EST. ($M)

President's FY13 Budget Request	FY2012	FY2013	FY2014	FY2015	FY2016	FY2017
Astrophysics	672.7	659.4	703.0	693.7	708.9	710.2

Table 4.6-8: Total Astrophysics Budget Runout

FUNCTIONS

The Astrophysics Division is responsible for strategic planning and implementation of its portfolio of missions and programs. This is carried out through three focused and two cross-cutting programs. In addition, the James Webb Space Telescope (JWST) is managed through implementation under a special programs office in SMD that reports to the NASA Associate Administrator. After launch and commissioning, the responsibility for managing and operating JWST returns to the Astrophysics Division.

The three focused programs are based on science areas that together span the range of NASA's astronomy and astrophysics research, and provide an intellectual framework for advancing science and strategic planning.

- **Cosmic Origins Program:** This program comprises projects that enable the study of how stars and galaxies came into being, how they evolve, and ultimately how they end their lives.
- **Physics of the Cosmo:** This program explores the most extreme physical conditions of the universe, from black holes to dark energy. This involves studying the building blocks of our own existence at the most basic level: the matter, energy, space, and time that create the living universe.
- **Exoplanet Exploration:** This program aims to advance our understanding of planets and planetary systems around other stars ("extrasolar planets" or simply "exoplanets"). The ultimate goal of this program is to extend this exploration to the detection of habitable, Earth-like planets around other stars, to determine how common such planets are, and to search for indicators that they might harbor life.

The two cross-cutting programs complement the focused programs by developing and launching smaller missions through the Astrophysics Explorers Program and by supporting the basic and applied research activities through the Astrophysics Research Program.

- **Explorer Program:** Explorers are smaller, focused, PI-led missions that provide opportunities for innovative science with relatively moderate investments. They provide a means for responding rapidly to new scientific and technical breakthroughs. The latest NRC decadal survey *New Worlds, New Horizons in Astronomy and Astrophysics* recommended an increased number of Explorer missions throughout the decade, to enable rapid response to science opportunities.
- **Research and Analysis (R&A):** Sponsored research programs prepare for the next generation of missions, through theoretical research, technology development, data analysis, and suborbital investigations. These programs are essential for pioneering new approaches to advancing the science objectives, maximizing scientific return of future and operating missions, and training the workforce required to ensure future competitiveness.

IMPORTANT ACTIVITIES

(Launched dates in parentheses):

Stratospheric Observatory for Infrared Astronomy (SOFIA) (ongoing) Strategic	Observations of stellar and planet-forming environments.
Explorer (EX) mission (final selection expected early 2013, with launch 2017) Competed	PI-led mission; exoplanet science.
Mission of Opportunity (MoO) (selection expected 2013, with launch 2017-2018) Competed	PI-led missions; science depends on final selection. One MoO expected to launch in 2017, another in 2018.
James Webb Space Telescope (JWST) (launch planned for 2018) Strategic Mission	In development 2013; successor to HST and Spitzer, JWST will answer fundamental astrophysical questions, ranging from the formation and structure of the universe to the origin of planetary systems.
Small Explorer (SMEX) (solicitation expected late 2013/early 2014) Competed	PI-led mission; science depends on final selection.
Explorer (solicitation planned for 2015 or later) Competed	PI-led mission; science depends on final selection.
Wide field infrared survey telescope (early next decade) Strategic Mission	Medium- to large-class mission, designed to settle essential questions in both exoplanet and dark energy research, and to answer key questions about the formation, growth, and structure of galaxies.

Table 4.6-9: Important Activities

JAMES WEBB SPACE TELESCOPE

In 2010, the James Webb Space Telescope (JWST) mission became a separate Program Office within SMD. JWST is a strategic astrophysics mission centered on a 6.5-meter infrared telescope and designed to study and answer fundamental astrophysical questions, ranging from the formation and structure of the universe to the origin of planetary systems. A scientific successor to the Hubble and Spitzer Space Telescopes, the JWST will be used by astronomers to conduct imaging and spectroscopic observations in the wavelength range 0.6 to 27 μm. JWST will study galaxies across cosmic time and unlike Hubble, will see the earliest stars and galaxies formed in the universe shortly after the Big Bang. This is done in large part by having a larger mirror (6.5 meters in diameter versus 2.4 meters for HST) with a collecting area seven times greater than HST. Also, JWST will remotely examine the atmospheres of exoplanets. It is currently scheduled for launch in the 2018 time frame.

BUDGET EST. ($M)

President's FY13 Budget Request	FY2012	FY2013	FY2014	FY2015	FY2016	FY2017
JWST	518.6	627.6	659.1	646.6	621.6	571.1

Table 4.6-10: James Webb Space Telescope (JWST) Budget Runout (not including cost of facilities)

JOINT AGENCY SATELLITE DIVISION DESCRIPTION

The Joint Agency Satellite Division (JASD) helps move forward the National Academy of Sciences' recommendations on Earth science observations. The Academy stated in its 2007 Earth Science decadal survey that "[s]ustained measurements of . . . key climate and weather variables are part of the committee's strategy to achieve its vision for an Earth observation and information system in the next decade." (p. 33). JASD advances this effort by working with other agencies to obtain these measurements.

SMD established JASD in April 2010 following the former Administration's decision to replace the National Polar-orbiting Operational Satellite System (NPOESS) with the NOAA/NASA Joint Polar Satellite System (JPSS) and the DOD Defense Weather Satellite System (DWSS). JASD builds on NASA's history of successfully executing reimbursable satellite programs on behalf of other agencies. The requirements and budget flow from the partner agencies, namely NOAA, and NASA is responsible for the space, and often ground, systems development and acquisition.

JASD program funding is fully reimbursable; the only JASD-related expense NASA incurs is the employment of the NASA Headquarters Full Time Employees (FTEs) who staff the JASD division.

BUDGET ($M)

JASD programs are fully reimbursable, and as such, the budgets lie with our partner agencies.

FUNCTIONS

JASD is responsible for managing Earth-observation satellite development work for our agency partners.

- **Acquisition and Development:** Carry out procurement for and development of reimbursable satellite systems for partner agencies.
- **Project Management:** Apply standard NASA program and project management processes to ensure mission success for our partners with a focus on efficiently managing operational satellite acquisitions.
- **Partner-Agency Interface:** Engage partner agencies early in the Federal Government planning process, support those agencies in their engagements with OSTP, OMB, and Congress, and offer the agencies a single interface for development and management of their satellite projects.

IMPORTANT ACTIVITIES

(expected launch dates in parentheses):

Suomi-NPOESS Preparatory Project (2011) Ongoing mission	Technology demonstration for NPOESS (now JPSS); provide data continuity between key elements of the NASA Earth Observing System (EOS) satellites and the first JPSS satellite. NOAA partnership.
Joint Polar Satellite System-1 (2016) Strategic mission	Provide data continuity for global environmental data used in numerical weather prediction models, climate modeling, and space weather observations. NOAA partnership, which has partnered with EUMETSAT and JAXA.
JPSS Freeflyer-1 (2016) **Strategic mission**	Provide continuation of global environmental change observations. Complementary mission to JPSS-I that will fly additional instruments. NOAA partnership.
Joint Polar Satellite Strategic System-2 (2021) Strategic mission	Provide data continuity for global environmental data used in numerical weather prediction models, climate modeling, and space weather observations. NOAA partnership, which has partnered with EUMETSAT and JAXA.
JPSS Freeflyer-2 (2021) **Strategic mission**	Provide continuation of global environmental change observations. Complementary mission to JPSS-2 that will fly additional instruments. NOAA partnership.
Jason 3 (2014) Strategic mission	Provides ocean topography measurements for determining ocean circulation, climate change, and sea level rise used in ocean weather-operational oceanography, surface wave forecasting and evaluation, and hurricane intensity forecasting. NOAA partnership, which has partnered with EUMETSAT and CNES.
Geostationary Operational Environmental Satellite-R Series (2015, 2017, 2019 & 2024) Strategic mission	Provide geosynchronous environmental monitoring with greater resolution and coverage, the first geo-orbiting lightning mapper, and increased capability to detect space weather and solar events. NOAA partnership. GOES-S, GOES-T, and GOES-U, which will have the same purpose as GOES-R, are set to follow in two-year intervals.
MetOp (2006, 2012, 2016) Ongoing mission	EUMETSAT satellites that provide weather data services to monitor climate and improve weather forecasts worldwide. NOAA partnership.
Climate Sensors (2016) Strategic mission	Measure the Earth's overall thermal radiation balance. Provides for restoration of a suite of sensors originally demanifested from NPOESS. NOAA partnership that will fly aboard JPSS-I and JPSS Freeflyer-I.
Deep Space Climate Observatory (2014) Strategic mission	Provide an early warning of solar storms to enhance the nation's space weather prediction capabilities. NOAA partnership, with the launch vehicle provided by DOD.

Table 4.6-11: Important Activities

KEY PERSONNEL

Dr. John M. Grunsfeld, Associate Administrator, was appointed in January 2012. He previously served as the Deputy Director of the Space Telescope Science Institute in Baltimore, MD, managing the science program for the Hubble Space Telescope and the forthcoming James Webb Space Telescope. In 2008, he was NASA's Chief Scientist. Selected as an astronaut in 1992, he flew on five space shuttle missions, including three to service the Hubble Space Telescope. Grunsfeld's background includes research in high energy astrophysics, cosmic ray physics, and in the emerging field of exoplanet studies with specific interest in future astronomical instrumentation

Charles J. Gay, Deputy Associate Administrator, has served NASA in senior management positions for over ten years. He was previously Deputy Director of the Office of System Safety and Mission Assurance at

Goddard Space Flight Center. He also served as Deputy Director of the Heliophysics Division at NASA Headquarters where he was responsible for programmatic development and implementation of NASA's solar physics and geospace science program. In addition to his experience at NASA, Gay has over 20 years experience in the aerospace industry, including Vice President of a division of Litton Advanced Systems.

Michael R. Luther, Deputy Associate Administrator for Programs, has over 42 years of industry and government experience in the development and management of space based scientific remote sensing systems. He joined NASA's Langley Research Center in 1981 for the development, launch and early mission operations of a series of Earth remote sensing instruments. Since joining NASA Headquarters in 1987, Luther has held a series of positions with increasing responsibilities including Upper Atmosphere Research Satellite Program Manager, Earth Science Division Flight Program Director, Deputy Associate Administrator in the Office of Earth Science, and Deputy Associate Administrator for Programs in the Science Mission Directorate (SMD).

Roy A. Maizel, **Deputy Associate Administrator for Management**, joined NASA in 1981 as a Presidential Management Intern, and acquired extensive experience as a Program Analyst on both the Space Shuttle and Space Station programs. Since 1988, he has held a series of progressively responsible management positions in the Space Shuttle, Space Station, Earth Science, and Space Science programs. When the Space Science and Earth Science programs merged in 2004 to become the Science Mission Directorate, Maizel became Director of the Business Management Division. In 2005, Maizel became Director of the Management and Policy Division, a position he held until his appointment to his present position in June 2008.

Dr. Marc S. Allen Deputy Associate Administrator for Research (Acting), manages Directorate-level science activities including the solicitation, evaluation, and selection process for SMD, the SMD Science Management Council, and SMD's research policies and procedures. He is the Directorate lead for Agency-wide science activities including grants activities, peer review services, and postdoctoral and graduate student fellowship programs. Before coming to NASA in late 1997, he served for seven years as Director of the National Research Council's Space Studies Board. Previously, he held management positions at CTA Incorporated and Computer Sciences Corporation, working at NASA's Langley Research Center and Goddard Space Flight Center in the areas of space systems analysis and applications software development.

4.7 SPACE TECHNOLOGY MISSION DIRECTORATE

MISSION STATEMENT

Space technology enables future human and scientific exploration, just as current and past mission successes were supported by previous technology investments.

Space Technology Mission Directorate (STMD)-developed technologies have high potential for offsetting mission risk, reducing cost, and advancing existing capabilities, thereby enabling more challenging missions. NASA identifies target technologies through the Strategic Space Technology Investment Plan (managed by the Office of the Chief Technologist) and through regular coordination with HEOMD and SMD. Progress is ensured through a steady cadence of solicitations and ground and flight demonstrations.

This approach provides NASA and the aerospace industry with a sustainable pipeline of technology advances. In addition, Space Technology develops the technology workforce through research fellowships and early career faculty and center innovation grants. Space Technology spurs innovation through small businesses, prizes and challenges, and through providing suborbital flights for technology demonstrations.

In managing its investments, STMD employs a portfolio approach that spans a range of discipline areas and technology readiness levels (TRL) from concept study to flight demonstration. By funding a mixture of early stage conceptual studies (TRL 1-3), ground-based and laboratory testing aimed at demonstrating technical feasibility (TRL 3-5), and relevant environment flight demonstrations (TRL 5-7), Space Technology helps NASA attain a balance between mission-driven technology investments and the long-range, transformational technology and capability investments required to meet our Nation's far-reaching goals. STMD facilitates infusion of available and new technology into operational systems that support specific human-exploration missions, science missions, and aeronautics.

Significant progress in technology areas such as space power systems, entry, descent, and landing systems, propulsion, radiation protection, and cryogenic fluid handling are essential for human exploration beyond low Earth orbit. By investing in high-payoff transformative technology, Space Technology matures the capabilities required for NASA's future, provides new capabilities, and lowers the cost for other government agencies and private industry. The development of advanced and innovative aerospace technologies is critical for our nation to meet its goals to explore and understand the Earth, our solar system, and the universe.

ORGANIZATIONAL STRUCTURE

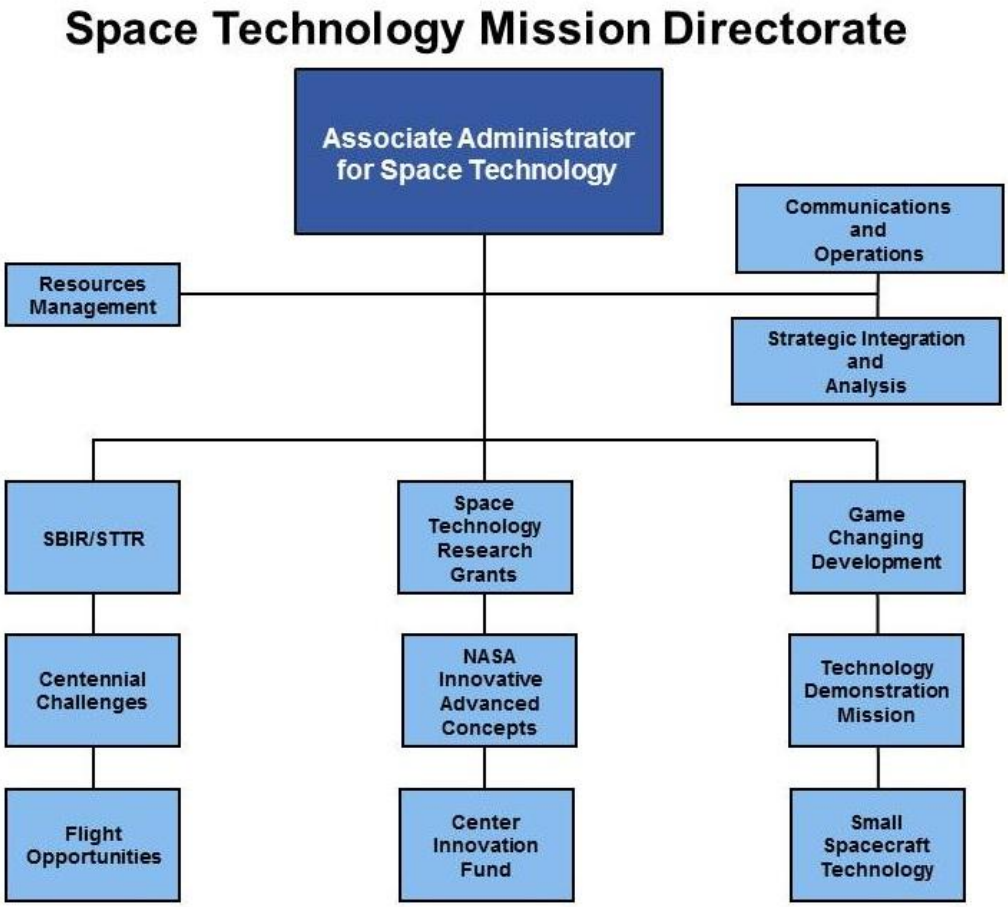


Figure 4.7-1: Organizational Structure of STMD

WORKFORCE

STMD has an allocation of 25 Full Time Equivalent (FTE) Civil Servants.

FUNCTIONS

Technology Demonstration Missions (TDM) matures and demonstrates crosscutting technologies, preparing them for rapid infusion into future human exploration and science missions. The goal of this program is to bridge the gap between early technology development and mission infusion by maturing revolutionary, system-level space technologies and demonstrating these technologies in a relevant operational environment (ground, air, suborbital, or orbital regime). STMD flight projects reduce risk and enhance capabilities for NASA's Exploration and Science missions by demonstrating advanced technologies allowing for mission infusion. TDM provides frequent opportunities for demonstration through competitive solicitations. TDM is working with NASA centers and Mission Directorates, aerospace industry providers, and other domestic and international partners to demonstrate technologies that have the potential to benefit multiple NASA missions, other government agencies, and the space industry.

Game Changing Development (GCD) seeks to identify and rapidly mature innovative/high impact capabilities and technologies that may lead to novel ideas and new approaches for the Agency's future missions. The most promising ideas are advanced from the early design phase through significant ground-based and/or laboratory testing.

Project teams are held accountable for ensuring that discoveries move rapidly from the laboratory to application. GCD projects produce both subsystem and system-level multidisciplinary innovations. Component and discipline innovations are developed when needed to enable system and advanced capabilities. While advances in discipline and core knowledge are by-products of the GCD program, the objective is to rapidly mature transformational innovations for follow-on system-level flight demonstrations. GCD invests in transformative space technologies that lead to advances in terrestrial capabilities as well as serve as a stimulus to the U.S. economy while providing inspiration and opportunity to our nation's youth.

NASA's Small Business Innovative Research (SBIR) and Small Business Technology Transfer (STTR). Congress established the Small Business Innovation Research (SBIR) Program in 1982 and the similar, but smaller, Small Business Technology Transfer (STTR) Program in 1992. All federal agencies with extramural R/R&D budgets exceeding $100 million are required to administer an SBIR Program. Five of these agencies with R/R&D budgets exceeding $1 billion are also required to administer an STTR Program. The Program's specific objectives are to stimulate U.S. technological innovation, use small businesses to meet federal R/R&D needs, increase private-sector commercialization of innovations derived from federal R/R&D, and to foster and encourage the participation of socially disadvantaged and women-owned businesses. The STTR Program has the additional intent of encouraging formal linkages between small businesses and non-profit research institutions. For NASA, the SBIR and STTR Programs have the dual objectives of providing the small business sector with an opportunity to develop technology for NASA and commercializing that technology to spur economic growth. NASA's SBIR/STTR Programs support early-stage research and development by small businesses through competitively awarded contracts. Space Technology works with NASA Mission Directorates and

centers to ensure solicitations include broad research topics consistent with the technical challenges and opportunities for the Agency.

Small Spacecraft Technology develops and demonstrates technologies to enable new small spacecraft capabilities for NASA's missions in science, exploration, and operations. Small spacecraft can provide a low-cost platform for rapid in-space testing of new technologies and operational innovations. Small spacecraft can also perform unique missions that would not be possible with conventional spacecraft, such as simultaneous space weather observations from dozens of small satellites distributed around the globe. Development and demonstration projects now underway with NASA small spacecraft include high-capacity radio communications, laser communications and navigation, rendezvous and docking, and demonstration of a communications network among ten separate spacecraft using one ground station. Another innovative project demonstrates the use of Smartphone electronics as the computer and navigation system for a satellite. Technology development in the coming year is expected to focus on propulsion to enable new mission capabilities in Earth orbit and deep space. The results of the program's development and demonstration missions will be shared with the national space community to provide opportunities for infusion into ongoing or planned missions.

Space Technology Research Grants promotes research in technology fields through two competitive opportunities. First, NASA provides award funds for competitive grants to university-based researchers conducting foundational research in space technology. Second, NASA competitively awards fellowships for graduate student research (Masters and Doctorate) that shows significant promise for future application toward NASA missions and strategic goals. By funding annual research announcements, STMD is able to accelerate emerging space technologies, foster innovation, and build skills in future technological leaders.

NASA Innovative Advanced Concepts (NIAC) solicits low Technology Readiness Level (TRL) research in support of NASA and Space Technology programs. In the spirit of the original NIAC, the program seeks innovative, technically credible advanced concepts that could one day change what is possible in aeronautics and space. NIAC efforts improve the Nation's leadership in key research areas, enable far-term capabilities, and spawn disruptive innovations that make aeronautics, science, space travel, and exploration more effective, affordable, and sustainable. The NIAC core program is managed from NASA HQ and supports innovative research through two phases of study. Phase I awards are typically nine-month efforts (up to $100 thousand) to explore the overall viability and advance the Technology Readiness Level (TRL) of visionary concepts. A follow-on Phase II is available to eligible recipients of Phase I awards in order to develop the most promising Phase I concepts for up to two years (about $500 thousand) and explore infusion paths within NASA and beyond.

Candidate studies may be selected from multiple sources: educational institution, commercial or not-for-profit organization, research laboratory, federal agency, or NASA centers (including the Jet Propulsion Laboratory). Any one study may have a team with a mix from all of these entities.

Center Innovation Fund stimulates and encourages creativity and innovation at the NASA centers. Distributed among the NASA centers, this program provides seed funding for new technologies, innovations,

and creative ideas that stem from the Agency's talented workforce. The funds are distributed among the NASA centers to allow them to support early stage innovative technology initiatives that leverage center talent and capability. The activities are envisioned to fall within the scope of NASA space technology roadmaps or technology addressing a significant national need. STRG supports 128 student research fellows from 50 universities across 26 states and 1 territory.

Through the Center Chief Technologist, NASA field centers conduct competitions to select ideas and projects and provide appropriate oversight. Detailed feedback describing the innovation pursued and progress made help determine the potential for follow-on funding.

Centennial Challenges: The Centennial Challenge program is designed to directly engage the public at large in the process of advanced technology development that is of value to NASA's missions and to the aerospace community. This is done through the offering of Congressional authorized prize purses and associated challenges developed by NASA and the aerospace community and set up as a competition awarding the prize money to the first individual or team to achieve the specified technology challenge. The program goal is to stimulate development of innovative solutions for technical problems that are impeding growth in areas of interest to NASA. Through these challenges, NASA encourages the participation of independent teams, individual inventors, student groups and private companies of all sizes in aerospace research and development.

Flight Opportunities matures technologies by providing affordable access to space environments while also facilitating the development of the commercial reusable suborbital transportation industry. The project also procures commercial parabolic flights to test technologies in environments that simulate microgravity and the reduced gravity environments. By facilitating access to these relevant flight environments, STMD provides the science and aerospace community an opportunity to work with NASA and other industry and government partners, to ensure that technologies are developed to further the Nation's interests.

STMD Mission Support Functions at Headquarters include resource management, communications, outreach and educational activities, and strategic integration, for the mission directorate. These functions include budget formulation and execution, financial management, program resources status analysis, OMB and Congressional budget preparation, quality control over all budget submittals, and independent budget cost estimate and profile validation.

IMPORTANT ACTIVITIES

Low Density Supersonic Decelerators demonstrates new technologies capable of safely landing high-mass payloads on planetary surfaces. This project element designs, develops, and tests ring sail parachutes and supersonic inflatable braking systems.

Laser Communications Relay Demonstration flies and validates a reliable, capable, and cost-effective optical communications technology. Optical communications technology provides data rates up to 100-times higher than today's radio communication systems. These higher bandwidth capabilities are necessary for future human and robotic space missions. The technology is directly applicable to the next generation of NASA's space communications network. After the

demonstration, the developed space and ground assets will be qualified for use by near-Earth and deep space missions requiring high bandwidth and a small ground station reception area.

Deep Space Atomic Clock validates a miniaturized mercury-ion atomic clock that is 10 times more accurate than today's ground based navigation systems. This project element will demonstrate ultra-precision timing in space and its benefits for one-way radio-based navigation. Precision timing and navigation is critical to the performance of a wide range of deep space missions and has the potential to improve the Nation's next generation GPS system.

Solar Sail Demonstration deploys and operates a solar sail with an area seven times larger than ever flown in space. It is potentially applicable to a wide range of future space missions, including serving as an advanced space weather warning system to provide more timely and accurate notice of solar flare activity. This technology also could allow for propellant-less deep space exploration missions. NOAA is collaborating with NASA and L'Garde Inc. on the demonstration.

Robotic Satellite Servicing conducts demonstrations, such as the active Robotic Refueling mission on ISS, and formulates the architecture options and technology needs for future robotic servicing missions. The project element intends to spur the growth of a new commercial satellite-servicing industry. This is an important technology development effort for future Earth orbital and deep space exploration missions and is managed by the HEOMD.

Edison Demonstration of Smallsat Networks (EDSN) will fly a group of 10 small satellites to demonstrate their utility as low-cost platforms for coordinated space science observations and other applications. Each satellite carries an instrument for measuring the space radiation environment and the information from all satellites will be collected through a single ground station.

Cryogenic Propellant Storage and Transfer demonstrates the capability of in-space long-term storage and the microgravity transfer of cryogenic propellants (liquid oxygen and hydrogen), essential for transportation on deep-space exploration missions. Cryogenic propellant storage and transfer is the most critical Space Technology demonstration for human exploration. Beyond the initial development of Space Launch System and the Orion Multi-Purpose Crew Vehicle (Orion MPCV) currently underway, the next essential architecture element to extend human presence beyond low Earth orbit is the development of a long-duration cryogenic propulsion stage. The cryogenic propulsion stage must be capable of performing long-term storage (greater than six months) and transferring cryogenic propellants such as liquid oxygen and liquid hydrogen. Creating this capability relies on the successful demonstration of the Cryogenic Propellant Storage and Transfer project element.

Human-Robotic Systems develops advanced robotics technology to amplify human productivity and reduce mission risks by improving human-robot interaction, robotic assistance, and providing in-space and surface servicing, manipulation, and mobility systems. This effort also supports the Agency's role in the National Robotics initiative and **Human Exploration Telerobotics** demonstrates continued and progressively challenging operations for Robonaut 2, as well as remote robotic operations using ISS, planetary rovers, and other human robotic systems efforts matured for demonstration.

Composite Cryogenic Propellant Tanks uses advanced composite materials to develop very large, lightweight propellant tanks applicable to future NASA human exploration architecture elements including the Space Launch System and its cryogenic propulsive stage.

MAJOR ISSUES

FY 2014 Budget Limitations for Space Technology based on projected flat budget profile:

- Statutory requirements for SBIR and STTR mandate increase over next several years, while NASA and STMD's budgets remain flat;
- STMD is managing multiple projects through key life cycle milestones, which require increased resource demands; and
- Identified technology needs are greater than available funding, reducing flexibility to pursue high priorities including: solar electric propulsion demonstration (strong Congressional interest); entry, descent, and landing demonstrations; radiation mitigation; and high-performance spaceflight computing.

KEY PERSONNEL

Dr. Michael Gazarik, Associate Administrator, has over 25 years of experience in the design, development, and deployment of spaceflight systems. He has contributed to the development of technology with application to NASA's Exploration Systems, Space Operations and Science missions. Gazarik came to NASA Headquarters from NASA's Langley Research Center (LaRC) in Hampton, VA, where he was the deputy director for programs in the Engineering Directorate. In this role, he focused the directorate's resources to deliver flight hardware for numerous flight programs, and led the formulation of a variety of programs in aeronautics, exploration and science. He has served as the project manager for the Mars Science Laboratory entry, descent and landing instrumentation project during the formulation and design phases. He led formulation of an advanced laser-based rendezvous and docking sensor system. Gazarik led Langley's formulation of the Autonomous Landing and Hazard Avoidance (ALHAT) project that has developed advanced senor systems for planetary landings. Prior to joining NASA, Gazarik served as project manager for the Geosynchronous Imaging Fourier Transform Spectrometer (GIFTS) project at the Massachusetts Institute of Technology's Lincoln Laboratory. Gazarik also worked in the private sector on software and firmware development for commercial and government applications. Gazarik earned his Bachelor of Science in Electrical Engineering from the University of Pittsburgh in 1987. He earned a Masters of Science in 1989 and Ph.D. in 1997, both in Electrical Engineering, from the Georgia Institute of Technology. Gazarik has received numerous awards, including NASA's Outstanding Leadership Medal and the Silver Snoopy Award. He has authored or co-authored more than 20 peer-reviewed publications.

Dr. James Reuther, Deputy Associate Administrator for STMD, oversees operations of Space Technology's nine development programs. Prior to his time at NASA Headquarters, Reuther served as the Lead of the Test and Verification (T&V) Office for the Orion spacecraft development. After graduating from the University of California, Davis with a Bachelors, Masters, and Ph.D. in mechanical and aeronautical engineering, Reuther performed

foundational research in Aerodynamic Shape Optimization. He served as the computation aerothermal sub-team lead for the Columbia Accident Investigation Board (CAIB) and NASA's Return to Flight (RTF) efforts under the Space Shuttle Program. Reuther also served on the 15 Member NASA Exploration Systems Architecture Study (ESAS) core team where they team led a multi-center team of hundreds of NASA engineers and scientists to develop the architectural roadmap for NASA's future human space exploration systems. In recognition for his contribution in ESAS, he earned the NASA Exceptional Service Medal. Reuther became the Project Manager for the Orion, Thermal Protection System (TPS), Advanced Development Project (ADP), where he lead a team to successfully deliver two integrated heat shield designs for the Crew Exploration Vehicle (CEV) preliminary Design Review. Reuther has received numerous awards, including NASA's Exceptional Achievement Medal, the Silver Snoopy Award, and the NASA Outstanding Leadership Medal.

4.8 MISSION SUPPORT DIRECTORATE

MISSION STATEMENT

The Mission Support Directorate (MSD) provides effective and efficient institutional support to enable the Agency to successfully accomplish its missions. It focuses on reducing institutional risk to NASA's current and future missions by improving processes, stimulating efficiency, and providing consistency and uniformity across institutional capabilities and services.

ORGANIZATIONAL STRUCTURE

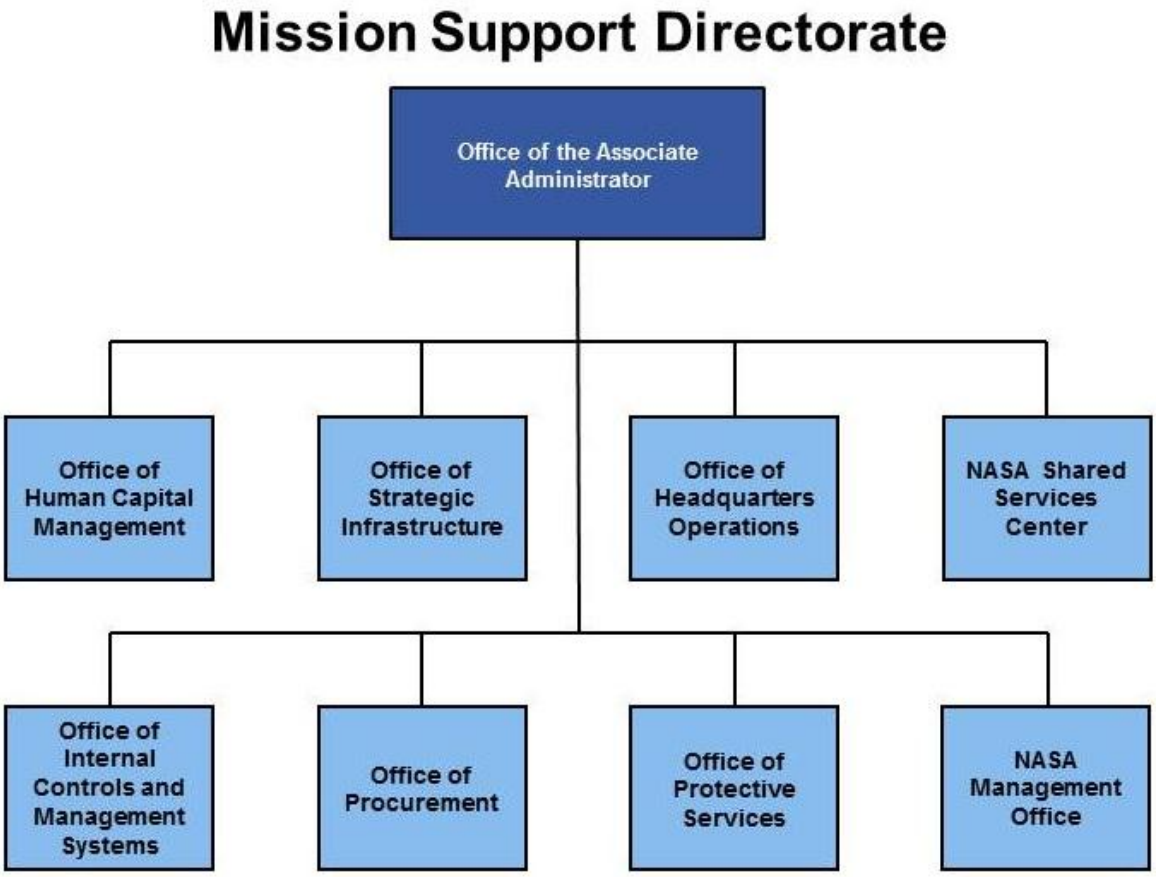


Figure 4.8-1: Mission Support Directorate Organizational Chart

OVERALL RESPONSIBILITIES

The Associate Administrator (AA) for MSD reports to the NASA Deputy Administrator.

Specifically, the Associate Administrator for MSD:

- Oversees management and assesses individual mission statements for the functional areas of the Offices of

Human Capital Management, Strategic Infrastructure, Procurement, Protective Services, Internal Controls and Management Systems, Headquarters Operations, the NASA Shared Services Center, and the NASA Management Office.

- Develops and implements plans that include the organization's goals, objectives, metrics, and actions needed to execute the strategic goals and outcomes in the NASA Strategic Plan.
- In concurrence with Center Directors, approves the assignment, promotion, discipline, and relief of the principal mission support official at each center and assesses their performance. Provides a written evaluation of the principal mission support official at each center, which shall be attached to that individual's annual performance appraisal.
- Ensures integration and alignment of mission support activities in support of Agency strategic needs and interfaces with the NASA Deputy Administrator, the Associate Administrator, and the Chief of Staff to support integration and alignment of these activities.
- Achieves consistency of approach to improve functional performance across the Agency.
- Monitors MSD functional programs' performance, as well as the effectiveness and efficiency of programs and processes.
- Provides an integrated projection of functional activities with associated costs and workload implications across the Agency.
- Oversees the preparation, presentation, and execution of the mission support budget. This includes all Cross Agency Support (CAS) accounts, Agency and Center Management and Operations (AMO, CMO), and Construction of Facilities and Environmental Compliance and Restoration (CoF and ECR, or CECR).
- Oversees the management of CAS funds at Headquarters and centers, including establishing consistent practices and reporting across the Agency.
- Ensures that personnel competencies and facility capabilities required to meet NASA's strategic needs are identified and provided.
- Ensures that NASA Headquarters is provided the institutional services and products necessary to support effective operations.
- Ensures that the procurement, security, counter-terrorism/counter-intelligence, internal control and management activities are effectively provided in support of NASA's mission and strategic needs.
- Provides oversight of NMO responsibilities and activities related to contract management and oversight of the Jet Propulsion laboratory (JPL) and the Applied Physics Laboratory (APL).
- Manages the Headquarters Corporate Management and Operations budget processes.
- Ensures statutory, regulatory, and fiduciary compliance.
- Serves as a liaison to external organizations performing similar functions and to stakeholders who establish government-wide policies and requirements.
- Oversees reporting as required by Congress, the Office of Management and Budget, and other external bodies.

Special Relationships

The Associate Administrator for MSD serves as a core member of NASA's Mission Support Council and member of the Program Management Council. The Associate Administrator for MSD serves as Chair of the NASA Shared Services and the Chair of the Senior Assessment Team (SAT).

Line Of Succession

In the following order: Deputy Associate Administrator for Mission Support; Executive Director for Headquarters Operations; Assistant Administrator for Human Capital Management; Assistant Administrator for Strategic Infrastructure.

Key Personnel

Mission Support Directorate
Associate Administrator: Woodrow Whitlow, Jr.

Woodrow Whitlow, Jr. is the Associate Administrator for Mission Support Directorate at NASA Headquarters. He was appointed to that position by Administrator Charles F. Bolden on Feb. 3, 2010.

The Mission Support Directorate enables program and institutional capabilities to conduct NASA's aeronautics and space activities. As the directorate's associate administrator, Whitlow is responsible for most NASA management operations, including human capital management, headquarters operations, agency operations, the NASA Shared Services Center, strategic infrastructure, cross-agency support, and construction and environmental compliance and restoration. Prior to being appointed to his current position, he was director of the Glenn Research Center. There, he was responsible for managing an annual budget of approximately $750 million, and overseeing a workforce of approximately 1,680 civil service employees that is supported by approximately 1,580 contractors. The center has 24 major facilities and over 500 specialized research facilities located at the 350-acre Cleveland site and the 6,400-acre Plum Brook Station site in Sandusky, Ohio. At Glenn, Whitlow led research and development efforts in the areas of aero-propulsion, in-space propulsion, aerospace power and energy conversion, communications technology, and human research. From September 2003 through December 2005, Whitlow served as the Deputy Director of the NASA John F. Kennedy Space Center. There his duties included assisting the director in determining and implementing center policy and in managing and implementing the center's missions and agency program responsibilities in the areas of processing, launch, and recovery of launch vehicles; processing of spacecraft; and acquisition of launch services. Prior to this appointment as Deputy Director, he served as the Director of Research and Technology at the Glenn Research Center. Whitlow began his professional career in 1979 as a researcher at the NASA Langley Research Center, Hampton, Va. He assumed various positions of increasing responsibility before moving to the Glenn Research Center in 1998. In 1994, he served as Director of the Critical Technologies Division, Office of Aeronautics, at NASA Headquarters. Whitlow earned his bachelor of science, master of science and doctor of philosophy degrees in Aeronautics and Astronautics from the Massachusetts Institute of Technology. He also holds an honorary doctor of engineering degree from Cranfield University. He has written more than 40 technical papers, most in the areas of unsteady transonic flow, aeroelasticity and

propulsion. Whitlow has received numerous awards, including the Presidential Rank of Distinguished Executive, Presidential Rank of Meritorious Executive, U.S. Black Engineer of the Year in Government, NASA Exceptional Service Honor Medal, NASA Equal Opportunity Honor Medal, the (British) Institution of Mechanical Engineers William Sweet Smith Prize, Minorities in Research Science Scientist-of-the-Year Award, and National Society of Black Engineers Distinguished Engineer of the Year Award. The American Institute of Aeronautics and Astronautics elected him as a Fellow in 2010.

Human Capital Management
Assistant Administrator: Jeri Buchholz

Jeri L. Buchholz became NASA's Chief Human Capital Officer and Assistant Administrator for Human Capital Management on Aug. 1, 2011.

As the Assistant Administrator for Human Capital Management and NASA's Chief Human Capital Officer, Buchholz has stewardship responsibility for NASA's workforce. She advises and assists the Administrator by carrying out responsibilities in accordance with the Chief Human Capital Officers Act of 2002. Her responsibilities include setting the agency's workforce development strategy, assessing workforce characteristics and future needs based on the agency's mission and strategic plan; aligning the agency's human resources policies and programs with organizational mission, strategic goals, and performance outcomes; and, serving as a member of the Office of Personnel Management-led Chief Human Capital Officers Council. Buchholz served as the Associate Director for Human Resources Operations and Policy at the U.S. Nuclear Regulatory Commission. She began her public service career in 1981 as a Peace Corps Volunteer in Zaire, now the Democratic Republic of the Congo. She also has served as the Chief Human Capital Officer at the Department of Health and Human Services' Office of Inspector General, as well as the U.S. International Trade Commission. In addition, she has held positions at the Office of Federal Housing Enterprise Oversight, the National Imagery and Mapping Agency, the Defense Intelligence Agency, the U.S. Information Agency and the U.S.

Strategic Infrastructure
Assistant Administrator: Olga Dominguez

Olga M. Dominguez became the Assistant Administrator for NASA's Office of Strategic Infrastructure on June 26, 2006. She leads the agency infrastructure policy efforts and the integration of infrastructure issues in support of accomplishing NASA's Science, Aeronautics, Space Operations and Exploration Missions.

Previously, Dominguez served as the Deputy Assistant Administrator for the Office of Infrastructure and Administration. Prior to that assignment, she served as the Director of NASA's Environmental Management Division, where she was responsible for agency environmental policy and guidance, agency environmental budgets and support to the NASA Administrator on environmental issues. She joined NASA Headquarters in 1990 and became a member of the United States of America Senior Executive Service in 1998. Earlier in her career, Dominguez directed the environmental program for the Navy's David Taylor Research Laboratories and was a lead enforcement inspector for the State of Maryland's Department of the Environment and the Prince George's County Health Department. The recipient of numerous awards, Dominguez has received

the Presidential Rank Award of Distinguished Executive for 2007; the Presidential Rank Award of Meritorious Executive; the Presidential Award for Leadership in Energy Management; Stennis Space Center's Frontline Award; NASA's Cooperative External Achievement Award; and, NASA's Medal for Outstanding Leadership. She was named one of "The 80 Elite Hispanic Women" by the Hispanic Business magazine in April 2002. Dominguez's educational background includes a Bachelor of Science degree in Fish and Wildlife Management, with emphasis in Zoology. She brings over twenty-five years of experience in leadership and management spanning local, state and federal governments. She and her family reside in Annapolis, MD.

Headquarters Operations
Executive Director: Jay M. Henn

Mr. Jay M. Henn is the Executive Director for Headquarters Operations.

In this capacity, Mr. Henn provides the executive leadership and oversight for the services and products required to support the effective operations of NASA Headquarters, including facilities services, information technology, human resources, logistics, acquisition management, and business management. Immediately prior to his current position, Mr. Henn was the Deputy Assistant Administrator for Human Capital Management, and served as NASA's Deputy Chief Human Capital Officer (CHCO). As the Deputy CHCO, Mr. Henn supported the Agency and the Office of Human Capital Management in developing and implementing the human resources policies, procedures, and systems needed by the NASA workforce to successfully carry out the Agency's mission. In 2007, while on detail from the Office of Human Capital Management, Mr. Henn served as Acting Assistant Administrator for Internal Controls and Management Systems. In that position, Mr. Henn was responsible for restructuring the Office and for designing and implementing an integrated Agency approach to meet NASA's internal control responsibilities. The Office also provided a range of related administrative support to the Agency in areas such as audit liaison, directives management, and management systems. Previously, Mr. Henn served as Assistant Associate Administrator for Enterprise Operations in the Aeronautics Enterprise; as Director for Management Programs in the Office of Aeronautics and Space Transportation Technology; and as Director for Strategy and Policy in the Office of Aeronautics. From June 2000 to April 2001, Mr. Henn was on detail to the Smithsonian Institution's National Air and Space Museum (NASM). At NASM, Mr. Henn served as Executive Officer to the Director and worked on issues of joint NASA/NASM interest, including the U.S. Centennial of Flight Commission. In recognition of his multiple contributions to the Agency, Mr. Henn has been awarded the NASA Outstanding Leadership Medal, the NASA Exceptional Service Medal (two times) and the Aeronautics Peer Excellence Award (two times), and was the recipient of a NASA Graduate Fellowship. In 2004, Mr. Henn received the Presidential Rank Award of Meritorious Senior Professional. Prior to joining NASA in 1988, Mr. Henn was a management consultant with Temple, Barker & Sloane, Inc., in Lexington, Massachusetts. While at TBS he developed, managed, and conducted international projects in strategic planning, industry and financial analysis, organization design, and management development for Fortune 100 clients in the transportation, telecommunications, automotive, and natural resources industries. Mr. Henn holds

a Bachelor of Arts degree with Honors in Anthropology and Mathematics from the University of Arizona and a Master of Arts degree in archaeology from Harvard University. While at Harvard he conducted fieldwork in France, Yugoslavia, and Central America. He also holds an MBA from the Harvard Business School, and is a Distinguished Graduate of the Industrial College of the Armed Forces, where he was awarded a Master of Science degree in National Resource Strategy in 1997.

NASA Shared Services Center
Executive Director: Michael Smith

Michael J. Smith serves as the executive director of the NASA Shared Services Center (NSSC) in Hancock County, Miss., where he leads a team of more than 550 civil service and service provider employees. Mr. Smith joined the NSSC as deputy director on January 18, 2011, and has served as the NSSC's executive director since November 6, 2011. As executive director of a multi-function shared services center, which includes financial management, information technology, human resources, procurement services, and business support services, Mr. Smith provides agency services to NASA employees, contractors, grantees, and vendors. Additionally, he manages the NSSC's operating budget of $320 million in the Working Capital Fund (WCF), approximately $100 million in non-WCF, and supports total payments of $18 billion a year for labor, travel, accounts payable and grants across NASA. Prior to joining the NSSC, Mr. Smith most recently served as a consultant to the Coca-Cola Company, providing support to executive management for a global shared services center strategy, including initial implementation of the SAP model in China. In previous roles, Mr. Smith had an impressive 17-year career working for Coca-Cola Enterprises (CCE). During his tenure with CCE, Mr. Smith held numerous positions in the United States and Western Europe, including CFO of Coca-Cola Beverages in Brussels, Belgium; director, Project Europe in London, England; and director of CCE's Shared Services Center in Tampa, Fla. Mr. Smith received a Bachelor of Business Administration degree in Accounting from Kennesaw State University near Atlanta, Ga., and is a Certified Public Accountant.

Internal Controls and Management Systems
Director: Nancy Anne Baugher

Nancy Anne Baugher came to NASA in June, 2012 to serve as NASA's Director of Internal Controls and Management Systems. In this role, she is responsible for providing executive and functional leadership, policy development, technical expertise, and oversight of NASA's integrated internal control program. OICMS also establishes and maintains the requirements for the documentation and promulgation of internal NASA policies, requirements, and external regulations codified in the Code of Federal Regulations, as well as manage NASA's External Audit Program.

Ms. Baugher holds a Bachelor's degree in Technology and Management and a Master's degree in Management, HCA from the University of Maryland University College. She is a Certified Public Accountant (CPA), Certified Government Financial Manager (CGFM), Chartered Global Management Accountant (CGMA), Registered School Business Official (RSBO), Certified Government Performance Manager, and Lean Six Sigma Greenbelt, among other credentials.

Prior to Federal service, Ms Baugher served in senior finance and administration roles in

public and private entities including service organizations, manufacturing organizations, wholesale distributorships, not-for-profits, universities, and state and local government. Formerly Assistant Dean at the University of Maryland College of Life and Chemical Sciences she began a Federal career at the Department of Homeland Security (DHS) and stood up the Agency's first controller's shop for the management of over $20 billion in program dollars. With this and other contributions and ground breaking endeavors she received a DHS CFO Medal of Excellence.

Ms Baugher is also a recipient of the International Eagle Award from the Association of School Business Officials for her contributions to Schools, Community and Profession, and the Certificate of Excellence Award in Comprehensive Annual Financial Reporting.

Procurement
Assistant Administrator: Bill McNally

Bill McNally is the Assistant Administrator for Procurement and Deputy Chief Acquisition Officer at NASA. He directs NASA's procurement functions throughout the Agency, providing strategic policy, leadership, and direction. He guides and oversees NASA's procurement activities in every area from programs studying the Earth to missions going into our solar system. He represents NASA procurement to the Executive and Legislative branches of the Federal Government, industry, and international organizations. McNally was appointed as the Assistant Administrator for Procurement in September 2007. McNally joined NASA in October 2005 as special procurement advisor in the Exploration Systems Mission Directorate. In this position, he provided strategic direction and contract management advice for all elements of the directorate's portfolio, which included the development of the Ares and Orion vehicles.

McNally was with the Air Force until he retired in 2003 at which time he joined industry. Most recently, he provided consulting advice to NASA as part of the Exploration Systems Architecture Study. He was a senior acquisition manager at two companies where he provided consulting advice and training to Federal agencies on Performance Based Acquisition and acquisition advice to the Pentagon Renovation Program. During his 26 year military career, McNally was involved in many facets of acquisition. These included positions as a contract administrator and industrial specialist for the Atlas Space Program, as a contracting officer and manager for the Tomahawk Cruise Missile, and as the Director of Technology Contracts at the Strategic Defense Initiative Office. As a Commander of a Defense Plant Office he oversaw the contract performance and business operations of a major defense company. He was the Chief of Air Force Contracting Policy and the Military Deputy in the Secretary of Defense's Acquisition Reform Office. Mr. McNally shared his procurement expertise as a professor at the Defense Systems Management College and as the Air Force Element Commander at the Defense Acquisition University. McNally holds a Level III certification in Contracting. He is both a Certified Professional Contracts Manager and a Fellow in the National Contract Management Association. His decorations include the NASA Exceptional Service medal, the Air Force Legion of Merit, the Defense Meritorious Service Medal, the Defense Superior Service Medal, and numerous Joint and Air Force Commendations Medals.

Protective Services
Assistant Administrator: Joseph S. Mahaley

Joe Mahaley is the Assistant Administrator (AA) for Protective Services at NASA. He leads the Office of Protective Services (OPS) and is the focal point for policy formulation, oversight, coordination, and management of the Agency's protective services. As the AA for OPS, he oversees NASA's security management, intelligence analysis, counter-intelligence/counter-terrorism (CI/CT) services, national security systems, handling of sensitive and classified information, identity, credential, and systems management, emergency management, and continuity of operations functions. Mr. Mahaley is the former Director of Security and Emergency Operations at the U.S. Department of Energy (DOE) and has over 35 years of experience in the government, military and private sectors. At DOE, he managed department-wide security policy, continuity of operations, continuity of government, the National Training Center and the security of DOE's Headquarters operations in the National Capital region, with responsibility for 240 federal staff and a $250 million annual operating budget. When he retired from DOE in 2003, he was the DOE's longest serving senior security official. Prior to his appointment as DOE's security director, he served as the Assistant General Counsel for Defense Programs and National Security, the senior legal advisor to DOE's nuclear weapons, nonproliferation and security programs. Following his service at DOE, Mr. Mahaley served as a security advisor to the Sandia Corporation Board of Directors, overseeing Sandia National Laboratories; a government-owned, contractor operated U.S. National Laboratory. He was also Vice President, Government Strategies and Chief Security Officer at Day and Zimmerman, then Vice President and General Manager, Integrated Security Solutions, at DRS Technologies. Mr. Mahaley also founded Security Strategies LLC, a consulting company, and was the Senior Vice President and Division Manager of the Applied Systems Division at Parsons Corporation. After leaving Parsons in 2009, he worked as an independent consultant and advisor to numerous companies, including, among others, the Abraham Group, Watermark Risk Management International, ManTech International Corporation, InfoZen, Logan Research, and SRC Incorporated. He is a recipient of the DOE's highest honorary award, the Secretary of Energy's Gold Award with medallion and rosette, the DOE Distinguished Career Service Award, the National Nuclear Security Administration Award for Exceptional Contributions to National Security Programs, the 2003 Nuclear Security Information Exchange Certificate of Excellence and the 2001 Presidential Rank Award, Meritorious Senior Executive. He also served as a Charter Member of the U.S. Federal Law Enforcement Training Accreditation Board. Mr. Mahaley graduated with merit from the United States Naval Academy and received his Juris Doctor degree with honors from George Washington University. In 2010, he was named a Fellow and Affiliate Faculty Member of the nationally and internationally recognized Center for Infrastructure Protection and Homeland Security at George Mason University Law School. Mr. Mahaley is also a retired U.S. Navy Captain.

NASA Management Office
Director: Eugene H. Trinh

Eugene H. Trinh is currently the Director of the NASA Management Office (NMO) located at the Jet Propulsion Laboratory,

California Institute of Technology. NMO is an element of the NASA Headquarters Mission Support Directorate. Before coming to the NMO, Dr. Trinh has held NASA Headquarters positions of Manager of the Human System Research and Technology development program in the former Exploration Systems Mission Directorate, and of Director of the Physical Sciences Research division in the former Office of Biological and Physical Research (OBPR).

To join NASA Headquarters in 1999, Dr. Trinh left his position as a Senior Research Scientist at the Jet Propulsion Laboratory where he had conducted experimental and theoretical research in Fluid Dynamics, Fundamental Materials Science, and Levitation Technology. Dr. Trinh was one of two science payload specialists on the first United States Microgravity Laboratory (USML-1) Space Shuttle flight. This Columbia/Spacelab mission was launched on June 25 1992, and lasted a record-breaking 14 days.

Dr. Trinh graduated with a BS in Mechanical Engineering from Columbia University and with a PhD degree in Engineering Science from Yale University. He has authored over sixty peer-reviewed technical papers, holds six patents, and is the recipient of the NASA Space Flight Medal, the NASA Distinguished Achievement Medal, and the NASA Headquarters' Creative Management Award. Dr. Trinh was a Fellow of the Acoustical Society of America, a member of the American Physical Society and of the American Association for the Advancement of Science.

4.9 NASA CENTERS

This section discusses NASA's 10 Centers:

- **Ames Research Center:** Simon P. Worden
- **Dryden Flight Research Center:** David D. McBride
- **Glenn Research Center:** Ramon (Ray) Lugo III
- **Goddard Space Flight Center:** Chris Scolese
- **Jet Propulsion Laboratory:** Charles Elachi
- **Johnson Space Center:** Michael L. Coats
- **Kennedy Space Center:** Robert Cabana
- **Langley Research Center:** Lesa B. Roe
- **Marshall Space Flight Center:** Patrick Scheuermann
- **Stennis Space Center:** Richard Gilbrech

4.9.1 AMES RESEARCH CENTER (ARC)

MISSION STATEMENT

Ames Research Center, located in California's Silicon Valley, enables exploration through selected development, innovative technologies, small affordable missions, and interdisciplinary scientific discovery. Ames provides leadership in Astrobiology; the search for habitable planets, airborne astronomy, small satellites, advanced thermal protection, intelligent / adaptive systems, robotic lunar exploration, supercomputing, and air traffic management. Ames develops tools for a safer, more efficient national airspace and unique partnerships benefiting NASA's mission.

Ames is located at the core of the research cluster of high-tech companies, universities, and laboratories that define the region's character. With about 2,500 employees, and approximately $890 million total annual budget, Ames' economic impact is significant, and its location makes it a natural lead for innovative public/private partnerships, such as those with Google, Sun, Microsoft, the University of California, and Carnegie-Mellon University. In addition, Ames hosts more than 600 national and international students annually. NASA Ames currently generates $1.3 billion in annual economic output, supporting over 8,400 jobs nationally, with 70 percent of those jobs remaining in California and more than 5,300 jobs and $877 million in annual economic impact in the San Francisco/San Jose Bay Area alone. In addition, the highly successful Ames-based NASA Research Park (NRP) has over 70 on-site partners projected to add 33,800 jobs nationally and $5.8 billion in annual economic output upon full build-out over the next decade. Combined, NASA Ames and the NRP represent the potential to deliver up to 42,000 jobs nationally and $7.1 billion in annual economic impact. Ames also leads the agency in proactively pursuing, in coordination with the Headquarters Office of International and Interagency Relations, international collaborations and is spearheading the agency's efforts in small, inexpensive satellites. As a leader in information technology research with a focus on supercomputing, networking, and intelligent systems, Ames also conducts the critical R&D and develops the enabling technologies that make NASA missions possible. Ames is at the forefront in entry, descent, and landing systems, nanotechnology, synthetic and fundamental space biology, biotechnology, aerospace, and human factors research. Ames is home to three virtual institutes and works collaboratively with the FAA, conducting research in air traffic management to make safer, cheaper, and more efficient air travel a reality. Ames engages in information and education outreach, and fosters commercial application of NASA technologies.

ORGANIZATIONAL STRUCTURE

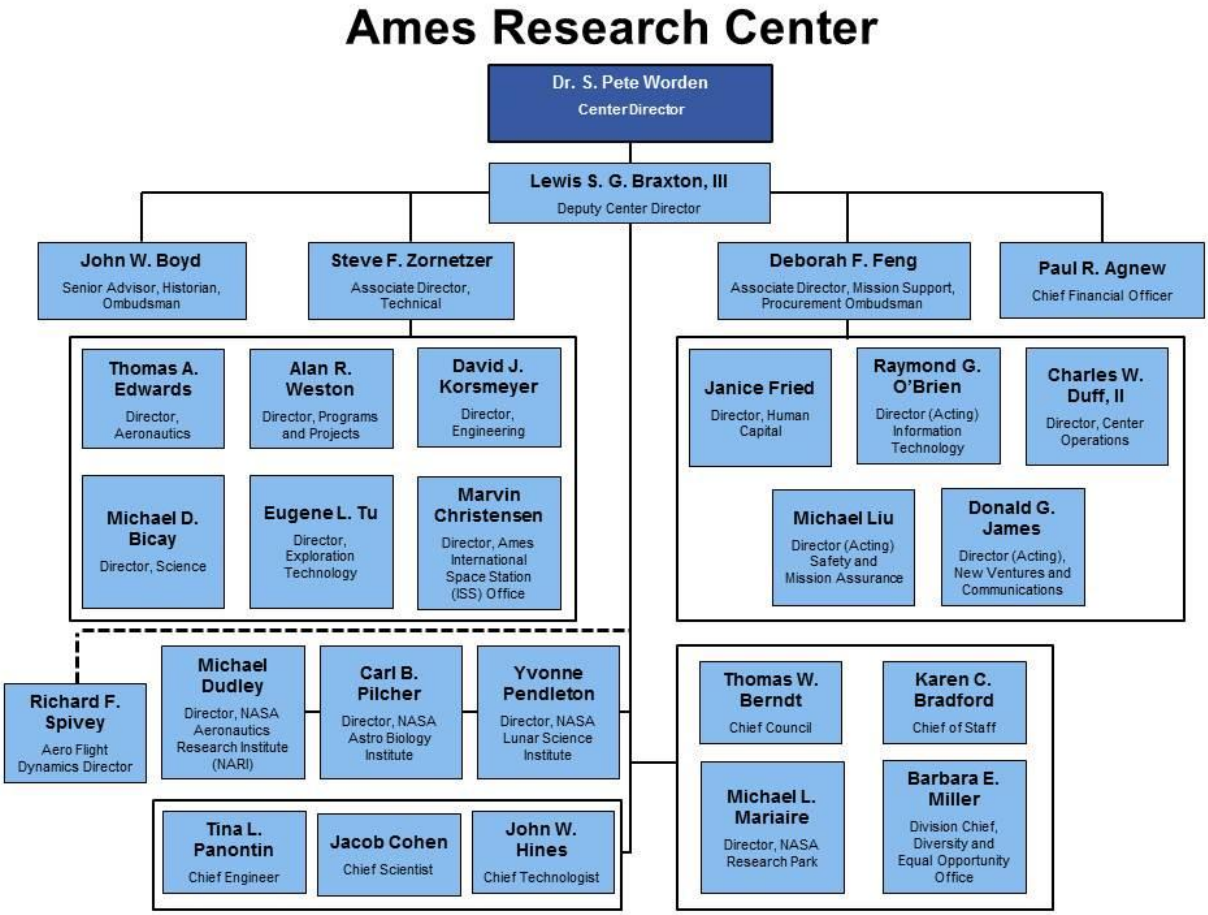


Figure 4.9.1-1: Ames Research Center Organizational Chart

WORKFORCE

ARC has an allocation of 1230 Full Time Equivalent (FTE) Civil Servants.

BUDGET EST. ($M)

President's FY13 Budget Request	FY2012	FY2013	FY2014	FY2015	FY2016	FY2017
Ames Research Center	$690.6	$710.6	$670.8	$648.0	$668.9	$773.9

Table 4.9.1-1: Ames Research Center Budget

CORE CAPABILITIES

To ensure the success of NASA's missions, NASA Ames applies core competencies in the following:

- Entry, Descent, and Landing Systems
- Advanced Computing and IT Systems
- Intelligent Human and Robotic Systems
- Air Traffic Management
- Aerosciences
- Astrobiology
- Space, Earth, and Life Science
- End-to-End Execution of Low-Cost Aerospace Missions
- Synthetic Biology

FUNCTIONS

Ames Research Center is organized into two major groups of directorates: technical and mission support.

NASA Ames promotes NASA's objectives in Aeronautics by providing concepts and technologies that make national impact on the efficiency and safety of flight. Ames enables NextGen through the development of air traffic control automation technology. Ames fosters the development of revolutionary aviation concepts such as electric aircraft and airships. Ames also provides national R&D capabilities in wind tunnel testing and flight simulation, and promotes aviation safety by developing intelligent systems to predict, detect, and diagnose hazards to aviation.

The Science Directorate conducts world-class space science, astrobiology, earth science, and biological research to achieve the strategic science goals of the Agency and performs technology development necessary to enable NASA's goals for long duration human exploration beyond low Earth orbit. The Exploration Technology Directorate's mission is to be world-class creators and facilitators of innovative, intelligent, high-performance, and reliable exploration technologies that will enable current and future NASA missions in space and aeronautics. The work focuses on advanced supercomputing (Ames has one of the fastest supercomputers in the world), human systems integration, intelligent systems, and entry systems.

The Programs and Projects Directorate designs and builds unique spacecraft and manages a diverse series of advanced projects. The focus is on technologies, subsystems, methodologies, and concepts for advanced space missions to lower the overall cost of scientific exploration, reduce the risks, reduce the time from commitment to flight, and provide test beds for advanced, new technologies and flight "heritage" for new spacecraft, launch systems, instruments, and components. Ames current and recently completed manifest includes: LCROSS (2009 mission identifying water ice at the south pole of the moon) and Kepler, as well as the major programs/projects listed below.

In addition, Ames hosts the NASA Astrobiology, Lunar Science, and Aeronautics Research Institutes—"virtual"

organizations created to establish (or re-establish) strong science and technology communities in their respective areas. The Institutes are pioneering new ways of connecting people separated by distance as well as disciplinary, organizational, and national boundaries in a cost-effective manner.

NASA Ames pioneers innovative tools, methods, and partnerships to bring NASA to more people, and specifically to engage students to pursue Science, Techonolgy, Engineering, and Mathematics [STEM] disciplines and careers. Ames uses social networking, internships, summer student programs, and special events and programs such as Yuri's Night, International Space University, the Mars Curiosity Landing, the transit of Venus, and The International Space Orchestra, for creative, high-impact experiences. In terms of outreach, Ames has undertaken a number of initiatives to engage new, diverse communities in NASA's exploration mission. Ames also supports educational excellence throughout 11 western states, and encourages students to engage in hands-on activities like robotics. More high school and college students choose to study at Ames than at any other NASA center.

Current Major Programs/Projects

Kepler: Launched in March 2009, the Kepler mission—NASA's first mission capable of finding Earth-size and smaller planets orbiting their parent stars—has identified more than 2,500 planet candidates. Of these, approximately 70 have been confirmed as planets by the Kepler science team and the broader science community. The mission's discoveries beyond our solar system include: the first unquestionably rocky planet, the first multiple-transiting planet system, the first small planet in the habitable zone, and the confirmation of a new class of double-star planetary systems. In April 2012, the mission was approved to continue the search through FY16.

SOFIA: The Stratospheric Observatory for Infrared Astronomy, a joint venture of the U.S. and German aerospace agencies, is the largest airborne observatory in the world. SOFIA studies the universe at infrared wavelengths, capable of making observations that are impossible for even the largest and highest ground-based telescopes.

LADEE: The Lunar Atmosphere and Dust Environment Explorer will orbit the moon to characterize its atmosphere and lunar dust environment. LADEE is scheduled to launch in 2013.

IRIS: The Interface Region Imaging Spectrograph will explore the solar chromospheres to provide greater understanding of energy transport into the solar wind. Led by the Lockheed Martin Advanced Technology Center, Ames will manage mission operations, flight operations, and ground systems activities. Ames' Multi-Mission Operations Center facility will be used for mission control. Launch is planned for February 2013.

RAVB: Rigid Airship Variable Buoyancy is a Department of Defense (DOD) project to demonstrate the concept and technology of airship buoyancy control through the compression of helium. This revolutionary approach, the first rigid airframe airship constructed in 80 years, has the potential to transform air transportation of cargo. Ames provides project management, systems engineering, structures, computational fluid

dynamics, and test support to DOD on this effort. The project is scheduled to be completed by the end of 2012.

PhoneSat: Ames has initiated the use of Smartphone technologies and components as the basis to construct and demonstrate the lowest cost and highest performance spacecraft ever flown. Ames has assembled and launched Phonesats which have the potential to transform the use of space from a hardware environment to a software (App)-based environment, just as the personal computer, Smartphone, and tablet have transformed mobile computing. This revolution promises to open up space weather, remote sensing, and space communications to new opportunities that will transform space debris management, Earth science and environmental monitoring, and space internet-based computational development.

IMPORTANT ACTIVITIES

International Collaborations: Ames leads the agency in proactively seeking international partners for cooperation and leveraging precious resources for space exploration. Ames currently also has technical collaboration agreements with Belgium, Canada, France, Italy, Japan, the Netherlands, Saudi Arabia, and the United Kingdom, and are in discussion with Sweden, Germany, and South Korea regarding additional collaboration efforts. Ames is currently exploring potential collaborations with the following 17 countries: Ireland, Poland, Lithuania, Switzerland, Czech Republic, Denmark, Australia, Bahamas, Trinidad and Tobago, Colombia, Ecuador, Peru, Mexico, Brazil, Argentina, Norway, and Belgium.

NASA Research Park: In its ninth year, with over 90 partners, NASA Research Park (NRP) at NASA Ames is a world-class, shared-use Research and Development (R&D) and education campus for industry, academia, non-profits, and government. The many universities located in the NRP, especially Carnegie Mellon University and Singularity University, not only have onsite degree programs, but are involved in assisting graduate students to develop new startups.

The NRP, with over 30 startup companies, continues to bring in new startups and universities into current facilities, while awaiting the construction of two large-scale campuses. In 2008, two separate leases were completed: the Google lease for their construction of 1.2 million square feet of new R&D and office facilities on 42 acres (to be built in 2013), and a consortium of universities called University Associates, led by the University of California for nearly three-million square feet of new R&D labs, classrooms, and onsite dormitory housing. These two new distinct campuses in the NRP will bring in thousands of predominantly young Google employees (with 20 percent of their time for their own research). The University Associates Campus is expected to dramatically expand the number of students and R&D employees onsite.

PREMIERE TEST AND EVALUATION CAPABILITIES

Arc Jets: In FY 2011, the Agency made the decision to consolidate the entry, descent, and landing testing activities from two Arc Jet facilities to one Arc Jet at Ames.

High-end Supercomputing: NASA's flagship Pleiades supercomputer is critical for the modeling, simulation, and analysis of a diverse set of agency projects in aeronautics research, Earth and space sciences, and the design and operation of future space-exploration vehicles. The

supercomputer is located at the NASA Advanced Supercomputing facility at Ames. Pleiades also plays a key role in producing high-fidelity simulations used for possible vehicle designs such as NASA's upcoming Space Launch System.

Wind Tunnels: Ames is home to the Unitary Plan Wind Tunnel Complex and the National Full-Scale Aerodynamics Complex (NFAC). The wind tunnel facilities offer a broad range of proven testing capabilities to customers from industry, DOD, other government agencies, and academia.

Vertical Motion Simulator: This facility provides researchers with exceptional tools to explore, define, and solve issues in both aircraft and spacecraft design. It offers fast and cost-effective solutions using real-time piloted simulation, realistic sensory cues, and the greatest motion range of any flight simulator in the world.

Affordable Small Spacecraft: Ames continues to build upon its success in developing architecture for low-cost missions with space platforms ranging from pico to micro satellites. The Ames approach combines using in-house resources and commercial off-the-shelf components and strategic partnerships to efficiently cover full mission life cycles, from proposal development to science data analysis.

Intelligent Robotics: NASA's exploration vision calls for closer cooperation between humans and robots than ever before. Creating robust robotic assistants, as well as making key spacecraft systems self sufficient, requires building systems that can adapt their behavior to environments that are complex, rapidly changing, and incompletely understood. Ames has unique expertise and agency leadership in applying autonomy to NASA missions, developing the individual technologies required, and integrating these pieces into autonomous systems for flight missions and terrestrial demonstrations. Areas of research and development include adaptive control technologies, control agent architectures, embedded decision systems, evolvable systems, intelligent robotics, adjustable autonomy, distributed and multi-agent systems, goal-level commanding, and planning and scheduling.

Aerosciences: In Aeronautics research, Ames continues to advance concepts and technologies for efficient national airspace operations, tools to analyze aviation data for safety, methodologies to improve human performance in the aviation system, and technologies to enable quieter and more capable rotorcraft.

Atmospheric Airborne Research: Ames leads the Agency in conducting scientific research on important environmental and climatic issues in stratospheric chemistry and ozone depletion, climatic changes due to clouds, aerosols, and greenhouse gases, stratosphere-troposphere exchange, and perturbations in the chemical composition of the troposphere. The center develops and deploys highly sensitive, state-of-the-art instruments to ground sites and on a variety of platforms including aircraft, balloons, unmanned aerial systems (UAS), and ships to make observations. Ames develops unique models of clouds, chemistry, dynamics, and radiative transfer processes to understand controlling mechanisms and performs experiments to advance and understand the detailed dynamic chemical interactions in the stratosphere.

NASA's Sustainability Base is unlike any other government building ever created. Dedicated in 2012, and using NASA

innovations originally engineered for space travel and exploration, the 50,000-square-foot, lunar-shaped Sustainability Base at Ames is simultaneously a working office space, a showcase for NASA technology, and an evolving exemplar for the future of buildings. Sustainability Base was awarded LEED platinum certification in April 2012.

MAJOR ISSUES

Aging Workforce: Ames has been targeted with civil servant reductions for the past 20 years. Currently, 52 is the average age of an Ames civil servant. The average age at other NASA centers is 47 to 49. Ames is known for innovation, but the inability to have a blended demographic makes it more difficult for the center to address complex problems and enact innovative solutions.

Facilities: There is a limited budget to perform a managed replacement program for the aging/beyond service life equipment throughout the infrastructure systems at Ames. The annual planned repair budget of $750,000 is insufficient to replace all of the presently obsolete systems.

KEY PERSONNEL

Dr. Simon P. Worden (Brig. Gen., USAF, ret.) is the Director of NASA Ames Research Center. Prior positions for Worden include: Research Professor of Astronomy, Optical Sciences and Planetary Sciences at the University of Arizona; Director of Development and Transformation, Space and Missile Systems Center, Air Force Space Command; Consultant to the Defense Advanced Research Projects Agency (DARPA) on space related issues; Congressional Fellow with the Office of Senator Sam Brownback as advisor on NASA and space issues; Staff officer for the President's National Space Council. Worden spearheaded efforts to revitalize U.S. civil space exploration and earth monitoring systems. He has authored or co-authored more than 150 scientific technical papers in astrophysics, space sciences, and strategic studies, served as a scientific co-investigator for two NASA space science missions and is a recognized expert on space issues – both civil and military. Worden retired in 2004 after 29 years of active service in the United States Air Force.

Lewis S.G. Braxton III is the Deputy Director of NASA Ames Research Center. He holds a Bachelor of Science degree in accounting from California State University, Fresno, a degree in general management from the Harvard Graduate School of Business, and has been recognized by NASA for his management and service excellence. He also has a Meritorious Presidential Rank Award (2007). Braxton has served as the NASA Ames' Chief Financial Officer and the Director for Center Operations. He has also qualified as a Certified Government Financial Manager (CGFM) through the Association of Government Accountants and maintains the certification. Awards Braxton has received include NASA's Exceptional Service Award in 1998 and a NASA Group Achievement Award for his involvement with the Dryden Separation Team in 1996. In 1995, Braxton received the NASA CFO Award for development and presentation of the Agency's Financial Management Crosscutting Report. He has been recognized in numerous group achievement awards and for his contributions to the Ames African-American Advisory Group. In 2011, he served as acting Associate Administrator for the Mission Support Directorate at NASA Headquarters before returning to Ames as Center Deputy Director.

Dr. Steven F. Zornetzer is the Associate Center Director, Technical, at NASA Ames Research Center. He is an internationally recognized leader in neuroscience and revolutionary, information technology-based applications to aerospace and space exploration missions. The breadth of his expertise ranges from basic research in cognitive, perceptual, and neural sciences to applied research in integrative biology, biological information processing, molecular biology, genetic engineering, and biomedical science. He plans, directs, and coordinates the technology, science, development, and operational activities for research and advanced technology across a broad spectrum of research and development including information technology. Zornetzer was recognized for his contributions to NASA by receiving the Presidential Meritorious Rank Award in 2001 from President Bush. He has over 80 journal publications and has published three books.

Deborah F. Feng is the Associate Director for Mission Support. Feng has over 20 years of experience in various critical positions at Ames, including Center Operations Director, Deputy Director of New Ventures and Communications, Deputy Chief Financial Officer, and Associate Director for Research and Development Services. She has a vast amount of technical and operational experience and spent the majority of the first part of her career as a financial analyst, both for Ames and the private sector. Feng has a Bachelor of Science degree in Mass Communications from the University of California, Berkeley and earned her Masters of Science degree in Business Administration from San Jose State University.

Jack Boyd serves as Senior Advisor to the Center Director, the Senior Advisor for History and the Center Ombuds. Jack started at Ames in 1947, when it was the Ames Aeronautical Laboratory and still part of the National Advisory Committee for Aeronautics (NACA). He has served as Executive Assistant to the Ames Center Director, Deputy Director of Dryden Flight Research Center, Deputy and Associate Director of Ames Research Center, and Associate Administrator for Management at NASA Headquarters. Additionally, he has served as Chancellor for Research for the University of Texas System. His many awards include the Stanford Sloan Fellowship, the NASA Exceptional Service Award, the NASA Outstanding Leadership Award, the Presidential Rank of Meritorious Executive, the NASA Distinguished Service Medal, the Army Command Medal, and the NASA Headquarters History Award. He is also a Fellow of the American Institute of Aeronautics and Astronautics (AIAA) and is a member of the Academy of Engineering Excellence at Virginia Tech.

In 2003, Boyd retired from the Ames Director's Office to two full-time jobs. As Center Ombuds, he hears privately about problems and tries to illuminate how the problem can be solved within the Ames culture. As Senior Advisor for History, he continues to lecture frequently about the Ames culture and how its leadership has evolved to fit the needs of the time. He returned to the Director's Office as Senior Advisor in 2006 and is currently a Principal Scientist at University of California Santa Cruz with an IPA to NASA Ames.

4.9.2 DRYDEN FLIGHT RESEARCH CENTER (DFRC)

MISSION STATEMENT

Advancing technology and science through flight. The Dryden Flight Research Center (DFRC), located at Edwards Air Force Base, California, performs flight research and technology integration to revolutionize aviation and pioneer aerospace technology; validates space exploration concepts; conducts airborne remote sensing and science missions; enables airborne astrophysics observation missions to discover the origin, structure, evolution, and destiny of the universe; and supports operations of the Space Shuttle and the International Space Station for NASA and the Nation. Dryden supports activities in all four of NASA's Mission Directorates.

ORGANIZATIONAL STRUCTURE

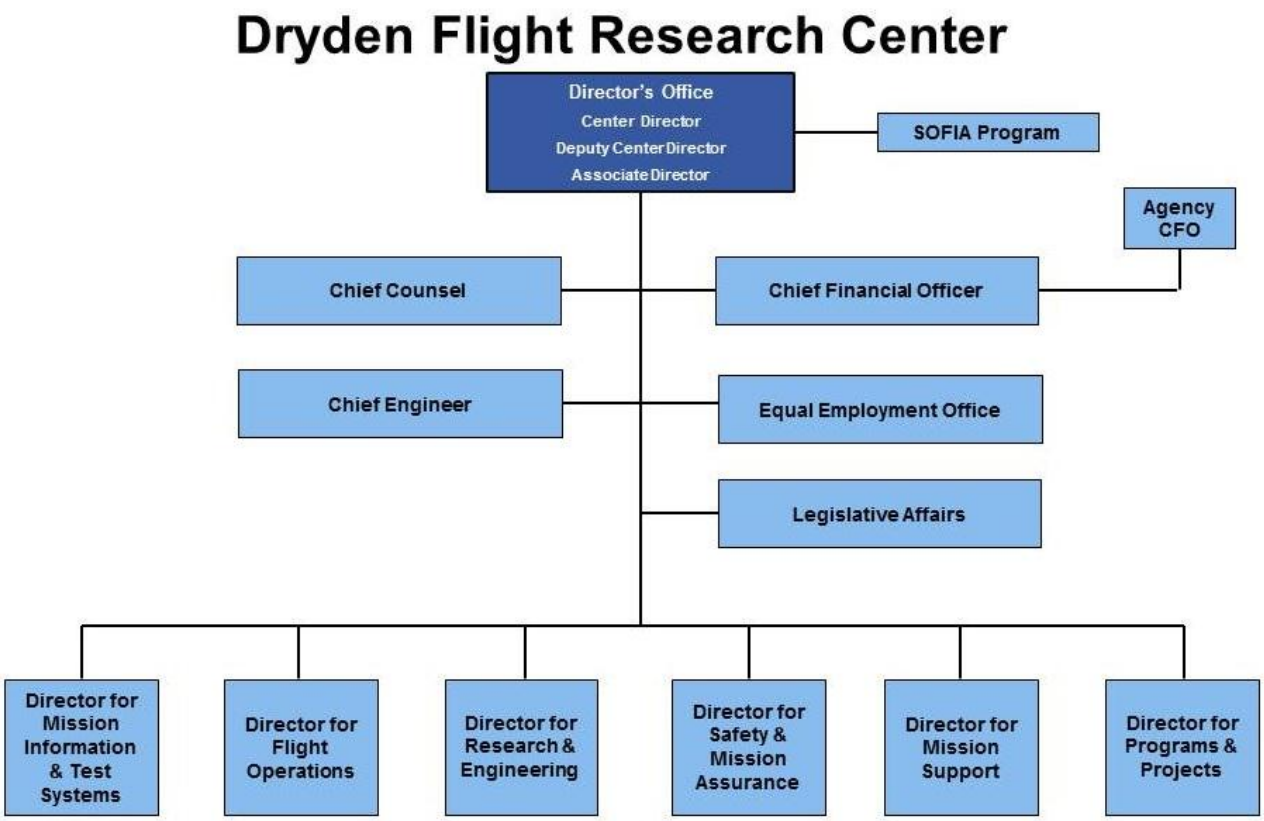


Figure 4.9.2-1: DFRC Organizational Structure

The Dryden Flight Research Center is NASA's primary center for atmospheric flight research and operations. Dryden is critical in carrying out the Agency's missions of space exploration, space operations, scientific discovery, and aeronautical research and development. Located at Edwards, California, in the western Mojave Desert, Dryden is uniquely situated to take advantage of the excellent year-round flying weather, remote area with the country's only overland supersonic corridor, and visibility to test some of the nation's most advanced and high-risk air vehicles.

For over 60 years, projects at Dryden have led to major advancements in the design and capabilities of many state-of-the-art civilian and military aircraft. The newest, the fastest, and the highest – from human powered to rocket powered – all have made their debut in the vast, clear desert skies over Dryden. Dryden Flight Research Center plays a vital role in advancing technology and science through flight. Here, we demonstrate America's leadership in aeronautics and space technology as we continue to push the envelope to revolutionize aviation and pioneer aerospace technology.

WORKFORCE

DFRC's workforce distribution:

- Allocation of Full Time Equivalent (FTE) Civil Servants = 555.0
- Contractors (Work Year Equivalents) = 620

BUDGET EST. ($M)

President's FY14 Budget Request	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017
Dryden Flight Research Center	$260.8	$256.1	$241.6	$263.7	$245.7	$241.8

Table 4.9.2-1: Dryden Flight Research Center's Budget Runout Estimates

CORE CAPABILITIES

Dryden Flight Research Center maintains a core competency for the Agency of atmospheric flight research and test. The conduct of atmospheric flight research and test requires expertise in 1) flight safety and risk management; 2) flight project and mission management; 3) flight research technology; 4) flight test operations; and 5) experimental aircraft - piloted and unpiloted.

To maintain atmospheric flight research and test as an Agency competency, the center utilizes a system-of-systems approach to flight test with experienced flight operations and engineering staff, experimental and testbed aircraft, unmanned aircraft systems, airborne science platforms, range and aircraft test facilities.

FUNCTIONS

Dryden Flight Research Center has been NASA's primary installation for flight research for more than six decades. Dryden is chartered to conceive and conduct experimental flight research and test for advanced aeronautical and aerospace configurations. The center also provides a very flexible and efficient science platform capability.

IMPORTANT ACTIVITIES

In support of NASA's Aeronautics Research Mission Directorate (ARMD) and in partnership with the FAA, DOD, and industry, Dryden is managing the technology development for Unmanned Aeronautical Systems integration into the National Airspace System (UAS in the NAS), is managing research aircraft in the development of new environmentally responsible technologies, and supporting the demonstration of new Aviation Safety technologies.

In support of the commercialization of space services and human exploration in NASA's Human Exploration and Operations Directorate (HEOMD), Dryden Flight Research Center supports the development of U.S. commercial space developers and is supporting the atmospheric flight test for the Dreamchaser vehicle. Also, in partnership with Johnson Space Center, Dryden supports the development and atmospheric testing of NASA's Multi-purpose Crew Exploration Vehicle (MPCV).

In support of NASA's Space Technology Program and Office of Chief Technologist, Dryden manages the Flight Opportunities Program designed to create multiple paths through which innovative space technologies may be matured from concept to flight. The program supports the evolving entrepreneurial commercial space industry in the development of commercial vehicles and also facilitates access to a simulated space environment for technology development.

In support of NASA's Science Mission Directorate (SMD), astrophysics, and space science discovery, Dryden Flight Research Center, in partnership with Ames Research Center and the German Aerospace Center (DLR), is managing the SOFIA (Stratospheric Observatory for Infrared Astronomy) program — a flying observatory with a telescope onboard a 747 aircraft — completing modifications for initial science capability science mission operations. New galactic discoveries have already been accomplished with this new capability.

In support of NASA's Science Mission Directorate (SMD), Dryden Flight Research Center is managing a fleet of Earth Science platforms (including Global Hawks, DC-8, ER-2s, C-20, and others) to provide in-situ atmospheric measurements in support of atmospheric sensor developments, support for new large scale atmospheric process studies, and support for advanced use of satellite data.

MAJOR ISSUES

Long-term Dryden roles have not been well defined in support of NASA's efforts toward space exploration. Dryden Center management is working with each mission directorate management to address future center roles.

Lack of systems level flight demonstration activity in Aeronautics Research Mission Directorate (ARMD) is a challenge for NASA's atmospheric flight research and test competency. Alternative aeronautics research management models have been proposed to ARMD.

Center management and operations burden is a continuing challenge for small center operations.

KEY PERSONNEL

David McBride is Director of NASA Dryden Flight Research Center. Prior management assignments include: Deputy Center Director, Flight Research Center Associate Director for Programs and Mission Director for Planning and Business Development; Project Manager

of the Agency's Vehicle System Program, Flight & Systems Demonstration project; and Program Manager for the Agency's Flight Research Program. McBride's prior technical assignments include Chief Engineer for the X-33 Extended Test Range, and lead Flight Systems engineer for the X-31 and X-29 Programs. McBride received a Bachelor of Science degree in Electrical Engineering from the University of New Mexico in 1985 and an Executive Master of Business Administration from the University of New Mexico in 1998.

Patrick Stoliker is the Deputy Director of NASA Dryden Flight Research Center. Prior assignments include: Acting Associate Director for Operations, Deputy Associate Director for Operations, Director for Research and Engineering, Assistant Director for Programs and Projects, Associate Director of Research Engineering, Project Manager of the Dryden implementation of the Integrated Financial Management Program, and Chief of the Controls and Dynamics Branch. Stoliker's prior technical assignments include Chief Engineer for the Digital Flight Control System upgrade for F-16XL, principal investigator for flight testing the JAS 39 control stick, and chair of the X-43 and X-38 flight readiness reviews. Stoliker earned a Bachelor of Science degree in Aerospace Engineering from the University of Southern California in 1978 and a Master of Science in Aeronautics and Astronautics from Stanford University in 1979.

Vince Chacon is Associate Director of NASA Dryden Flight Research Center. Prior assignments include: Director of Safety and Mission Assurance, Associate Director for Business Systems, Deputy Director for Research Systems, Chief of the Systems Engineering Branch, and Chief of the Flight Systems Branch. Chacon's prior technical assignments include: Chief Engineer for the Landing Systems Research Aircraft and Lead Systems Integration Engineer for the High Alpha Research Vehicle and the X-29 Forward Swept Wing Vehicle. Chacon earned a Bachelor of Science degree in Electrical Engineering from the University of New Mexico in 1970 and a Master of Science in Systems Design and Management from the Massachusetts Institute of Technology in 2003.

4.9.3 JOHN H. GLENN RESEARCH CENTER (GRC)

MISSION STATEMENT

In support of the Agency's mission, the NASA Glenn Research Center (GRC) drives research, technology, and systems to advance aviation, enable exploration of the universe, and improve life on Earth. The NASA Glenn Research Center (GRC) at Lewis Field develops critical space flight systems and technologies to advance the exploration of our solar system and beyond while maintaining leadership in aeronautics. In partnership with U.S. industries, universities, and other government institutions, research and development efforts focus on advancements in propulsion, power, communications, nuclear, and human-related aerospace systems.

ORGANIZATIONAL STRUCTURE

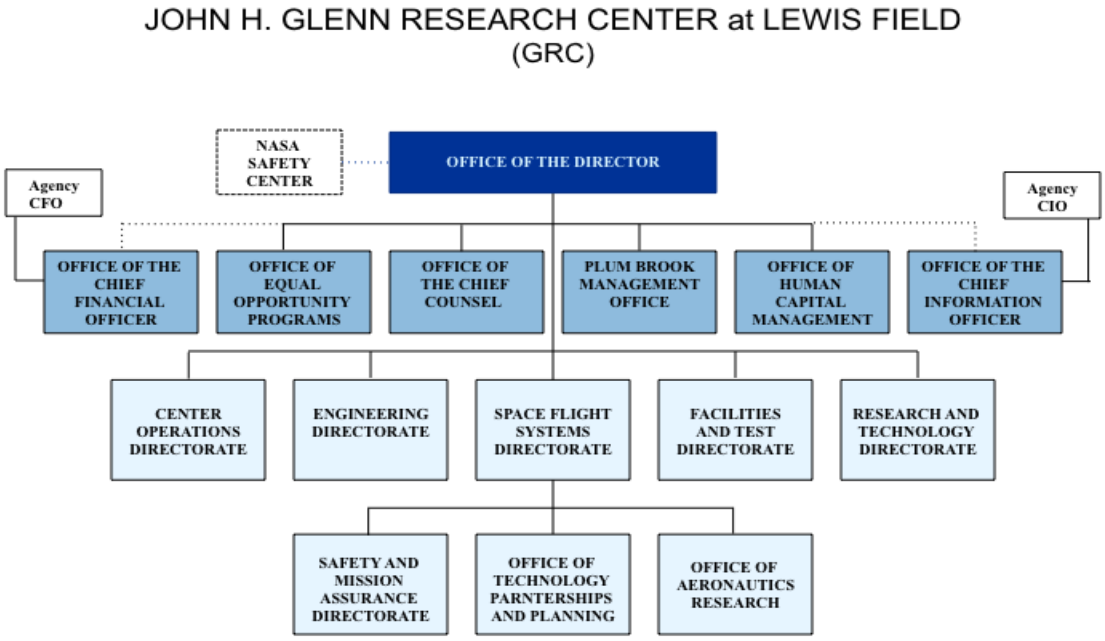


Figure 4.9.3-1: GRC Organizational Structure

The John H. Glenn Research Center (GRC) at Lewis Field was established in 1941 as the Aircraft Engine Research Laboratory of the National Advisory Committee for Aeronautics (NACA). It was later renamed the Lewis Research Center in honor of the late George Lewis, NACA's Director of Aeronautical Research. The name was then changed in 1999 to honor Ohio Senator John H. Glenn, the first American to orbit the Earth. The GRC scientists and engineers pioneered the use of liquid hydrogen for aircraft and rocket propulsion in the 1940s and 1950s, which eventually led to U.S. leadership in the development of the highly successful Centaur upper stage with its liquid-hydrogen-fueled RL–10 engines. Centaur, the Nation's highest performing and most used upper stage, has launched spacecraft to Earth orbit, the moon, the planets (Voyager, Pioneer, Viking, and

Cassini missions), and beyond for over 40 years. In addition, GRC designed the largest power system ever deployed in space. The technology was transferred to industry and built for the International Space Station (ISS). For aeronautics, GRC develops advanced technologies such as ultra-low-emission combustors, chevron nozzles, and aspirated fans to improve the performance of and reduce emissions and noise from aircraft engines. The GRC's work enabled the development of the GE90 jet engine, the world's most powerful aircraft engine, which powers the Boeing 777. Over the last 35 years, the maximum thrust of commercial aircraft engines has been increased from 40,000 lbf to over 100,000 lbf, while specific fuel consumption at cruise has been significantly decreased. The GRC research and development has played an important role in these advancements.

WORKFORCE

GRC's workforce distribution:

- Allocation of Full Time Equivalent (FTE) Civil Servants = 1,652.0
- Contractors (Work Year Equivalents) = 1,632

BUDGET EST. ($M)

President's FY13 Budget Request	FY 2013	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017
Glenn Research Center	$641.3	$658.4	$668.3	$661.2	$649.9	$622.5

Table 4.9.3-1: Glenn Research Center's Budget Runout Estimates

CORE CAPABILITIES

The GRC has many technical and institutional competencies. The six core competencies approved by the center and described in this section are critical to the health and future of the center. Glenn's core competencies and mission-enabling capabilities are integral parts of the Agency capability portfolio that supports NASA's strategic plan and missions.

Air-Breathing Propulsion includes revolutionary concepts, technologies, and new systems aimed at significantly advancing air-breathing propulsion for aerospace vehicles that enable reduced energy consumption, use of alternative energy sources, reduced noise and emissions, increased versatility, improved safety of operations, faster modes of air transportation, and reduced costs for aerospace travel.

Communications Technology and Development includes research, development, demonstration, and infusion for advanced communications to enable order-of-magnitude increases in mission data transfer and continuous, cost-effective, and secure high-data-rate communications.

In-Space Propulsion and Cryogenic Fluids Management includes the research, technology development, technology demonstration, and flight development of components, subsystems, and systems for spacecraft propulsion systems, propulsion stages, and cryogenic fluid flight systems to enable new mission capability; increased reliability, safety, and affordability; and reduced trip times.

Power, Energy Storage, and Conversion includes the research, development, demonstration, and application of new technologies, subsystems, and systems for power generation; energy conversion and storage; and power management and distribution from concept to flight.

Materials and Structures for Extreme Environments includes the research, development, demonstration, and application of advanced materials, structures, and mechanisms to enable high-performance, long-life aerospace systems subjected to the extreme environments encountered in aircraft engines, space propulsion systems, planetary reentry, planetary surface operations, and long-duration space travel.

Physical Sciences and Biomedical Technologies in Space includes the research, development, demonstration, and flight of advanced physical and biomedical systems to enable sustainable exploration of space with enhanced safety, extended mission duration, and reduced deleterious effects of space.

FUNCTIONS

ENGINEERING DIRECTORATE

The Engineering Directorate provides a full range of integrated engineering services, including concept exploration and requirements development, preliminary design, detailed design, development, manufacturing, test, verification, certification, flight/ mission sustainment, and disposal. The directorate also provides full engineering support through teams or individuals for Research, Technology, Facility, and Test needs. The Director of Engineering serves as the engineering technical authority agent for the Center Director to implement NASA governance engineering checks and balances.

FACILITIES AND TEST DIRECTORATE

The Facilities and Test Directorate provides management of all institutional and test facilities, systems, and infrastructure for NASA, the Glenn community, and outside industry. Services include engineering and design, systems operation, project management, technician support, construction management, and quality assurance

PLUM BROOK MANAGEMENT OFFICE

The Plum Brook Management Office provides unique world-class test facilities, which are available for use by NASA, other governmental agencies, and the private sector. In addition, they provide full service facility and test system preparation for complex and innovative research and flight programs. Facilities can simulate the conditions of the upper atmosphere, deep space, planetary and lunar environments, and cryogenics.

SPACE FLIGHT DIRECTORATE

The Space Flight Directorate manages the planning, formulation, and implementation of flight systems, ground systems, and the development of technologies in support of NASA's space flight missions. In addition, negotiates program, project, and task commitments with the appropriate mission directorates and program/ project offices, and manages the implementation of those commitments via other GRC organizations, other NASA centers, and contractors.

AERONAUTICS RESEARCH OFFICE

The Aeronautics Research Office serves as the focal point for aeronautics research at NASA Glenn Research Center and provides project

management, leadership, and oversight in support of the Aeronautics Research Mission Directorate (ARMD). It has responsibility for integrating requirements, representing aeronautics research, advocating, negotiating for support, and communications across the center and between the center and customers. Also, the office serves as the formal Center Point of Contact (POC) between NASA Headquarters' Aeronautics Mission Directorate and the Glenn Research Center.

The office ensures successful execution of the aeronautics research projects by working closely with other Directorates and Offices at NASA Glenn Research Center, other NASA centers, academia, other government agencies, and industry.

Safety and Mission Assurance Directorate

The Safety and Mission Assurance (SMA) Directorate ensures a safe, healthful, and protective environment for the GRC community and enables the mission success of our programs and projects.

Research and Technology Directorate

The Research and Technology Directorate contains, directs, and maintains the core research and technology capabilities at the center. In addition, executes research and technology development activities in support of NASA missions as well as project management for aeronautics research programs. Research and development activities are conducted using in-house facilities and in partnership with industry, universities, other NASA centers, and other government agencies.

NASA Safety Center

The NASA Safety Center provides Agency-wide services to the SMA community, the NASA management team, and NASA employees in four key areas: Technical Excellence for the SMA Community; Knowledge Management, Capture, and Dissemination; Audits and Assessments; and Mishap Investigation Support.

The center plans, organizes, and directs the activities required to strategically manage the services provided in most efficient, effective, and user-friendly way possible. In addition, it utilizes in-house expertise and partnerships with industry, universities, and other agencies to advance NASA's safety mission.

Important Activities

The GRC has roles in all of NASA's missions:

Human Exploration & Operations

- Co-manage, with Johnson Space Center, the Crew & Service Module for the Orion Multi-Purpose Crew Vehicle and International cooperation on European Service Module
- Environmental testing at Plum Brook Station for Orion and Commercial Space Program
- Lead payload shroud/fairing element of Space Launch System
- Develop and operate microgravity fluids and combustion experiments on the Space Station
- Space Station electrical power system; sustainment and upgrade
- Agency lead for radio frequency (RF) spectrum management
- Development of advanced RF space communication system technologies
- Operation of the Space Communication and Navigation Testbed on Space Station

- Human Research Program: Human Health and Exploration Medical Capability
- Lead advanced modular power system technology development
- Lead Spacecraft Fire Safety demonstration project

SCIENCE

- Lead Radioisotope Power Systems program
- Lead Advanced Power System development for solar system exploration
- Management of the In-Space Propulsion Technology Program
- Extreme environment testing facilities for solar system exploration

SPACE TECHNOLOGY

- Lead cryogenic propellant storage and transfer technology flight demonstration project
- Lead high performance Solar Electric Propulsion capability development
- Lead fission power technology project
- Lead in-space propulsion technology development
- Lead space power systems project
- Lead Manufacturing Innovation project

AERONAUTICS

- Provides technical and project management leadership in propulsion and high temperature materials, instrumentation and dynamic controls, acoustic research, revolutionary technologies, and aircraft concepts for the Fundamental Aeronautics Program. Serves as Host Center for the Fixed Wing Project.
- Provides project management leadership and center researchers for tools, methods, concepts, and technologies to improve overall aircraft safety of current and future aircraft Aviation Safety Program. Serves as the Host Center for the Atmospheric Environment Safety Technologies Project.
- Provides technical and project management leadership to conduct research at an integrated system level on promising propulsion and communication concepts and technologies and demonstrate the benefits in a relevant environment for the Integrated Systems Research Program. Manages the propulsion element under the Environmentally Responsible Aviation Project and the communication element for the Unmanned Aircraft Systems Integration in the National Airspace System Project.
- Under the Aeronautics Test Program investment, ensures GRC's facilities are strategically aligned to critical needs for national priorities. Develops innovative test methods.

TECHNOLOGY

- Lead seven technology research, development, and demonstration areas, including cryogenic propellant storage and transfer, solar electric propulsion, nanotechnology, and energy storage systems.
- Lead the new NASA Space Technology Research Grants Program, which includes fellowships for over 100 graduate students performing aerospace technology research.

MAJOR ISSUES

UNRESOLVABLE REQUIREMENTS

NASA's workforce must increase the number of people with experienced and critical skills to meet the challenge of the center's responsibilities within NASA, specifically to fill skill gaps in areas like systems engineering and software. At the same time, the center needs to increase the number of early career hires to assure succession plans can be met. Unfortunately, the size of the Glenn workforce is capped, thus limiting the ability to achieve these increases.

CURRENT MITIGATION STRATEGIES

The GRC is giving priority to meeting near-term milestones while the Agency constrains its overall hiring. It is also considering buyouts to increase attrition. Finally, GRC is slightly reducing the number of co-op students in our pipeline so as to make room for early career (recent graduate) hires. The GRC is also managing all hiring decisions at the Center Director level, using dynamic prioritization processes.

CENTER MANAGEMENT AND OPERATIONS BUDGET (CM&O)

The various services funded by the CM&O budget are critical to sustain a viable infrastructure and ensure the institutional capabilities are available to support the Aeronautics, Science, Space Flight, and Space Technology programs that are a part of GRC's roles/ mission. This has become increasingly difficult during this planning, programming, budget, and execution (PPBE) cycle as the requirements for CM&O services remains steady in a declining budget environment.

The CM&O budget has been reduced by over 19 percent since 2009, either during the formulation or execution phases of the budget process. Every year, the center scrutinizes each functional area and has continually reduced services attempting to retain the services required for programs (with minimum risk) and safely operate the center. However, in order to stay within the PPBE14 guidelines, drastic reductions will have to be implemented, incorporating significant risk to the center's infrastructure and ability to support the programs.

CURRENT MITIGATION STRATEGIES

A flat CM&O budget profile results in increasing reductions to the non-labor funding as civil servant salaries grow with inflation. The FTE reduction proposed for CM&O was re-directed to procurements but is not sufficient to offset the magnitude of the reductions. A large portion of the CM&O budget is contractor workforce and to get within the guidelines will require significant contractor layoffs.

The CM&O reductions taken in FY11 (10 percent of the contractor workforce and 8 percent of purchases) were assumed to

continue in the out years. The center continues to pursue alternative ways to deliver services in order to reduce operating costs and looks for opportunities to find more efficient and less costly ways to operate. The reductions necessary to stay within guideline may also result in operating savings, which will continue to be reviewed every year.

KEY PERSONNEL

Ramon (Ray) Lugo III, Director, manages a workforce of approximately 1,628 civil service employees that are supported by 1,632 contractors, and a complex with 24 major facilities and over 500 specialized research facilities located at the 350-acre Cleveland site and the 6,500-acre Plum Brook Station site in Sandusky, OH. Prior to this position, Lugo served as the deputy center director for GRC where he shared with the center director responsibility for planning, organizing, and directing the activities required in accomplishing the missions assigned to GRC. Prior to coming to GRC, he served as the deputy program manager of the Launch Services Program at Kennedy Space Center (KSC) and was principally responsible for managing, directing, and evaluating the progress of all ongoing launch operations and activities including Expendable Launch Vehicles engineering and analysis, payload integration, launch site support, and campaigns. He began his NASA career at KSC in 1975 as a co-operative education student, and his first assignment was in the Construction and Modifications Branch as an engineer responsible for construction modifications to Launch Complex 39A in preparation for the first space shuttle launch. Since becoming a member of the Senior Executive Service in 2001, Lugo served as the executive director of the Cape Canaveral Spaceport Management Office. Other leadership positions include director and deputy director of Expendable Launch Vehicle Services, manager of Facilities and Support Equipment Division in the Space Station Project Office, and chief of the Business Office of the Joint Performance Management Office. He earned a Bachelor of Science degree in Engineering in 1979 from the University of Central Florida and a Master of Science degree in Engineering Management in 1982 from the Florida Institute of Technology.

James M. Free, Deputy Director, shares with the center director the responsibility for planning, organizing, and directing the activities required in accomplishing the missions assigned to GRC. Prior to becoming the deputy director, Free served as the director of Space Flight Systems Directorate at GRC and was responsible for overseeing the management of GRC's activities that included significant roles in the Agency's Constellation, Space Shuttle, International Space Station, Space Communications, Human Research and Science Programs. He served as chief of GRC's Orion Projects Office, where he had responsibility for all Orion-related work at GRC. This included Orion service module design and development requirements management, Space Environmental Test Project for Orion qualification testing, and low-impact docking system seal development. His technical expertise and leadership capabilities were further demonstrated as the Orion test and verification manager at NASA Johnson Space Center in Houston, TX, where he was responsible for the planning and execution of all verification activities supporting the development of NASA's next-generation human space vehicle. He also served as the Orion service module manager at GRC and was responsible for the technical, cost, and schedule performance for the development, production, test, and flight operations of the Orion Service Module. Free joined GRC in 1999; his first assignment was as the ISS liaison for the Fluids and Combustion Facility.

He also led the development of electric actuation technologies for NASA's Next Generation Launch Technology Project. Free then served as the launch vehicle manager and autonomous rendezvous and docking manager for the Prometheus spacecraft and as the Lox methane project manager.

Free began his career at NASA's Goddard Space Flight Center in Greenbelt, MD as a propulsion engineer and later as a systems engineer on NASA's Tracking and Data Relay Satellites. He worked on the first in-house spacecraft propulsion system built for the Tropical Rainfall Measuring Mission.

Free earned his Bachelor's degree in Aeronautics from Miami University in Oxford, OH and his Master's degree in Space Systems Engineering from Delft University of Technology in the Netherlands.

Janet L. Watkins, Associate Director, is responsible for the overall management of the institutional operations for GRC and provides the coordination and integration of institutional activities which cross directorate organizations. She serves as GRC's focal point for all institutional functions and coordinates the consideration and evaluation of means to improve the efficiency and effectiveness of the services provided by the institutional organizations at the center. Prior to coming to GRC, Watkins served as the technical expert/in-sourcing and acting deputy director, Manpower, Personnel and Services at Wright Patterson Air Force Base in Dayton, OH, and as the organization division chief of Manpower, Personnel and Resources Directorate, United States Air Force (USAF) Headquarters at the Pentagon. Watkins held a number of increasingly responsible management positions for the USAF. Watkins holds a Bachelor's degree in Business Administration and Management from Wright State University in Fairborn, OH, and a Master's degree in Public Administration from Central Michigan University.

4.9.4 GODDARD SPACE FLIGHT CENTER (GSFC)

MISSION STATEMENT

The people of Goddard Space Flight Center (GSFC), located in Greenbelt, MD, expand the knowledge of Earth and its environment, the solar system, and the universe by enabling and analyzing observations from space. The center also conducts scientific investigations, develops and operates space systems, maintains the networks that support space and ground communications, and advances essential technologies.

ORGANIZATIONAL STRUCTURE

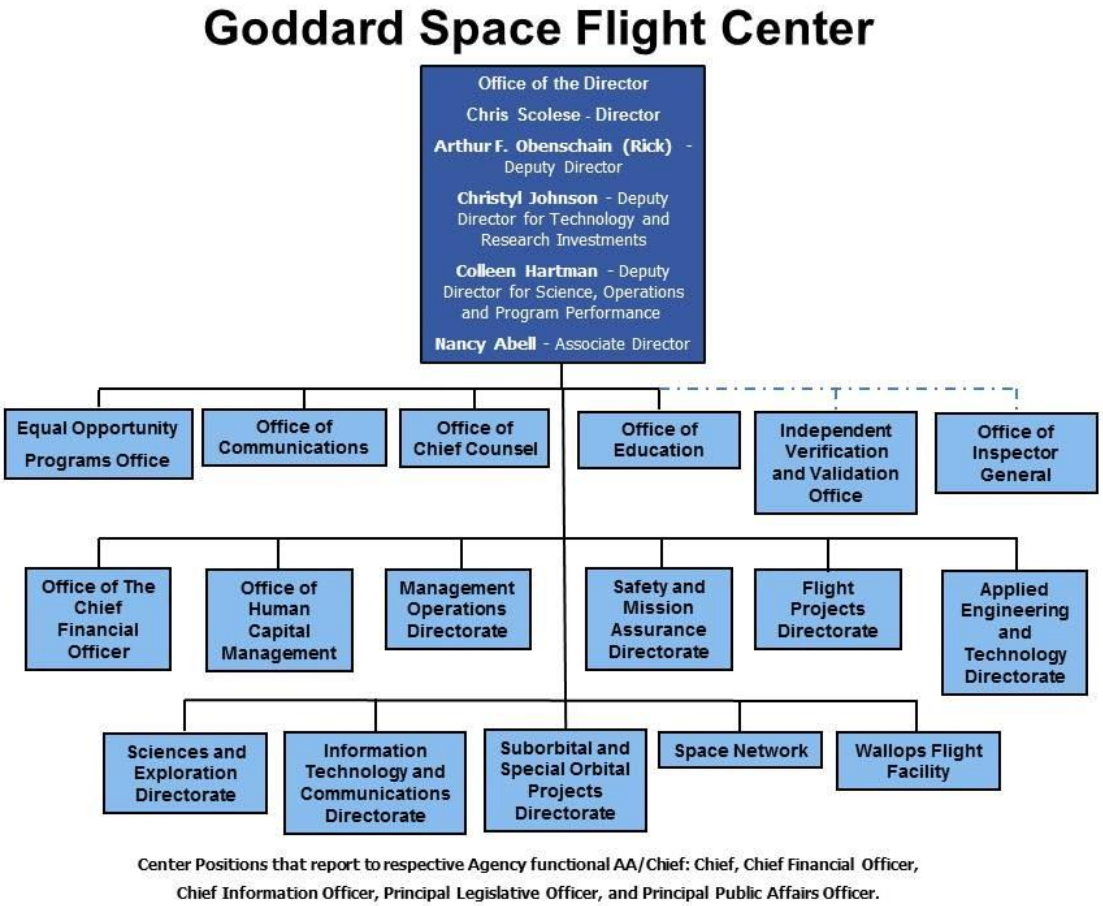


Figure 4.9.4-1: GSFC Organizational Chart

WORKFORCE

GSFC's workforce distribution:

- Total Allocation of Full Time Equivalent (FTE) Civil Servants = 3,392.0
- Contractors (Work Year Equivalents) = 6,515.0

BUDGET EST. ($M)

President's Budget Request	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017
Goddard Space Flight Center	$3246.2	$2963.6	$2832.3	$2671.2	$2377.5	$2179.0

Table 4.9.4-1: Goddard Space Flight Center's Budget Runout Estimates

CORE CAPABILITIES

Core capabilities are in the areas of Earth and space science, engineering and technology development, and project and program management. The center's work entails design, development and implementation of sensors, instruments and flight missions investigating phenomena across the electromagnetic spectrum and inclusive of other planets, as well as astronomical phenomena. Goddard has supplied more instruments for the study of Mars than any other institution in the world. Goddard is the only NASA center whose work and employees garnered a Nobel Prize in Physics.

The center also oversees studies of the Earth's atmospheric, oceanographic, cryospheric, hydrological, geologic, and biogeochemical cycles to understand the Earth as a system, and application of this understanding to the study of the nature and evolution of other planets, as well as application of discoveries from this study of other planets to an improved understanding of Earth. Theoretical research, analysis, modeling, and simulations are performed to develop and test theories and synthesize data from space missions and ground-based observations. The center's assigned roles include management of NASA's spaceflight tracking, data acquisition, communications, and data handling networks in support of NASA and other spacecraft.

Within the next two years, Goddard's expertise in end-to-end systems will be demonstrated through the launch of two major in-house built missions: the Global Precipitation Measurement (GPM) mission, which will provide next-generation observations of rain and snow worldwide every three hours; and the Magnetospheric Multiscale (MMS) mission, comprised of four identically instrumented spacecraft that will study the microphysics of three fundamental plasma processes: magnetic reconnection, energetic particle acceleration, and turbulence.

Goddard is also managing the Agency's flagship Astrophysics mission, the James Webb Space Telescope, which will build on the legacy of the Hubble Space Telescope and allow scientists to peer back to the very beginning of the universe. In Earth Science, in early 2013, Goddard will launch the Landsat Data Continuity Mission (LDCM). The Landsat program provides repetitive acquisition of high-resolution multispectral data of Earth's surface on a global basis. The data from the Landsat spacecraft constitute the longest record of Earth's continental surfaces as seen from space, and LDCM will continue to obtain this valuable data and imagery used in agriculture, education, business, science, and government. Goddard will also expand on the record of the changing polar ice sheets with the Ice, Cloud, and land Elevation Satellite-2 (*ICESat-2*) mission, a second-generation orbiting laser altimeter designed to gather the multi-year elevation data needed to determine ice sheet mass balance, scheduled for launch in 2016.

In Planetary Science, Goddard's Sample Analysis at Mars (SAM) instrument suite on

the Mars Science Laboratory *Curiosity* is the most complex instrument ever sent to another planet and promises to make amazing discoveries as *Curiosity's* mission continues. Meanwhile, Goddard is leading the next mission to Mars, the Mars Atmosphere and Volatile Evolution (MAVEN) mission, to explore the planet's upper atmosphere, ionosphere, and interactions with the sun and solar wind. Goddard's groundbreaking Origins-Spectral Interpretation-Resource Identification-Security-Regolith Explorer (OSIRIS-REx) will be the first U.S. mission to carry samples from an asteroid back to Earth. The center is also collaborating with Ames Research Center and Marshall Space Flight Center to launch the Lunar Atmosphere and Dust Environment Explorer (LADEE) mission to orbit the moon, scheduled to launch this coming year.

Goddard is continuing its more than 40-year history of successfully working with the National Oceanic and Atmospheric Administration (NOAA) to develop the Nation's weather satellites through the Joint Polar Satellite System (JPSS) and GOES-R programs. Goddard is also collaborating with NOAA in the area of space weather with the Deep Space Climate Observatory (DSCOVR).

Goddard will maintain its unique role in providing space communications for human exploration since its inception with launch and operations of the next-generation Tracking and Data Relay Satellites (TDRS) and through the development of a groundbreaking, long-duration optical communications mission, the Laser Communications Relay Demonstration (LCRD).

Goddard's Wallops Flight Facility (WFF) on Virginia's Eastern Shore, NASA's only owned and operated launch range, serves as the Agency's premier site for suborbital sounding rockets and balloons. WFF is also the home to Orbital Sciences Corporation's (OSC) Antares vehicle through NASA's Commercial Orbital Transportation Services (COTS) contract to resupply the International Space Station (ISS). A test flight of Antares is planned in the late 2012/early 2013 timeframe and positions Wallops to be a leader in orbital flights to the ISS in the post-Shuttle era.

In addition to its primary site in Greenbelt, MD and WFF, Goddard is comprised of the Goddard Institute for Space Studies (GISS) in New York, a world leader in the study of climate change, the Independent Validation and Verification (IV&V) facility in Fairmont, WV, dedicated to the highest level of safety and cost effectiveness for mission critical software, and ground stations at the White Sands Complex in New Mexico that enable space-to-ground communications for NASA missions.

FUNCTIONS

The Office of the Director sets overall strategic direction for the center to ensure that capabilities are aligned to meet Agency goals and is ultimately responsible for executing the Independent Technical Authority function for center Programs and Projects. The Office of the Director houses: the New Opportunities Office; the Offices of the Chief Counsel, Communications, Education, Government and Community Relations, and Equal Opportunity programs; and the center's Diversity, Knowledge, Alternative Dispute Resolution, and Ombuds programs.

The Office of Human Capital Management provides human capital strategies, solutions and services to achieve

mission success. The Office's initiatives are to continue transformation from transactional business to human capital, to become more strategic/outcome-focused, to implement organizational performance assessment, and to implement redesigned academic training.

The Office of Chief Financial Officer provides financial services to Goddard, NASA Headquarters and the NASA Management Office/Jet Propulsion Laboratory. It is responsible for the internal control program, audit activities and policy documentation; oversees budget planning, process, and execution activities, independent assessments for research and development and institutional programs; financial system training, financial information reporting, and customer support for NASA financial systems; and cost modeling policy guidance and support for new business proposals.

The Management Operations Directorate provides support in procurement, facilities design, construction and operations maintenance, multi-media services, logistics, protective services, health, environmental management, and NASA Headquarters institutional support (procurement, grants management, logistics, and conference support).

The Safety and Mission Assurance Directorate provides an independent voice and perspective for implementing safety and mission assurance to enable mission success.

The Flight Projects Directorate currently manages nine Level 2 NASA programs, four in-house and eleven out-of-house projects in development; 20 projects in pre-formulation/formulation; nine Space Network, one Ground Network, eight earth science, and 17 space science mission operations projects; and an advanced concepts and formulation rapid spacecraft development project.

The Applied Engineering and Technology Directorate provides engineering expertise for development of cutting-edge science and exploration systems and develops technologies in support of future missions.

The Sciences and Exploration Directorate provides scientific leadership to enable space-based studies of Earth, the sun and heliosphere, the solar system, and the universe. It provides project scientists to work with the science community to develop mission requirements and ensure these requirements are met during mission development and operations. Goddard scientists are also instrument and mission principal investigators, lead research and analysis programs typically awarded through peer-reviewed competitions, lead modeling and science data center activities for the science community, and work to widely communicate NASA's scientific results.

The Information Technology and Communications Directorate is led by Goddard's Chief Information Officer and enables the center's mission by leading the development and implementation of a broad range of Agency and center information technology (IT) services and products. ITCD establishes and provides: assistance and guidance on the delivery of mission IT communications operations, to include launch support; IT governance and investment analysis; performance and quality management; policies to provide improved management of information resources and technology; IT strategy development and application of information systems and infrastructure, innovation, and technology infusion required to improve mission delivery; security, resiliency, and

reliability of the center's and NASA's mission and corporate communications infrastructure; and better, more efficient, and scalable IT services to our employees.

The Suborbital and Special Projects Directorate, located primarily at Goddard's Wallops Flight Facility, conducts the Sounding Rocket Program, Scientific Balloons Program, Aircraft Sciences Program (P-3 aircraft operations and management of contract aircraft carrying instruments); operates a research range for suborbital and orbital rocket launches, UAV operations, and reimbursable activities; plans Advanced Projects; and operates a safety program for range and institutional safety.

IMPORTANT ACTIVITIES

The most critical NASA Goddard activity is the development, design, implementation and management of successful missions in support of the Agency's priorities. Goddard collaborates with the scientific and aerospace communities, U.S. and international, to define science requirements for upcoming missions, develop mission concepts through scientific/technical trade studies, and ensure scientific productivity of NASA's science missions during development and flight. Goddard has a lead-center role in Earth Science, Astrophysics and Heliophysics, as well as a supporting role in Planetary Science.

Development of enabling technologies to support NASA missions is also an important role. With funding from NASA technology development programs as well as a small internal research and development program, Goddard aligns technology investments with upcoming science and mission needs. Areas of key technology expertise are: advanced detectors and instruments, flight dynamics and formation flying, optical communications, high-end data processing, cryogenics and propulsion, coatings, and composite structures. Goddard also establishes partnerships with other government agencies to develop mutually beneficial technologies.

As previously noted, Goddard's Wallops Flight Facility is playing a key role in the implementation of the Agency's COTS program for commercial resupply of the ISS, serving as the launch site for OSC's Antares rocket.

MAJOR ISSUES

Large unplanned workforce balances in FY14 – FY18 threaten Goddard's ability to maintain critical skills and expertise. Mitigation includes pursuit of additional work opportunities with the Mission Directorates and looking for opportunities to bring contractor-performed work in-house for civil service performance. As referenced above, Goddard will launch both of its current in-house missions within the next two years, so the capture of the next major in-house build is a top Goddard priority.

Buying power impact of Center Management & Operations (CM&O) guidelines over the next five years is inadequate to address aging infrastructure. Agency funding guidelines for CM&O since FY09 have not kept pace with rapidly increasing civil servant salary costs and have reduced available funds to address serious infrastructure issues. Mitigation includes increased use of landfill gases, reduced electricity usage, and significant institutional service cuts to address highest priority needs in facilities, Information Technology security, and center services. However, over-guideline requirements remain in three major areas: (1) underfunding for

institutional Construction of Facilities (CofF); (2) required investments in IT Security; and (3) continued erosion of funding for laboratory equipment and engineering facilities.

Goddard remains vigilant in meeting our commitments on all of our missions. For instance, the JWST project is on track to meet the rebaselined cost and schedule milestones established in 2011. The center also recognizes the vital importance of the JPSS program to the Nation's weather forecasting capabilities and continues to work with NOAA to deliver these critical satellites on-time and on-budget.

Looming gaps in Earth observation data will be detrimental to developing the scientific understanding and predictive capability needed to understand our changing climate and help inform decisions on adaptation strategies. We continue to work to extend the life of current missions and to implement new missions in as timely and cost effective ways as possible.

KEY PERSONNEL

Chris Scolese, Director, Goddard Space Flight Center, previously served as the NASA Associate Administrator at NASA Headquarters in Washington, DC. In this position, he was responsible for leading the development, design, and implementation of the nation's civil space program. Before becoming Associate Administrator, Scolese served as NASA's Chief Engineer, where he was responsible for ensuring that development efforts and mission operations within the Agency were planned and conducted on a sound engineering basis, as well as for the long-term health of the NASA engineering workforce. Previously, Scolese was the Deputy Director of Goddard Space Flight Center and also served as the Deputy Associate Administrator in the Office of Space Science at NASA Headquarters. Scolese started his career at Goddard in 1987, serving as the Earth Orbiting Satellite (EOS) Program Manager and the Deputy Director of Flight Programs and Projects for Earth Science at Goddard.

Arthur F. Obenschain (Rick), **Deputy Director, Goddard Space Flight Center**, shares responsibility with the director for executive leadership and overall direction and management of Goddard and its assigned programs and projects. He served as Director of Flight Projects Directorate from September 2004 to 2007, before which he served as Director of the Applied Engineering and Technology Directorate beginning June 2000. He has served as Deputy Project Manager for Goddard's Space Station Freedom Development Project, Project Manager for the EOS Platforms Project, GOES Project Manager, Project Manager of the Earth Science Data and Information System, and head of the Electrical Systems Center.

Dr. Christyl Johnson, Deputy Director for Technology and Research Investments, manages the center's future science and technology goals and leads an integrated program of investments aligned to meet those goals. Before coming to GSFC in 2010, she was on a detail to the White House Office of Science and Technology Policy, where she served as the Executive Director of the National Science and Technology Council (NSTC). Prior to that, Johnson served as the NASA Assistant Associate Administrator, where she provided the oversight of the agency's technical mission areas and field center operations. She also served as the Deputy Chief Engineer for Program Integration and Operations for the Office of the Chief Engineer. Johnson began her career at

Langley Research Center in 1985 in the Remote Sensing Technology Branch where she designed and built laser systems for advanced remote sensing of the atmosphere.

Dr. Colleen Hartman, Deputy Director for Science, Operations and Program Performance, Goddard Space Flight Center, assists in overall management of the center's assigned science programs and activities, since July 2012. Prior to coming to GSFC, Hartman served as the Assistant Associate Administrator in the Science Mission Directorate at NASA Headquarters. She is a Professor of Space Policy and International Affairs at the George Washington University's Elliott School of International Affairs in Washington, DC. Before joining the faculty at George Washington University, she served as the Deputy Associate Administrator at NASA's Science Mission Directorate and as the Deputy Assistant Administrator at the National Oceanic and Atmospheric Administration. Hartman also worked on Capitol Hill, as an engineer at NASA Goddard, as a Senior Policy Analyst at the White House Office of Science and Technology Policy, and as Deputy Division Director for Technology and Deputy Division Director for Science at NASA Headquarters.

Nancy Abell, Associate Director, Goddard Space Flight Center, exercises oversight responsibility for all human capital, institutional, and business management activities at Goddard. She is the Center lead for institutional budget accounts and processes, providing a safe and secure infrastructure, and providing critical planning and regulatory compliance. She served as Goddard's Chief Financial Officer from July 1998 to September 2007 and was responsible for development, implementation, and administration of Goddard's system of resources management and financial control. In 1995, she was named the Center's Deputy Comptroller, where she consolidated functions in the finance arena and streamlined NASA business practices by successfully leading a major consolidation of the Goddard, NASA Headquarters, and NASA Management Office/Jet Propulsion Laboratory financial organizations, resulting in the Agency's first and only Regional Finance Office. Abell has held positions in Goddard's Office of Chief Financial Officer, as well as serving for five years as Chief, Administration and Resources Management Office, Space Sciences Directorate.

4.9.5 JET PROPULSION LABORATORY (JPL)

MISSION STATEMENT

The Jet Propulsion Laboratory (JPL) is a Federally Funded Research and Development Center (FFRDC) managed for NASA through a contract with the California Institute of Technology (Caltech). The FFRDC is a unique non-government entity sponsored and funded by NASA to meet specific long-term technical needs that cannot be met by any other single organization within NASA. The Contract between NASA and Caltech is the sponsoring document for JPL as a FFRDC. JPL develops and maintains technical and managerial competencies specified in the contract to perform the following current mission in support of NASA's strategic goals: (1) explore our solar system to fully understand its formation and evolution — physical, chemical, and biological; (2) establish continuous permanent robotic presence at Mars to discover its history and habitability — past, present, or future — and prepare for human exploration; (3) make critical measurements to better understand global and regional climate change, including studies of the solid surface, subsurface, oceans, and atmosphere of our home planet; (4) conduct observations to search for neighboring solar systems and Earth-like planets, and help understand formation, evolution, and composition of the universe; (5) conduct communications and navigation for missions beyond Earth orbit; (6) provide support, particularly in robotic infrastructures and robotic precursors that enables human exploration of the moon, Mars and beyond; and (7) under Caltech's initiative, apply our capabilities to collaborate with other federal and state government agencies and commercial endeavors in areas synergistic with our work performed for NASA.

ORGANIZATIONAL STRUCTURE

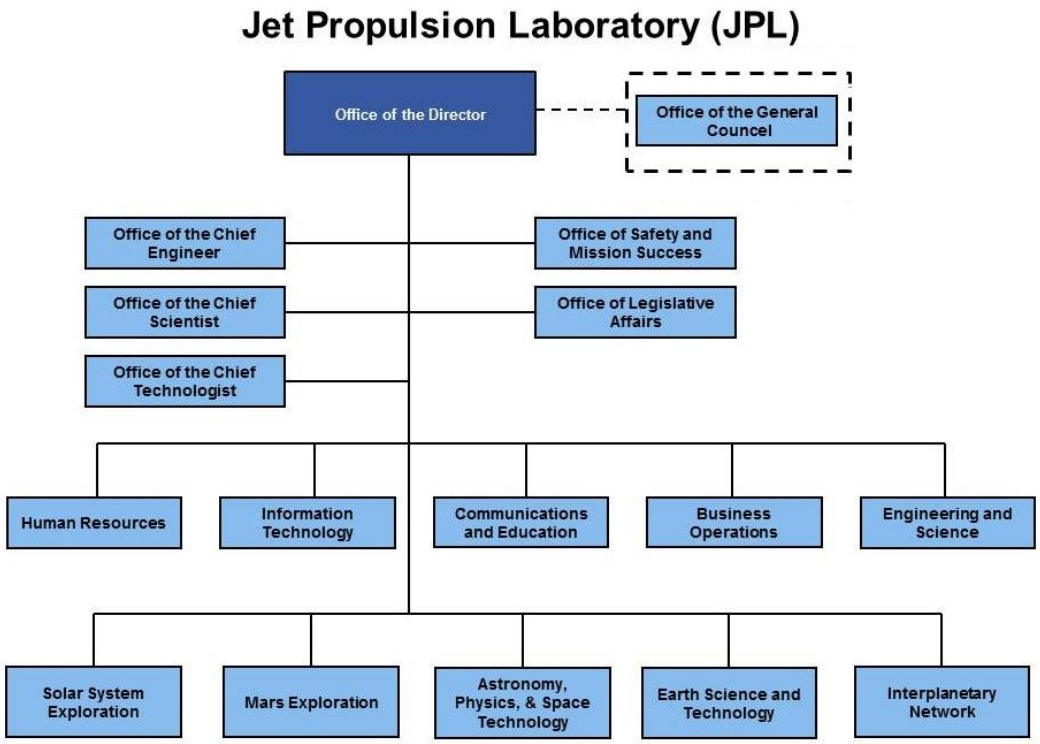


Figure 4.9.5-1: JPL's Organizational Structure

WORKFORCE

JPL's on-site workforce includes approximately 4,700 Caltech standard employees (WYE) plus 300 on-site support contractors. The workforce is organized in a matrix organization with Program Offices forming project teams that draw engineering and science expertise from the technical divisions.

BUDGET EST. ($M)

President's FY13 Budget Request	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017
Jet Propulsion Laboratory	$1232.1	$1090.4	$854.4	$794.8	$708.1	$595.1

Table 4.9.5-1: Jet Propulsion Laboratory's Budget Runout Estimates

CORE COMPETENCIES

JPL's overarching core competency is the *End-to-End Implementation of Unprecedented Robotic Space and Earth Science Missions.* This competency is accomplished by: (1) Developing and integrating world-class capabilities in Science, Engineering, and Technology; and (2) Using our hands-on, in-house, experienced workforce in collaborating

with industry, other NASA centers, academia and — in coordination with the Headquarters Office of International and Interagency Relations — international partners. In addition to these human capital core competencies, JPL maintain key national facilities, including: environmental test facilities (such as the 25-foot space simulator), spacecraft and instrument assembly facilities, Micro-devices Laboratory, and Space Flight Operations Facility. JPL also manages the Deep Space Network facilities on behalf of NASA. JPL applies these core competencies and key facilities to lead roles for NASA in the Mars Program, Planetary Exploration, Search for Exo-solar planets, the Deep Space Network, and Oceanography and Solid Earth observations.

FUNCTIONS

JPL has five "program" directorates, which are responsible for the planning, formulation, implementation, and operation of NASA missions within their respective disciplines corresponding to the first five elements in JPL's mission statement: Solar System Exploration Directorate, Mars Exploration Directorate, Earth Science & Technology Directorate, Astronomy, Physics, and Space Technology Directorate, and the Interplanetary Network Directorate. The final two elements in the JPL mission statement are implemented within the Human/Robotic Mission Systems Office (part of Solar System Exploration) and the National Space Technology Office (part of Earth Science & Technology), respectively.

Cross-cutting functions in support of the Program Directorates are provided by the Engineering and Science Directorate, which provides the technical workforce to execute missions; the Office of Safety and Mission Success, which independently assesses risk and safety; the Office of Communication and Education, which supports NASA's goals in strategic communication, public affairs, and education; the Office of the Chief Information Officer, which provides the information technology applications and services to JPL employees, contractors, and partners; and the Office of the Chief Scientist and Chief Technologist, which leads the scientific and advanced technology research at JPL.

IMPORTANT ACTIVITIES

JPL applies its core competencies, advanced technologies, and key facilities in support of lead roles for NASA in the Mars Program, Planetary Exploration, Search for Exo-solar planets, and other astrophysical missions, the Deep Space Communications Network, and Oceanography, Solid Earth observations, and Earth environmental missions. Thus, JPL places great importance on investing in these three cornerstones of JPL's value to NASA programs and projects.

People: In the area of staff capabilities, the Engineering and Science Directorate is engaged in a "Raise the Bar" initiative to ensure the technical capability of the workforce is at world-class levels through strategically targeted collaborations with faculty and students on student projects, curriculum development, and research activities. In addition, each year JPL hires a large number of "early career hires" to replace retirees and other voluntary departures, again with the strategic emphasis on those

disciplines that contribute to end-to-end implementation of unprecedented robotic space and Earth science missions.

Technology: JPL has developed a strategic technology plan, which identifies those areas of technology that are critical to JPL's ability to contribute to NASA's future success and developed with JPL leadership. Currently, this plan focuses investments in large-aperture systems, precision flying, detectors and sensors, cryogenic systems, in-situ planetary exploration systems, planetary protection, survivable systems for extreme environments, deep space communication, deep space navigation, engineering systems, mission system computing and avionics, and utilization of high-capability computing.

Facilities: JPL continually invests in its key facilities, which are also critical to supporting NASA's programs, including: project design center, spacecraft assembly facility, MARS Yard mobility testbed, computer vision lab, robotics lab, pyro-devices lab, environmental test labs, micro-devices lab, space flight operations facility, cryo-cooler R&D facility, observational instruments laboratory, guidance/navigation/control lab, formation interferometer testbed lab, GPS lab, Table Mountain Telescope facility, MESA antenna test facility, and the airborne radar testbed.

MAJOR ISSUES

TECHNOLOGY

NASA created the Space Technology Mission Directorate (TMD) to provide the guidance and resources necessary to invest meaningfully in advanced technologies. With the responsibility to address the advanced technology needs of NASA's mission directorates and to ensure that all of NASA's technology investments are coordinated and mutually supportive, this new program provides the mechanism to bring high-priority technology advances to the level of technological maturity needed for their ready infusion into future robotic and human space exploration missions. With its increasing commitment to programs like Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR), the Space Technology Program is not yet funded to the level needed to satisfy its objectives. As the resources available to it grow to the level envisioned at its inception, this program will allow NASA to achieve worldwide technological leadership.

Technologies today are not being adequately matured prior to a mission Preliminary Design Review (PDR) such that they can be developed at a predictable cost during the project's implementation phase. With emphasis on space technology development, NASA can provide the means to mature these high-priority technologies from laboratory testing to first use on a mission. The investments made within the TMD in maturing and validating technology advances is substantially less than the investment required to accomplish the same result in the high-pressure flight project environment. Consequently, the costs avoided by a project failure return a savings to NASA many times greater than the TMD investment. Though the TMD currently does have the full resources needed to accomplish the above goal, the anticipated fully funded program will yield this result.

CORE CAPABILITIES

Constrained budgets in the Science Mission Directorate (SMD) at NASA is resulting in few launch opportunities for JPL early to mid next decade, with a corresponding workforce impact to JPL that started in 2010. Critical capabilities and skills nurtured over the past many years are at risk with a net loss to NASA. Capabilities such as Entry, Descent and Landing on extraterrestrial bodies, deep space mission capability, Solar Electric Propulsion, Optical Communications, Advanced Astronomical Observation and several other capabilities are in danger of falling below critical mass. Once lost, it will be hard to reprise this talent.

KEY PERSONNEL

Dr. Charles Elachi, Director of the Jet Propulsion Laboratory, is vice president of the California Institute of Technology. Elachi received a Bachelor's degree (1968) in physics from University of Grenoble, France; the Diplome Ingenieur (1968) in engineering from the Polytechnic Institute, Grenoble; and a Master's degree (1969) and Doctorate (1971) in Electrical Sciences from the California Institute of Technology, Pasadena. He also has a Master's degree (1983) in Geology from the University of California, Los Angeles, and a Masters of Business Administration (1979) from the University of Southern California. He joined JPL in 1970. He is professor of electrical engineering and planetary science at Caltech. He is a fellow of the Institute of Electrical and Electronics Engineers and the American Institute of Aeronautics and Astronautics, and a member of the National Academy of Engineering and the International Academy of Astronautics.

Eugene L. Tattini, Deputy Director of the Jet Propulsion Laboratory, was appointed in July 2001. He is the Laboratory's chief operating officer responsible to the director for the day-to-day management of JPL's resources and activities, including management of the Laboratory's Programmatic Directorates as well as all business operations. Before his retirement from the Air Force as a lieutenant general, Tattini was commander of the Space and Missile Systems Center, Los Angeles Air Force Base, California, where he was responsible for managing the research, design, development, and acquisition of space launch, command and control, and satellite systems.

Born in Madison, WI, Tattini was a distinguished graduate of the Reserve Officer Training Corps program at the University of Illinois and entered the Air Force as a second lieutenant in 1965. He also holds a Masters in Business Administration from Oklahoma City University, and certificates from both the Air War College and Industrial College of the Armed Forces.

Christopher P. Jones, Associate Director, Flight Projects & Mission Success of the Jet Propulsion Laboratory, was appointed in March 2009. He also chairs the Project and Engineering Council Management Council (PEMC). The PEMC's role is to assure the success of JPL missions through the deployment of effective institutional policies, practices, and infrastructure. Previously, Jones was the Director for Solar System Exploration. He came to this position from the Space Science Flight Projects Directorate,

where he was Deputy Director. From 1991 to 1998, he was the Spacecraft Development Manager for the Cassini Program and subsequently managed the Space Interferometry Mission. Since joining JPL in 1969, Jones has contributed to the design, test, and flight operations of numerous planetary spacecraft including Mariner 9, Voyager, and Galileo, and has managed the Laboratory's Spacecraft Systems Engineering, and Guidance and Control sections.

Jones graduated with a Bachelor of Science degree in 1968 and a Master of Sciencedegree in 1969, both in Aerospace Engineering, from the University of Southern California. He received numerous NASA awards and citations, including NASA's Exceptional Service Medal for his work on Voyager, the Outstanding Leadership Medal for Cassini, and the Distinguished Service Medal for his contribution to deep space exploration

Jakob van Zyl, Associate Director, Project Formulation & Strategy of the Jet Propulsion Laboratory was appointed in August 2011. Van Zyl also chairs the Strategic Planning Management Council (SPMC). The SPMC's role is the development of JPL strategic plans and the selection of investments that support those plans.

Previously, van Zyl was the director for JPL's Astronomy and Physics Directorate. He received an honors Bachelor's degree *cum laude* in Electronics Engineering from the University of Stellenbosch, Stellenbosch, South Africa. He received both his Master's and his Doctorate in Electrical Engineering from Caltech.

Van Zyl joined JPL in 1986 and held positions of increasing responsibility in the synthetic aperture radar program. In addition, he managed the Radar Science and Engineering Section, the Earth Science Flight Missions and Experiments Office, and the Focused Physical Oceanography and Solid Earth Program Office. He was appointed deputy director for the Astronomy and Physics Directorate in 2002. He has been an adjunct faculty member in the Mechanical and Aerospace Engineering Department, University of Southern California, where he taught the class "Remote Sensing Systems from Space" from 1997 to 2001. Since 2002, he has been teaching the class "Physics and Techniques of Remote Sensing" at Caltech.

Stephen L. Proia, Chief Financial Officer and Director for Business Operations of the Jet Propulsion Laboratory, was appointed in February 2011. Proia also chairs the JPL Operations Management Council, a standing Laboratory committee that provides policy guidance and management overview of all institutional and business activities.The Business Operations Directorate has management and leadership responsibility for accounting, finance, institutional business systems and tools, contracts, program and project resources, acquisition, materiel management and logistics, technical information, facilities, and protective services.

Proia has held increasingly responsible positions in contracts management and finance during a 37-year career, 27 years of which have been spent at JPL. He has received NASA Leadership and Exceptional Achievement Medals, serves on the Board of Directors for the Caltech Employees Federal Credit Union.

Born in Washington, D.C., Proia received his Bachelor of Science degree and his Masters of Business Administration from the University of Maryland.

4.9.6 JOHNSON SPACE CENTER (JSC)

MISSION STATEMENT

The Johnson Space Center (JSC) mission within NASA is human spaceflight. JSC hosts and staffs program and project offices; selects and trains astronauts; manages and conducts projects that build, test, and integrate human-rated systems for transportation, habitation, and working in space; and plans and operates human spaceflight missions. The work requires a comprehensive understanding of space and planetary environments, as well as research into the effects of those environments on human physiology. It also requires that we develop technology to sustain and preserve life; maintain a supply chain to design, manufacture, and test flight products; select, train, and provide medical care to those people who fly space missions; and continue to provide administrative mission support services. JSC is currently hosting, staffing, and supporting the International Space Station Program, the Multi-Purpose Crew Vehicle Program, the Human Research Program (HRP) Program, and the Commercial Crew and Cargo Program.

ORGANIZATIONAL STRUCTURE

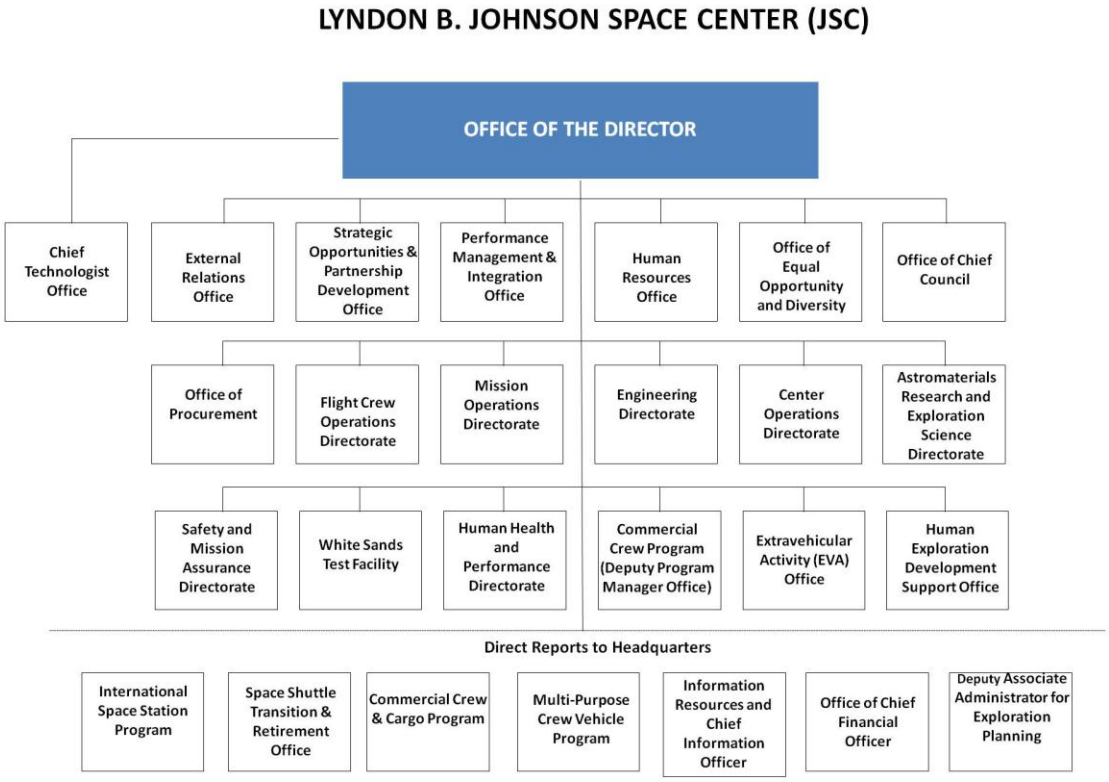


Figure 4.9.6-1: JSC Organizational Structure

WORKFORCE

JSC's workforce distribution:

- Allocation of Full Time Equivalent (FTE) Civil Servants = 3,219.4 (includes 39.5 at White Sands Test Facility)
- Contractors (Work Year Equivalents) = 11,100 (includes 470 at White Sands Test Facility)

BUDGET ESTIMATES ($M)

President's FY13 Budget Request	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017
Johnson Space Center	$4910.4	$4463.1	$4644.9	$4666.4	$4692.3	$4714.7

Table 4.9.6-1: Johnson Space Center's Budget Runout Estimates

CORE CAPABILITIES

The Johnson Space Center (JSC) provides a variety of capabilities for the Agency's Human Spaceflight Programs, including:

Program Management: JSC has a history of managing large-scale human spaceflight programs. Currently, Program Management for the International Space Station, and Multi-Purpose Crew Vehicle Programs reside at JSC. The Center provides staff to the programs who have the skills, expertise, and experience required for significant spaceflight programs.

Flight Crew: NASA's Astronauts—the cornerstone of human spaceflight—are selected and trained at the Johnson Space Center. The spacecraft crew today is assigned as the Commander or Flight Engineer for the International Space Station.

Engineering: JSC Engineering provides engineering design, development, and test support for spaceflight programs assigned to JSC, such as the Space Station and Multi-Purpose Crew Vehicle and advanced spacecraft. Engineers perform complete in-house design, development, manufacturing, and testing of certain government-furnished equipment, including crew support equipment and various flight experiments. Engineering discipline expertise includes: guidance, navigation, and control; electrical power generation, storage, and distribution; all other avionic systems including data management, display and control, and instrumentation; telemetry and communications; structures and materials; thermal protection and control; mechanical systems; propulsion, fluid management, and pyrotechnics; environmental control and life support; spacesuits and extravehicular equipment; aerodynamics, aerothermodynamics, and aeroelasticity; flight software; mission planning and analysis; robotics and advanced automation systems; and overall systems engineering and simulation.

JSC maintains expertise in manufacturing and test facilities and computational complexes that support these core engineering capabilities.

Operations: JSC specializes in ensuring successful operations in high-risk environments. JSC provides a variety of capabilities to fly human vehicles in space, including: preflight planning/integration;

facility development and training; real-time operations, which includes failure analyses and responses to protect crew and vehicle safety and successfully achieve mission objectives; integration of operational requirements into vehicle design and development, which reduces a program's life-cycle costs; and sustaining engineering to support vehicles in space. JSC's Operations capabilities provide "mission insurance" – 49 years of corporate knowledge in the conduct and execution of human spaceflight operations.

Extravehicular Activity (EVA) - JSC provides the full range of responsibilities for Extravehicular Activity (EVA) or "spacewalking," which involves safe EVA execution, training, integration, and operations, development for suits, systems, and support equipment, and all EVA-related advanced technology.

Human Health and Performance: JSC has a long history of effective human spaceflight medicine and research. Our scientists and medical doctors enable mission success, optimizing human health and productivity in space before, during, and after the actual spaceflight experience of our flight crews, and include support for ground-based functions.

White Sands Test Facility (WSTF): The White Sands Test Facility (WSTF), located in Las Cruces, NM, provides unique capabilities for JSC. Specifically, WSTF conducts simulated mission duty cycle testing to develop numerous full-scale propulsion systems; and WSTF is formally certified to perform precision cleaning and depot-level refurbishment of flight-critical propulsion systems components. WSTF is a center of technical excellence in the fields of high-pressure oxygen systems/materials and rocket propellant safety. WSTF offers NASA and commercial customers: functional and performance evaluation tests; hazards/failure analyses of materials, components, and complete systems; system design evaluation and recommendations; and safety training courses and manuals.

Astromaterials Research and Exploration Sciences (ARES): JSC's capabilities and facilities in Astromaterials Research and Exploration Sciences (ARES) involve basic research in earth, planetary, and space sciences and the curatorial responsibility for all NASA-held extraterrestrial samples. ARES scientists and engineers also provide support to the human and robotic spaceflight programs with expertise in orbital debris modeling, analysis of micrometeoroid/orbital debris risks to spacecraft, image analysis, and earth observations.

Safety and Mission Assurance (SMA): JSC's core capabilities enable Safety and Mission Assurance (SMA) that insures successful spaceflight. JSC has a long history of integrated SMA, as the safety, reliability, and quality functions were consolidated into a single organization following the Apollo fire. JSC's SMA capabilities reduce risk by providing technical evaluations, assessments, and analytical services through the life cycle of NASA's human spaceflight programs and projects.

FUNCTIONS

JSC functions include the following:

Chief Technologist Office: Working closely with the Headquarters Chief Technologist and Chief Engineer, the Chief Technologist Office provides guidance and advice to center leadership on research and technology matters.

External Relations Office: The Extermal Relations Office offers strategic

communications planning and operations in the areas of education, public affairs, spaceflight awareness, university research, and community and government affairs.

Strategic Opportunities and Partnership Development Office (SOPD): Collaborates with JSC organizations to establish strategic, beneficial partnerships with external entities, develop center implementation plans that support Agency strategies, facilitate the transfer of technology and intellectual property for commercial development, and manage the space act agreement process.

Performance Management and Integration Office: Develops and sustains Program Planning & Control (PP&C) capabilities by providing cost estimating, scheduling and cost assessment skills, training, tools, and techniques. It is responsible for providing strategic, integrated analysis to center management, Headquarters, and programs.

Human Resources Office: Provides guidance, tools, and services to recruit, develop, and retain a capable, committed, and diverse workforce.

Office of Equal Opportunity and Diversity: Ensures equal opportunities for all employees and applicants for employment, protects against discrimination, and promotes a working environment that respects and values the expertise of the entire workforce.

Office of Chief Counsel: Provides in-depth legal support in the areas of ethics and general legal services, procurements, and contracts, and providing guidance in the resolution of center managerial issues within the framework of law and NASA administrative practices.

Office of Procurement: Conducts acquisitions and manages contracts to ensure the center obtains what it needs at a fair and reasonable price using the best methods and tools while ensuring adherence to high standards and professional integrity.

Flight Crew Operations Directorate: Provides trained crew members for all human spaceflight endeavors and expertise to help resolve operations and development issues within the human spaceflight programs. Responsible for all JSC aircraft operations, including aircrew training.

Mission Operations Directorate: Provides the planning and training required for flight crews and flight controllers in support of all human spaceflight. Conducts mission operations for the programs in conjunction with commercial and international partners.

Engineering Directorate: Provides expertise in aerodynamics, mechanical, electrical, biomedical, industrial, propulsion, chemical, and computer engineering to produce, test, and certify aerospace systems and concepts to meet human spaceflight objectives.

Center Operations Directorate: Operates the Center's infrastructure and supports the employees through facilities management, environment services, logistics, and protective services.

Astromaterials Research and Exploration Science Directorate: Conducts research in earth, planetary, and space sciences. The Directorate bears curatorial responsibility for all NASA-held extraterrestrial samples. It provides micrometeoroid/orbital debris risk assessments.

Safety and Mission Assurance Directorate: Provides technical evaluations, assessments, and analytical services through the life cycle of NASA programs and projects to assure successful spaceflight and to promote a safe and healthy work environment.

White Sands Test Facility: Provides for testing and evaluating potentially hazardous materials, spaceflight components, and rocket propulsions systems. Also provides infrastructure support for two Goddard Tracking and Data Relay Satellite System ground stations.

Commercial Crew Program: JSC hosts the Deputy Program Manager. This Program facilitates the development of a U.S. commercial crew space transportation capability with the goal of achieving safe, reliable, and cost-effective access to and from the International Space Station and low Earth orbit. This office assists the program manager at the Kennedy Space Center.

Human Health and Performance Directorate: Provides human health and countermeasures research, medical operations, habitability and environmental factors activities geared toward optimizing human health and productivity before, during, and after spaceflight experience.

Extravehicular Activity Office: Provides final review and approval for all areas of Extravehicular Activity (EVA), including safe EVA execution, training, integration and operations, development of suits, systems and support equipment, and all EVA-related advanced technology.

Human Exploration Development Support Office: Provides expertise in systems engineering, architecture and mission design for planning and integrating NASA human spaceflight exploration missions beyond low earth orbit.

IMPORTANT ACTIVITIES

International Space Station (ISS): JSC is the host center for ISS and is leading operations on a 24/7 basis. Partnerships are key to ISS success and serve as a model for future space exploration with ISS having over 100,000 people of 5 space agencies in 15 countries and 500 US contractor facilities in 37 states. ISS serves as a key component of commercialization activities and a test bed for exploration, research, and technology development.

Multi-Purpose Crew Vehicle (MPCV): JSC is home to MPCV (Orion), the new human spacecraft for exploration beyond low Earth orbit and leads Orion's design, development, and mission operations. Orion uses the experience from JSC's safety and mission assurance, engineering, life support, human health and performance, astronaut training, as well as programmatic expertise. JSC works closely with the Marshall Space Flight Center (MSFC) and the Kennedy Space Center (KSC), integrating Orion with the exploration architecture.

Support to Commercialization of Low Earth Orbit (LEO): As commercial partnerships assume an increasing role in spaceflight development and operations, JSC is leveraging our national investments and capabilities to ensure mission success. The expertise at JSC, which ensures success includes: human rating and protecting crew health during particularly during launch and landing and assuring successful docking with repairs as required prior to re-entry and mitigating orbital debris risk.

Research and Technology for Exploration: JSC is focused on research and technology required for future space exploration using the Human Research Performance (HRP), Advanced Exploration Systems (AES), and Space Technology Mission Directorate initiatives.

MAJOR ISSUES

International Space Station (ISS) Funding Uncertainty: Several JSC organizations have tasks identified as unfunded, including the International Space Station (ISS) requirements, which means key institutional resources for program and mission support are at risk of insufficient or no funding for FY15 and beyond. In addition, further uncertainty due to pending reductions to the overall ISS budget will exacerbate the Program's ability to mitigate the institutional risks. An additional element of risk is contained in flight seats to ISS. The potential for having to pay for extra seats on Soyuz exists if commercial space vehicles are delayed, as most new vehicles are initially.

Health of the Center Infrastructure: Reductions in the past and continued downward pressure on future Center Management Operations (CMO) budgets are resulting in a trend of reduced capacity for center services, less redundancy of facilities and expertise while impacting availability of facilities and services to programs and projects at JSC. JSC's preventive to corrective maintenance ratios are well below industry standards. In fact, JSC has been doing as much repair as maintenance [PM/CM ratio is currently 58 / 42 percent, while industry standard is 70 / 30 percent). Further budget reductions will negate improvements JSC has made since 2004 to increase maintenance and improve the infrastructure health with response time to respond, repair, and address customer organization's concerns and problems pushed to longer times to complete work.

KEY PERSONNEL

Michael L. Coats, **Director of the Johnson Space Center,** was named in November 2005. In 1978, he was selected as an Astronaut after serving as a Navy pilot and flight instructor. He is a veteran of three space shuttle missions, serving as the Commander for two of these missions. Prior to becoming the JSC Center Director, he spent 14 years in the corporate arena serving in three Vice President positions for Loral Space Information Systems and the Lockheed Martin companies. He received a Bachelor of Science degree from the United States Naval Academy in 1968, a Master of Science in Administration of Science and Technology from George Washington University in 1977, and a Master of Science in Aeronautical Engineering from the U.S. Naval Postgraduate School in 1979.

Ellen Ochoa, Deputy Director, has served since November 2007, having previously served as the Deputy Director and Director of Flight Crew Operations. She is a veteran of four space shuttle missions, serving as a Mission Specialist, Payload Commander, and Flight Engineer. She received a Bachelor of Science degree in Physics from San Diego State University in 1980 and a Masters of Science degree and doctorate in Electrical Engineering from Stanford University in 1981 and 1985, respectively.

Melanie Saunders, Associate Director (Management), Johnson Space Center, was named to the post in January 2009. Previously, she served as the Associate Program Manager for the International Space Station Program. She received a Bachelor of Arts degree in History from the University of California, Santa Barbara, in 1984 and a Juris Doctor degree from the University of California, Davis, in 1987.

J. Milt Heflin, Associate Director (Technical), has served in this position since March 2007. Previously, he was Deputy Director of Mission Operations and Chief of the Flight Director Office. He has served as a Flight Director in Mission Control for twenty space shuttle missions and as the Lead Flight Director for six of these flights. He received a Bachelor of Science in Physics and Math from the University of Central Oklahoma in 1966.

Lauri N. Hansen, Center Director's Chief of Staff, has served in this position since January 2011. Prior to this assignment, she has served the Constellation Program as Director of the Constellation System Engineering and Integration Office, Project Manager for the Lunar Lander Project, and Director of the Constellation Safety, Reliability and Quality Assurance Office. She has previously served as the Deputy Director of the JSC Safety and Mission Assurance Office, the Deputy Director of the JSC Engineering Directorate, the Manager of the JSC Engineering Project Management Office, and Deputy Manager of the ISS Vehicle Office. She received a Bachelor of Science Degree in Aerospace Engineering from the University of Michigan in 1985.

4.9.7 JOHN F. KENNEDY SPACE CENTER (KSC)

MISSION STATEMENT

The Kennedy Space Center (KSC) is responsible for the preflight processing, launch, landing, and recovery of the Agency's human-rated spacecraft and launch vehicles; the integration and processing of International Space Station (ISS) research and flight experiments; efforts to stimulate the private sector to develop and demonstrate safe, reliable, and cost-effective space transportation capabilities; and the acquisition and management of Expendable Launch Vehicles (ELV) for other Agency spacecraft. KSC leads the development of ground systems supporting human-rated spacecraft and launch vehicle and lunar In-Situ Resource Utilization hardware elements. KSC also hosts the manufacturing of the Orion Multi-Purpose Crew Vehicles.

ORGANIZATIONAL STRUCTURE

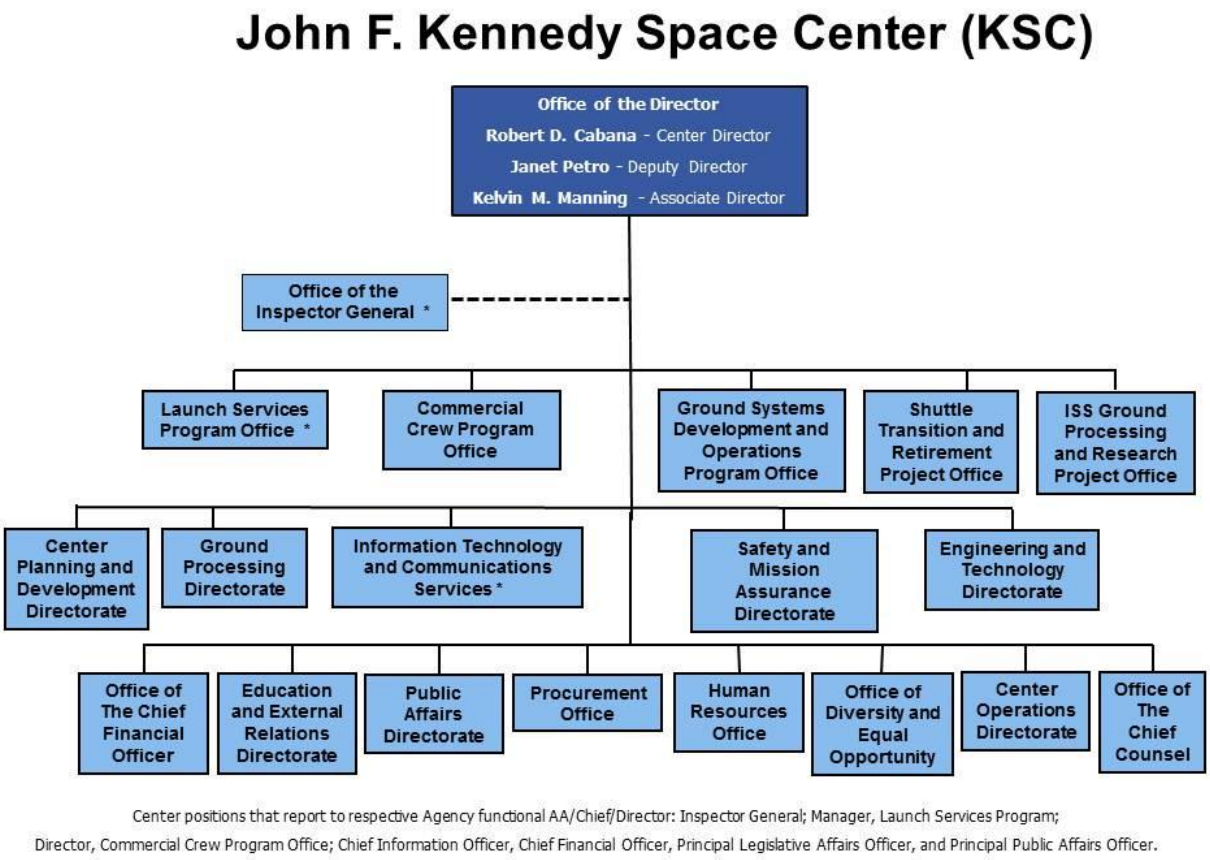


Figure 4.9.7-1: KSC Organizational Structure

The Kennedy Space Center (KSC) is located on the east coast of Florida, about half way between Miami and Jacksonville, in an area affectionately known as the Space Coast. It occupies 140,000 acres with over 900 facilities totaling 25.36 million square feet with a current replacement value of $6.06 billion. KSC represents a unique blend of technology and nature, as nearly half of the center is part of the Merritt Island National Wildlife Refuge.

WORKFORCE

KSC's workforce distribution:

- Allocation of Full Time Equivalent (FTE) Civil Servants = 2,098.2
- Contractors (Work Year Equivalents) = 3,490

BUDGET EST. ($M)

President's FY13 Budget Request	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017
Kennedy Space Center	$1812.8	$2136.3	$2035.7	$1899.2	$2077.0	$1812.7

Table 4.9.7-1: Kennedy Space Center's Budget Runout Estimates

CORE CAPABILITIES

Since 1967, the Kennedy Space Center (KSC) has been America's spaceport. Over the years, KSC has learned to adapt and adjust its focus due to shifting circumstances. Where once only NASA or military launches occurred, soon there will be launches from commercial partners. It's a new way of doing business for a new generation of explorers. KSC prides itself on expertise in several core capabilities:

Acquisition and Management of Launch Services and Commercial Crew Development: The ability to successfully acquire and manage commercial launch services for human and science-related missions is critical to expanding the United States aerospace markets as we continue to live, learn, and explore in space.

Launch Vehicle Processing, Launching, Landing and Recovery, Operations, and Sustaining Engineering: Over the last 50 years, KSC has led and performed the preflight processing, launch, landing, and recovery of the Agency's human-rated spacecraft and launch vehicles. The capability began with the Redstone and Atlas vehicles for Mercury, matured through Titan for Gemini and Saturn for Apollo, and continued with the space shuttle. KSC's capability is evolving once again to move the NASA mission forward by preparing for the Space Launch System (SLS) and commercial launch vehicles. KSC also has led the preflight processing and launch of Expendable Launch Vehicles (ELVs) since the 1960s. In 1998 the management of ELV activities across the Agency was consolidated at KSC in the formation of the Launch Services Program (LSP). The LSP acquires commercial launch services for

NASA science missions and other government-sponsored missions.

Spacecraft, Payload, and Flight Science Experiment Processing, Integration, and Testing: KSC continues to lead the launch site assembly, integration, and processing of spacecraft as well as their payloads and flight experiments. KSC also leads the integrating and processing of International Space Station (ISS) research and flight experiments. KSC is preparing to do the same for the Orion Multi-Purpose Crew Vehicles (MPCVs) in addition to hosting the manufacturing of the Orion MPCVs. KSC's ability to develop, integrate, and test a variety of different payloads and research experiments, provide controlled environments to sustain critical science cargo, offer contamination control services, and consistently deliver time critical launch/landing site payload customer services has earned KSC recognition within the NASA community.

Designing, Developing, Operating, and Sustaining Flight and Ground Systems and Supporting Infrastructure: KSC's engineers are skilled in electrical systems, avionics, mechanical accessories, fluids and propulsion, information technology, and pyrotechnics.

Development, Test, and Demonstration of Advanced Flight Systems and Transformational Technologies: KSC's staff is adept in using real-time prototypes to construct hardware, thus enabling rapid solutions to complex problems. The center also partners with industry to resolve technical problems, with results that lead to dual-use products or spinoffs.

Developing Applied Technology to Advance Exploration and Surface Systems: KSC leads the development of applied technologies and systems required to improve processing and launch systems. KSC also designs, operates, and maintains the facilities, systems, support equipment, and test equipment necessary for launch vehicle and spacecraft processing. KSC is leading the development of ground systems supporting human-rated spacecraft and launch vehicles and lunar In-Situ Resource Utilization hardware elements.

The backbone of KSC's future will be the Launch Services, Commercial Crew, and Ground Systems Development and Operations Programs, along with ongoing support to the ISS research community. These will provide safe, reliable, cost-effective transportation to low Earth orbit and beyond for humans, cargo, and NASA's science and robotic spacecraft; develop partnerships to transform KSC into a multiuser site; and enable full utilization of a world-class platform for research discovery and technology demonstration. All of KSC's resources (e.g., workforce, infrastructure, facilities, contracts, budget, and strategic relationships) are focused on supporting these capabilities to ensure mission safety and success.

FUNCTIONS

KSC is organized to provide program, technical, and institutional support to successfully accomplish mission objectives. The organizations directly responsible for Ground Systems Development and Operations, Launch Services, Commercial Crew, and ISS programs at KSC are described below. Via the remaining directorates, KSC provides technical and institutional resources to satisfy program requirements and schedules (e.g., engineering and safety and mission assurance) and ensures that human, financial, infrastructure, and other

supporting resources are properly applied to programs. Brief biographies for the center key leaders are also provided at the end of this section.

The Ground Systems Development and Operations Program is responsible for processing and launching the next generation of launch vehicles and spacecraft in support of NASA's exploration objectives, and developing the ground systems, infrastructure, and operational approaches to sustainably enable that mission. In support of the SLS, KSC facilities and infrastructure are being modified and refurbished for future use. A key aspect of the program's approach to long-term sustainability and affordability is to make processing and launch infrastructure available to commercial and other government entities, thereby distributing the fixed cost burden among multiple users and reducing the cost of access to space for the United States.

The Launch Services Program provides leadership, expertise, and cost-effective commercial launch services to satisfy Agency-wide space transportation requirements and maximizes the opportunity for mission success. The program is responsible for NASA oversight of the launch service, including launch vehicle engineering and manufacturing, launch operations and countdown management, and providing added quality and mission assurance in lieu of the requirement for the launch service provider to obtain a commercial launch license.

The Commercial Crew Program, in cooperation with the Johnson Space Center, is responsible for managing the investment in the development of U.S. commercial end-to-end transportation systems so the United States can safely, reliably, and cost effectively journey to and return from the ISS and other low Earth orbit destinations. The program also manages the crew transportation system design, development, demonstration and certification process, and the supporting technical and programmatic Partner Integration/oversight functions.

The International Space Station and Ground Processing Research Project Office is responsible for the implementation of technical, cost, and schedule requirements of the ISS Program at KSC as well as the ISS research requirements from the Space Life and Physical Sciences Research and Applications Division (SLPSRA) from NASA Headquarters. The project office leads KSC planning and implementation of all ground processing and research requirements and is the interface between the Center, the ISS program, and SLPSRA.

The Center Planning and Development Directorate serves as the front door for internal and external partnerships with Kennedy Space Center, facilitating future center development strategies that maximize use of underutilized infrastructure, both for NASA missions as well as commercial and non-NASA customers.

The Engineering and Technology Directorate provides leadership, capabilities, and expertise to make significant contributions in engineering, research, and technology development across the entire life cycle of government and commercial launch vehicles, spacecraft and their associated ground and surface systems, and equipment for current and future spaceflight customer needs.

IMPORTANT ACTIVITIES

Kennedy Space Center has set the stage for America's space programs for fifty years.

By retrofitting its world-class ground systems and facilities for both government and commercial users, and infusing innovative ideas into on-going and forward-looking programs such as Launch Services, International Space Station, Commercial Crew, Orion, and Space Launch Systems, the center helps NASA reach America's space exploration goals.

In the coming decade, KSC will support the final construction and integration of the first test flight of Orion, scheduled for 2014. This will be followed by the first unmanned test flight of the new Space Launch System (SLS) in 2017, with the first manned flight scheduled for 2021. Starting in 2012 KSC began the processing of ISS payloads for our commercial partners, like SpaceX, who through an agreement with NASA will provide commercial resupply capabilities to the space station.

In August of 2012, the Commercial Crew Program, located at KSC, announced the selection of three companies that will receive funding during the Commercial Crew Integrated Capability (CCiCap). CCiCap has an expected initial capability by the year 2017 and includes the spacecraft, launch vehicle, ground operations, and flight operations – the entire life cycle.

KSC's Center Planning and Development Directorate will continue to pursue and develop partnerships with external organizations and bring new business to the center. Recent successes have included agreements with Space Florida, allowing them the use of KSC facilities like the Orbiter Processing Facility, the Space Shuttle Main Engine Processing Facility, and the Processing Control Center.

MAJOR ISSUES

Enabling Commercial Space: KSC continues the transformation from a 30-year Space Shuttle program that represented a large part of KSC's budget to a more diverse portfolio with new or smaller government programs and commercial operations. NASA has many authorities highlighting our key role in enabling commercial space. However, legislation, policies, processes, and practices often were developed under a different operating model (only government use of NASA capabilities as opposed to government and commercial use of NASA capabilities).

Transforming Our Infrastructure to Support the Launch Systems of the Future: KSC is modernizing the center and the Eastern Range to enhance existing capabilities and further transform KSC into a spaceport for the nation's 21st-century space programs, including future NASA programs and other potential government, Department of Defense, and commercial users. We are balancing the need to develop and upgrade our aging heritage infrastructure before requirements are fully matured from various potential users with long lead times for designing and constructing unique launch and processing infrastructure.

Maintaining Critical Capabilities: KSC is approaching the first year without space shuttle activities, since Transition and Retirement ends in FY 2013. In this post-shuttle era, the center has many challenges with capabilities once funded by the shuttle program, such as divesting of capabilities no longer needed or funded and sustaining those capabilities deemed to be needed in the future.

Fiscally Constrained Environment: Since KSC's institutional budget, Center

Management Operations (CMO), has already experienced several budget reductions over the past few years, there is no flexibility to fund capabilities not funded by other entities. The center has already implemented a minimal baseline approach that reduced $37 million in content over the last two fiscal years. As CMO evaluates the impacts of additional reductions this budget cycle (ranging from FY 2014 - $24 million, or a 6 percent reduction, to FY 2018 - $68 million, or a 16 percent reduction with an over-10 percent average reduction), serious questions about the viability of the institutional service model arise. It is not clear how routine institutional services and a facility maintenance program for the protection and operation of facilities, infrastructure, and equipment can be maintained with the proposed funding levels identified. The lack of funding escalation for procurement requirements, utility costs, and civil service salaries directly leads to a progressive gap that leaves few options for resolution.

Summary: We face significant challenges ahead. In these austere budget times, we must continue to become more efficient and affordable, including partnering to share capabilities and enable commercial space. KSC's workforce and infrastructure are transitioning, and we are focusing on maintaining critical skills with limited resources.

KEY PERSONNEL

Robert D. Cabana, Kennedy Space Center Director, is the tenth Director of NASA KSC. Prior to this appointment, he served as director of NASA's John C. Stennis Space Center. Cabana also served as deputy director of the Johnson Space Center in Houston, TX. Cabana was selected as an astronaut candidate in 1985 and has flown four space shuttle missions: pilot of Discovery on STS-41 1990, pilot of Discovery on STS-53 in 1992, commander of Columbia on STS-65 in 1994, and commander of Endeavour on STS-88, the first International Space Station assembly mission, in 1998. In addition to his duties as an astronaut, Cabana's NASA experience includes assignments as Deputy Chief, Aircraft Operations Division; Chief, NASA Astronaut Office; manager, International Operations, International Space Station Program; Director, NASA Human Space Flight Program in Russia; Deputy, International Space Station Program; and Director, Flight Crew Operations. Cabana graduated from the U.S. Naval Academy in 1971, with a Bachelor of Science degree in Mathematics and was commissioned as an officer in the U.S. Marine Corps. He is a distinguished graduate of the U.S. Naval Test Pilot School and has logged more than 7,000 hours in 45 different aircraft.

Janet Petro, Deputy Director, has served as Deputy Director of KSC since April 2007. Prior to joining NASA, she served in various management positions for Science Applications International Corporation, also known as SAIC, where she provided extensive program management and technical leadership since December 2000. She also held various senior management positions with McDonnell Douglas Aerospace, including program manager of a classified $13 million U.S. Department of Defense program. She holds a Bachelor's degree in Engineering from the U.S. Military Academy at West Point, NY, and a Master of Science degree in Business Administration from Boston University Metropolitan College.

Kelvin M. Manning, Associate Director, began his career at Kennedy in 1992 and has served in a number of positions within the former Shuttle Processing Directorate

including Flow Director for Space Shuttle Atlantis, Chief Engineer (acting) for Shuttle Upgrades, Vehicle Manager for Space Shuttle Columbia, and NASA Test Director. More recently, Manning was the Orion Division Chief in the Kennedy Constellation Project Office. As an Air Force officer, Manning served six years as a Space Operations Analyst. Following his military service and prior to joining NASA, Manning was a Systems Engineer with General Electric Aerospace, Military and Data Systems Operations and McDonnell Douglas Space Systems Company.

Manning obtained his Bachelor of Science degree from the U.S. Air Force Academy and has a Master of Science degree in Engineering Management from the University of Central Florida.

4.9.8 LANGLEY RESEARCH CENTER (LARC)

MISSION STATEMENT

The Langley Research Center (LaRC) is a research, science, technology, and development center that provides game-changing innovations to enable NASA to make significant contributions to the nation. We are leaders in systems innovation for expanding air mobility, exploring space, and definitively characterizing the Earth's changing climate. Our work spans fundamental research to mission development and operations with an eye toward the next generation of cutting-edge ideas that provide new capabilities or significantly improve performance or cost.

ORGANIZATIONAL STRUCTURE

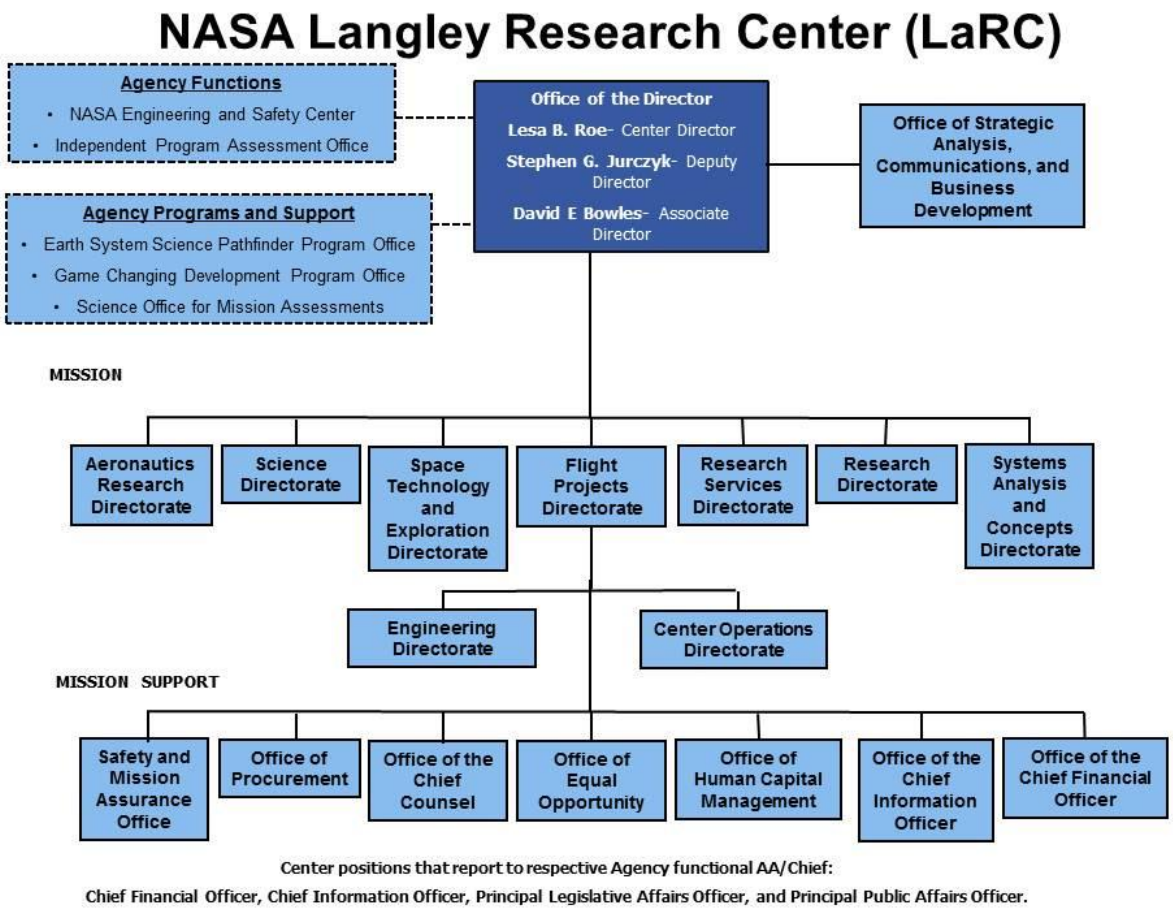


Figure 4.9.8-1: LaRC's Organizational Structure

Located in Hampton, VA, NASA Langley Research Center was founded in 1917 as the nation's first civilian aeronautics laboratory. Langley has pioneered aviation breakthroughs and continues to be a vital contributor to aeronautics, space, and science programs, advancing how we fly within and outside our atmosphere. Langley was home to the first

Space Task Group for Project Mercury, leader of the Viking Mission to Mars, has had more than 20 successful space flight instruments for studying the Earth's Atmosphere, a Nobel Peace Prize, and notable aviation and space contributions that resulted in seven Collier Trophies, over 1,400 patents, and numerous R&D 100 awards.

WORKFORCE

LaRC's workforce distribution:

- Allocation of Full Time Equivalent (FTE) Civil Servants (including students) = 1,928.0
- Contractors (Work Year Equivalents) = 1,700

BUDGET EST. ($M)

LaRC's budget runout is presented below in Table 4.9.8-1.

President's FY13 Budget Request	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017
Grand Total	$766.4	$737.5	$791.1	$768.4	$750.2	$731.0

Table 4.9.8-1: Langley Research Center's Budget Runout Estimates

CORE CAPABILITIES

Langley Research Center's core capabilities provide expertise to the nation in: aerosciences; structures and materials; atmospheric characterization; entry, descent, and landing; and systems analysis**.** In support of the research, technology, and flight development activities that these capabilities enable, Langley maintains the nation's largest and most comprehensive set of civilian aeronautics test facilities. These include major research facilities that cover all flight regimes from subsonic to hypersonic, as well as several unique specialized facilities, laboratories, and simulators.

Langley's core capabilities combined with its facilities are applied to solve some of the most challenging problems across the full spectrum of NASA missions, from the concept stage to flight, and include:

- Supporting the Orion Multi-Purpose Crew Vehicle (MPCV) and Space Launch System (SLS) Programs;
- Supporting Human Exploration and Operations Mission Directorate (HEOMD) exploration architectures definition, assessments, and concepts development;
- Providing engineering analysis and test expertise in support of Commercial Space;
- Developing new innovative technologies to enable the next generation of space and science missions;
- Leading critical Science climate change research, instrument development, and missions;

- Providing entry, descent, and landing (EDL) expertise for planetary missions, including the recent and very successful Mars Science Lab (MSL)/Curiosity robotic mission to Mars; and
- Leading and/or contributing to all of NASA Aeronautics programs across Fundamental Aeronautics, Aviation Safety, Airspace Systems, and Integrated Systems Research.

Additionally, Langley and the NESC provide 911 support to other government Agencies, such as the National Transportation Safety Board, the Federal Aviation Administration, and Department of Defense, to solve challenging national problems. As an example, in FY2012 we supported the F-22 hypoxia concern, the V-22 envelop expansion, and the KIOWA warrior helicopter aerodynamic stability.

FUNCTIONS

Langley Research Center's organizational structure and functions align with the Agency's mission and mission support construct. The Office of Director provides strategic direction and center leadership to accomplish the Agency's mission. Langley hosts several Agency Functions and Agency Programs: the NASA Engineering and Safety Center, the Independent Program Assessment Office, the Science Office for Mission Assessments, the Space Technology Game Changing Development Program (GCDP) Office, Aeronautics Test Program Office, and the Earth System Science Pathfinder Program (ESSPP) Office. These organizations perform Agency roles ranging from independent testing, analysis, and assessments for Agency decision makers, to developing new game-changing technologies for future space missions, to supporting mission assessments for the Science Mission Directorate.

Langley's Mission directorates consist of Product Units and Core Resource Units. The Product Units (Aeronautics Research, Space Technology and Exploration, and Science Directorates) are the primary customer interface for center work, having overall budget integration and business execution responsibility. The Flight Projects Directorate has focused responsibility on all Langley Research Center flight projects' processes, implementation, and execution. The Core Resource Units provide the science, research, technology, and engineering capabilities and have lead responsibility for technical execution, including the discipline expertise and facilities that comprise the previously identified core capabilities.

The **Mission Support** directorates provide the business support and services required to accomplish center work including: safety; procurement; legal; human resources and equal opportunity programs; information and financial management; education and strategic analysis, communications, and business development.

IMPORTANT ACTIVITIES

Langley Programmatic Roles Tied to Strategic Goals: Langley is focused on mission success in Human Exploration and Operations, Science, Space Technology, and Aeronautics research and development. Specific activities include:

Human Exploration and Operations – Langley supports the Orion Multi-purpose Crew Exploration Vehicle (MPCV) development, including leadership of the Launch Abort System (LAS); landing systems development, including testing and analysis (Langley's Hydro Impact Basin tests); and aerosciences across ascent (nominal and abort) and reentry. This aerosciences support includes aerodynamics, aerothermodynamics,

and guidance navigation and control (GN&C) analysis and wind tunnel testing. The same suite of aerosciences support is also applied to the SLS development. At the strategic level, Langley supports mission/architecture design and analysis, vehicle conceptual design, and technology trades and analyses. For Commercial Space, Langley provides engineering and management support to the Commercial Cargo and Crew Program Offices, as well as engineering analysis and test support to several commercial space companies via reimbursable Space Act Agreements (SAAs). Langley serves as the deputy of the Space Radiation element of the Human Research Program (HRP) using unique expertise in radiation transport code development and analysis, and supports the Advanced Exploration Systems (AES) activity in radiation protection, Multi-Mission Space Exploration Vehicle, and Deep Space Habitat, Common Avionics, and Autonomous Hazard Avoidance and Landing Technology (ALHAT) development.

Science – Langley will continue to obtain and analyze critical data from Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation (CALIPSO), Clouds and Earth's Radiant Energy System (CERES) instruments operating on the Terra and Aqua spacecrafts, and CERES Flight Model - 5 (FM-5) on Suomi National Polar-orbiting Partnership (NPP) spacecraft. Langley is preparing the Stratospheric Aerosol and Gas Experiment III (SAGE III) instrument on International Space Station (ISS) for launch in 2015 and the follow-on CERES FM-6 instrument. Langley provides system engineering leadership to the Committee on Earth Observing Satellites (CEOS). Langley will lead the airborne DISCOVER-AQ mission under Earth Venture (EV-1) of ESSPP, and Langley will continue to provide EDL analysis supporting future planetary missions.

Space Technology - Langley is making significant contributions across the full spectrum of Space Technology programs and projects. Langley leads several GCDP projects, including: Lightweight Materials and Structures, Advanced Radiation Protection, and Hypersonic Inflatable Aerodynamic Decelerator (HIAD) [Langley led the very successful technology demonstration flight project, Inflatable Reentry Vehicle Experiment - 3 (IRVE-3), which launched during the summer of 2012]. Langley is developing concepts for a HIAD Atmospheric Reentry Test (HEART) that would be the first spaceflight test of a large-scale, hypersonic inflatable aerodynamic decelerator, making the benefits of this technology available for a wide range of future science and exploration missions. Langley is also leading the formulation of the Materials International Space Station Experiment-X (MISSE-X) project for the Technology Demonstration Missions (TDM) program in support of the Space Technology Mission Directorate.

Aeronautics – Langley is actively involved in aeronautics research projects within the Fundamental Aeronautics, Aviation Safety, Airspace Systems, and Integrated Systems Research Programs, and contributes to the advancement of ground and airborne testing capabilities within the Aeronautics Test Program. Langley is developing innovative solutions and advanced technologies required for the next generation of air transportation known as NextGen, and supports decision analysis through vehicle conceptual design, technology trades, and assessments. NASA's foundational and systems-level research across all flight regimes, including expertise in aerosciences, structures and materials, airspace modeling and simulation, combined with its related test infrastructure are essential to tackling the aviation safety, energy efficiency, and environmental challenges that must be addressed to make NextGen a reality.

Addressing these challenges will enable: simultaneous reduction in fuel burn, noise and emissions; routine operation of unmanned aerial vehicles in the National Airspace System; enhance aviation's ability to diagnose and respond to problems or system failures; and improve the flow and efficiency of the air transportation system while maintaining safety and security. Langley is planning a new proposed Advanced Composites Initiative to accelerate the timeline to bring innovative composite materials/structures products to market – moving from a 10-20 year template for development and certification to a 3-5 year cycle.

Revitalization of the Center's Infrastructure and Workforce to Meet Future Mission Needs and Emerging Technologies - Langley's physical infrastructure revitalization strategy (ViTAL) includes six new, state-of-the-art facilities, renovation of critical infrastructure, and demolition of non-essential assets, all of which enable Langley to respond to the strategic and infrastructure challenges of the Agency while making the center more efficient to operate. Execution of this 20-year revitalization strategy reduces the operations and maintenance burden of the aging campus, while enabling future mission success. In addition to the physical infrastructure, Langley initiated new studies to develop comprehensive, multi-year transformation plans that are strategically aligned with future mission priorities and emerging new skills, such as modeling and simulation, that include both workforce and computational tools, and methods and infrastructure.

MAJOR ISSUES

Workforce Reshaping - The center's ability to reshape the workforce skill mix to align with current and future mission requirements is limited due to workforce age demographics and continually reduced center Full Time Equivalent (FTE) Civil Servant ceilings through FY15. This limits hiring and the ability to acquire skills in new emerging areas. Training can help with this issue, but ever tightening Center Management and Operations (CM&O) budgets limit the funding available for this training.

Hypersonics - The FY13 NASA budget reduction within hypersonics research places NASA's — and thus the nation's — air-breathing hypersonic capabilities at risk. Given that the cost of access to space is extremely high, NASA needs to look at options for the generation after next access to space launch system that hold the potential for reduced cost. NASA studies (c. 2002) conducted under the Next Generation Launch Technology Program identified hypersonic air-breathing propulsion as one such option that reduced cost, and in certain vehicle architectures, also greatly improved safety and operational flexibility compared to rocket-powered launch vehicles. It is in NASA's long-term interest to mature these hypersonic air-breathing propulsion-powered vehicle technologies to higher technology readiness levels, allowing well-informed decisions when NASA requires the generation after next space launch system. Given the current budget scenario, hypersonic airbreathing propulsion technology research will be restricted to primarily near and mid-term Department of Defense (DOD) applications.

KEY PERSONNEL

Lesa B. Roe, Center Director. In October of 2005, Roe was named Director of NASA's Langley Research Center. She is responsible for the center's technical implementation of aeronautical, space, and science programs and overall management of the center's facilities, personnel, and administration. She started her NASA career in 1985 and has over 25 years in engineering, technical, and managerial

positions in government and private industry, including NASA center leadership, International Space Station program management, technical management, and project engineering experience. She has worked at three NASA centers, including Johnson Space Center and Kennedy Space Center. She holds a Bachelor of Science degree in Electrical Engineering from the University of Florida and a Master of Science degree in Electrical Engineering from the University of Central Florida. Roe has received numerous honors, including the Presidential Rank Award, Exceptional Service Medal, and is an Associate Fellow in AIAA.

Stephen G. Jurczyk, Center Deputy Director. As Deputy Director, Jurczyk assists in general management and helps plan, organize and direct center and inter-center activities to advance research significant to national aerospace programs and objectives. He began his NASA career at Langley in 1988, has worked at Headquarters and Goddard Space Flight Center, and has served Langley as Deputy Director for Flight Systems; Director of the Systems Engineering Competency; and Director of the Research and Technology Directorate. Jurczyk earned Bachelor of Science and Master of Science degrees in electrical engineering from the University of Virginia in 1984 and 1987, respectively. He is a recipient of the NASA Outstanding Leadership Medal and the Presidential Rank Award of Meritorious Executive.

David E Bowles, Center Associate Director. As Associate Director, Bowles is responsible for day-to-day operations of the center and is senior advisor to the Center Director. Bowles began his NASA career in 1980 and has served Langley as Director of Exploration and Space Operations; Project Manager in NASA's Next Generation Launch Technology Program and in NASA's Advanced Subsonic Technology Program; and as Assistant Head of the Applied Materials Research Branch. Bowles completed a Senior Executive Service developmental assignment at Marshall Space Flight Center, and has served on several Agency-wide teams. He earned Bachelor of Science, Master of Science, and Ph.D. degrees in Engineering Mechanics from Virginia Polytechnic Institute and State University in 1978, 1980, and 1990, respectively, and is a recipient of NASA's Outstanding Leadership Medal.

4.9.9 MARSHALL SPACE FLIGHT CENTER (MSFC)

MISSION

The Marshall Space Flight Center (MSFC) performs systems engineering and integration for both human and robotic space missions. Marshall performs engineering design, development, and integration of the systems required for space operations, exploration, and science. The center also manages the Michoud Assembly Facility, which supports the unique manufacturing and assembly needs of current and future NASA programs, and provides critical telecommunications and business systems for the Agency.

ORGANIZATIONAL STRUCTURE

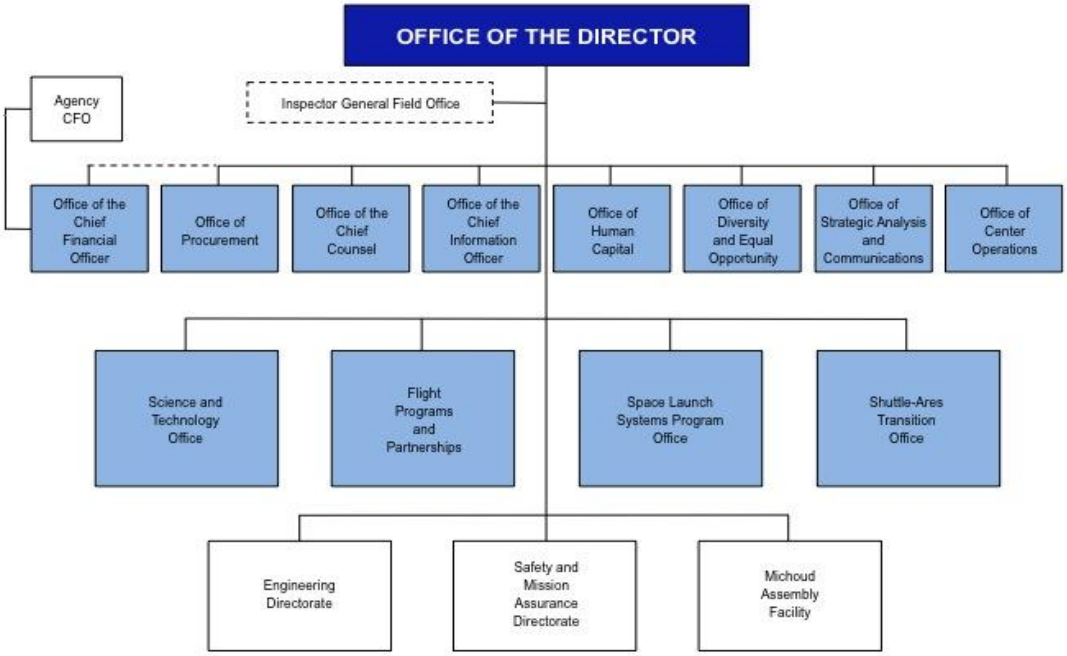


Figure 4.9.9-1: MSFC Organizational Structure

WORKFORCE

MSFC's workforce distribution:

- Allocation of Full Time Equivalent (FTE) Civil Servants = 2,489.6
- Contractors (Work Year Equivalents) = 2,913

BUDGET EST. ($M)

President's FY13 Budget Request	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017
Marshall Space Flight Center	$2280.9	$2170.9	$2230.0	$2281.9	$2307.6	$2255.8

Table 4.9.9-1: Marshall Space Flight Center Budget Runouts

CORE CAPABILITIES

Marshall provides the Agency with mission critical design, development, and integration of the propulsion, transportation, and space systems required for space operations, exploration, and scientific missions. The Center is also responsible for management of critical mission support efforts that provide telecommunications and business systems for the Agency. Marshall is one of NASA's largest field centers, occupying more than 1,800 acres on the U.S. Army's Redstone Arsenal. Marshall Space Flight Center's unique capabilities support sustaining engineering for today's challenging missions, while pioneering future U.S. journeys of discovery beyond Earth orbit.

Propulsion Systems: Marshall researches, develops, tests, and matures propulsion systems and technologies for both Earth-to-orbit launch and in-space missions. The center managed key propulsion hardware and technologies required to maintain the space shuttle's safe operation until it was retired. Marshall has significant expertise in chemical, nuclear, and propellant-free propulsion systems, as well as new green energy sources, such as space solar power and high-energy electric propulsion. Marshall has also developed new propulsion technologies such as the Fastrac engine system, which was developed in only three years and is the foundation for the SpaceX Merlin engine.

Space Transportation: Marshall capabilities and expertise support every stage of spacecraft and vehicle development. Teams at the center develop, test, and evaluate materials, processes, designs, and systems for space transportation, as well as full-up vehicles. The development of complex space transportation systems, including a national heavy-lift capability, is critically important to enhance U.S. aerospace competitiveness. Under NASA's Human Exploration and Operations Mission Directorate's Exploration Systems Development Division, the center oversees the design, development, and delivery of the Space Launch System (SLS), the nation's new heavy-lift launch vehicle. Marshall also provides solid rocket booster engineering and expertise to the Orion Multi-Purpose Crew Vehicle's launch abort system. The center is a leader in space transportation system design, analysis and testing of structural, avionics, and flight mechanics systems.

Space Systems: Marshall develops and manages human space systems that not only sustain humans in space, but also enable scientific observations, instrument deployment, and resource exploration. Many of Marshall's space systems are currently operational on the International Space Station, including logistics modules and connecting nodes, the Environmental Control and Life Support System (ECLSS), the Materials Science Research Rack (MSRR), and the Microgravity Science Glovebox (MSG). As home to the Payload Operations Center, NASA's primary International Space Station (ISS) science command post, Marshall plays a key role in coordinating and supporting U.S. and international experiment activities on the station. Marshall's space systems capabilities and expertise applied to space systems

technology demonstrations, scientific spacecraft and advanced concepts for future habitats is helping to lay the foundation for a new era of space exploration.

Scientific Research: Marshall's expertise opens the door to new scientific discoveries. Since the early days of the space program, the center has expanded human understanding through scientific exploration of Earth, the solar system, and the universe. The center's expertise in scientific specialties of planetary/lunar, Earth sciences, and high-energy sciences has enabled programs such as the Chandra X-ray Telescope, Gamma-ray Large Area Space Telescope (GLAST) Burst Monitor, Hinode solar research satellite, Hurricane Imaging Radiometer (HIRAD), and Discovery and New Frontiers solar system exploration programs. The Short-term Prediction Research and Transition (SPoRT) Center translates high-resolution scientific data for use by the National Weather Service and the SERVIR project integrates satellite information about natural or man-made disasters to provide real-time information to public health agencies and relief workers.

FUNCTIONS

The Space Launch System Program Office is responsible for developing the heavy-lift launch vehicle that will expand human presence to destinations beyond Earth orbit. This new rocket will be capable of lifting the Orion Multi-Purpose Crew Vehicle (MPCV) to asteroids, Lagrange Points and ultimately for missions to Mars. It will also serve as a backup launch system for supplying and supporting the International Space Station cargo and crew requirements not met by other available launch vehicles. SLS Program Office responsibilities involve activities associated with launch system hardware development and integration, including: propulsion systems (core stage and upper stage engines, boosters, and stages); the cryogenic propulsion stage; and spacecraft and payload integration. The SLS Program Office includes a Ground Operations liaison and an Advanced Development Office with the responsibility to identify and prioritize upgrades to evolve the launch vehicle as required by future exploration missions.

The Science and Technology Office is responsible for managing programs and projects outside of traditional transportation elements like the shuttle and the Space Launch System (SLS). As such, it performs researches, conceives, develops, integrates, operates, and manages activities for NASA science and exploration missions. The office also manages and develops new technologies for exploration. The office has made key contributions to the state of the art in Earth science (including weather prediction and climate change), space science, and human exploration. The office manages the operations and data analysis of the Chandra X-ray Observatory Program and the Fermi Gamma Ray Burst Monitor. Advanced exploration-focused technology projects, include but are not limited to: development of lightweight materials and structures, advanced propulsion systems, nuclear fission surface power and nuclear propulsion technologies, cryogenic propellant storage and transfer, and advanced in-space propulsion systems.

The Flight Programs and Partnerships Office manages the implementation of the center's work in the areas of Human Exploration projects and tasks, flight mission programs, and external partnerships. The office performs program management of MSFC-hosted science and technology flight mission programs and project or program management of MSFC-led medium to large science missions – from Discovery and larger to flagship class robotic spacecraft missions. The ISS office manages and operates human

spaceflight payloads and facilities, including the Environmental Control Life Support System. The office provides project and engineering support for the Launch Abort Systems for the Orion MPCV. The office also manages STMD Technology Demonstration Missions, with responsibility for each project development, launch, on-orbit checkout, mission operations, and data analysis. The Partnerships Office identifies opportunities to develop and maintain partnerships external to the Agency, including commercial, other government agencies, academia and, in coordination with the Headquarters Office of International and Interagency Relations, international partners.

The Engineering Directorate provides the highly skilled technical workforce that sustains space propulsion systems and supports the range of science missions under Marshall's purview. The Directorate conducts research and development activities related to engineering design, system integration, material and process engineering, test and evaluation, data analysis, space systems, payload operations, and system simulation. The Directorate's broad expertise in propulsion, materials, electrical, mechanical, thermal, software, and systems engineering makes it the focal point for technical excellence across the range of products Marshall delivers to further NASA's strategic goals and in working with a variety of partners and implementing industry best practices.

Shuttle-Ares Transition Office was established pursuant to the agency's transition plan. The office is responsible for identification and disposition of all areas associated with the transitioning and close-out of the space shuttle and Constellation Program's Ares Projects Office, including real and personal property, capabilities, hardware, records, and associated workforce as they affect Marshall. These responsibilities encompass the Space Shuttle Main Engine, External Tank, Reusable Solid Rocket Booster, and Constellation Ares projects.

The Safety and Mission Assurance Directorate plans, establishes, implements, and directs all safety and mission assurance activities for Marshall in-house and contracted activities to ensure compliance with program and project requirements and controls, and provides support and independent evaluations of projects and programs for compliance with and implementation of NASA requirements.

The Michoud Assembly Facility in New Orleans is an Agency-owned manufacturing facility that is managed by Marshall to provide vital support to NASA exploration and discovery missions. The Facility's capabilities include the manufacture and assembly of critical hardware components for the space shuttle and exploration vehicles under development at Marshall and other NASA field centers.

IMPORTANT ACTIVITIES

The NASA Enterprise Applications Competency Center (NEACC), located at Marshall, is designed to lead and sustain the transformation of NASA's administrative and business processes using enabling technology and proven industry best practices. The NEACC manages the majority of business systems that enable the major financial, procurement, logistics, human capital, and security processes for the Agency. This approach is consistent with the overall Federal Government strategy to consolidate, standardize, and modernize internal business processes to improve efficiencies and streamline Agency business functions. Marshall is responsible for the overall management of NASA's IT communication networks. The NASA Communications Service Office (CSO) is led out of MSFC and

is responsible for the implementation, evolution, and operations of NASA's wide-area-networks and local networks at each NASA center. The CSO's mission is to provide high quality, cost-effective telecommunications systems and services. The centrally controlled resources that comprise the NASA Integrated Space Network (NISN) Wide Area Network (WAN) services provide an effective means for NASA centers and facilities distributed across the United States and abroad to communicate on NASA internal planning and operations of NASA aeronautic and space missions.

The Agency Consolidated End-User Services (ACES) activity, managed by the Marshall Center, is one of five contracts under NASA's Information Technology Infrastructure Integration Program (I3P). ACES is a consolidated solution for delivering end-user IT services across the Agency to achieve increased efficiencies and reduced costs through standardization. Services include: purchasing, management, and support of computers, printers, cellular devices, office software, and NASA Operational Messaging and Directory Services (NOMAD) email and calendar. HP Enterprise Services is NASA's end-user IT service provider.

The Earned Value Management (EVM), a NASA initiative supported by Marshall, was implemented across the Agency. The center serves as the NASA Earned Value Management (EVM) Program Executive, which oversees Agency policy, strategic planning, and implementation of performance management processes and tools. Marshall also helps improve the Agency's project management processes by providing subject matter expertise in developing Agency handbooks for program control topics, and serves as the functional manager and database administrator for the Agency-wide EVM data analysis tool, *wInsight,* and Cobra.

MAJOR ISSUES

Marshall's strategic transition from a post-shuttle environment to one that strengthens and aligns its core competencies with the exploration mission of the agency is ongoing and affects the entire center's workforce, facilities, and infrastructure. The center provides mission-critical expertise for space operations, exploration, and scientific missions. Where appropriate, the center is pursuing partnerships with the aerospace community to make available its unique facilities, capabilities, and expertise.

KEY PERSONNEL

Patrick E. Scheuermann, Center Director. Scheuermann was named director of Marshall in September 2012. From 2010 to 2012, he served as director of NASA's Stennis Space Center where he implemented the Agency's mission in the area of rocket propulsion testing; developed and maintained NASA's world-class rocket propulsion test facilities; and ensured Stennis continued to serve as the systems engineering center for the Agency's applied science activities. Scheuermann was deputy director at Stennis from 2008 to 2010, and served as associate director from 2007 to 2008. From 2005 to 2007, he was the chief operating officer of NASA's Michoud Assembly Facility in New Orleans, LA. From 1998 to 2000, Scheuermann served in Washington, DC as a legislative fellow for U.S. Senate Majority Leader Trent Lott of Mississippi. Scheuermann joined NASA in 1988 as a propulsion test engineer at Stennis. A native of New Orleans, Scheuermann received a Bachelor's degree in Mechanical Engineering in 1986 from the University of New Orleans.

Vacant, Deputy Director.

Robin N. Henderson, Associate Director. Henderson was named associate director of Marshall in 2004. She previously served as chief operating officer of the National Space Science and Technology Center (2002-2004) and as deputy manager of Marshall's Microgravity Research Program Office (1998-2002). Henderson began her career at NASA in 1983 as a technical analyst and subsequently served in a progressive series of roles leading to her current appointment. She earned a Bachelor's degree in Industrial Engineering from the University of Alabama in Tuscaloosa.

4.9.10 JOHN C. STENNIS SPACE CENTER (SSC)

MISSION STATEMENT

The John C. Stennis Space Center (SSC) implements NASA's mission in areas assigned by two Agency Mission Directorates. The center manages and operates Rocket Propulsion Test facilities and support infrastructure for the Human Exploration and Operations Mission Directorate. It serves as Systems Engineering Center for and manages assigned Applied Sciences program activities for the Science Mission Directorate. SSC serves as the federal manager and host Agency of a major government multi-agency center.

ORGANIZATIONAL STRUCTURE

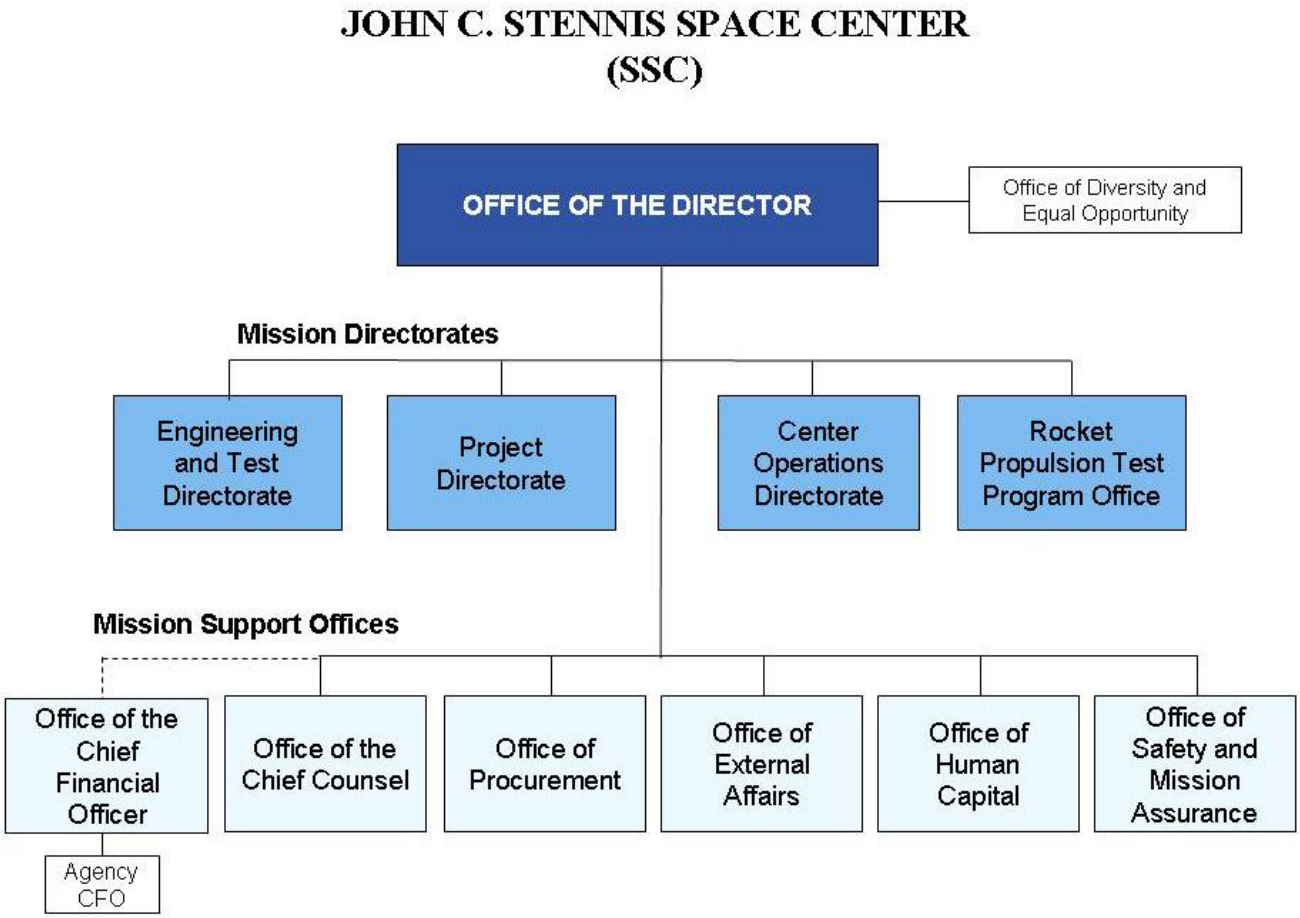


Figure 4.9.10-1: SSC Organizational Structure

WORKFORCE

SSC's workforce distribution:

- Allocation of Full Time Equivalent (FTE) Civil Servants = 307.0
- Contractors (Work Year Equivalents) = 1,070

BUDGET EST. ($M)

President's FY13 Budget Request	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017
Stennis Space Center	$179.1	$152.1	$125.8	$137.0	$140.7	$141.8

Table 4.9.10-1: Stennis Space Center's Budget Runout Estimates

CORE CAPABILITIES

Stennis is NASA's premier center for liquid rocket propulsion testing, providing a full range of capability, including component, subsystem, engine system, and integrated stage testing. The four large-engine test stands, canal system, and 125,000-acre acoustical buffer zone are considered national assets. Stennis is also host to the Navy, NOAA, NASA Shared Services Center, a number of state universities, and several commercial companies for a total of 5,131 personnel and an annual economic impact of $682 million within a 50-mile radius of the center.

MAJOR PROGRAMS/PROJECTS

The two major programs currently supported by Stennis are the Space Launch System Program (SLS) and the Commercial Spaceflight Program. This includes the SLS Core Engine (RS-25), Upper Stage Engine (J-2X), integrated core stage test, Orbital Science's flight certification of their AJ-26 first stage engine, and Blue Origin's engine component development testing.

FUNCTIONS

SSC's major functions are discussed immediately below.

Mission Directorates at Stennis Space Center include:

- The Engineering and Test Directorate (EA00),
- Project Directorate (PA00),
- Center Operations Directorate (RA00), and
- The Rocket Propulsion Test Program Office (TA00).

These organizations perform the following activities:

- Execute the center's major lines of business in rocket propulsion testing;
- Manage propulsion test projects for NASA, commercial customers, and other government agencies;
- Perform advanced planning for NASA programs to ensure Stennis is aligned with the Agency's strategic plan and initiatives;
- Extend the benefits of NASA's investment in Earth system science to demonstrate the value of advanced Earth observations, models, and research for the nation;
- Provide a comprehensive, integrated program of institutional services for the center;
- Provide leadership for NASA's rocket propulsion testing assets, activities, and resources; and

- Manage the center's day-to-day operations.

Mission Support Offices include:

- Office of the Chief Financial Officer (BA00),
- Office of the Chief Counsel (CA00),
- Office of Procurement (DA00),
- Office of Education (UA00),
- Office of Public Affairs (IA00),
- Office of Human Capital (LA00), and
- Office of Safety and Mission Assurance (QA00).

These offices carry out the following functions:

- Business and financial support to center programs, institutions, and resident agencies;
- Legal counsel and assistance to all organizational elements;
- Sound acquisition management and capabilities consistent with federal acquisition regulations and NASA Policy Directive (NPD) 5101.32;
- Effective communications with all constituencies;
- Strategic human capital management; and
- Reliable safety, risk, independent assessment, configuration management and quality assurance expertise for all programs, facilities, and support infrastructure.

IMPORTANT ACTIVITIES

Stennis currently operates 11 major test positions ranging from a small rocket engine component test capability to large rocket engine and stage test. SSC is currently supporting the Space Launch System (SLS) by testing the J-2X upper stage engine. SSC is also conducting planning to test the SLS core stage engine (RS-25). Early facility restoration work has begun to enable testing of the SLS core stage prior to its first flight.

The A-1 Test Ttand is currently being utilized for development testing of the turbo machinery subsystem of the J-2X engine system. By the first quarter of the year it will be transitioned to J-2X engine system development testing.

The A-2 Test Stand is currently being utilized for the development and certification of the J-2X engine system.

Construction of the A-3 Test Stand is on schedule to be completed in 2013. Activation planning is in work and activation testing is anticipated to begin midyear.

The B-1 Test Stand is currently used by Pratt Whitney Rocketdyne, pursuant to a Space Act Agreement, for development, certification, and acceptance testing of the RS-68 engine for the Delta IV launch vehicle for the U.S. Air Force.

The B-2 Test Stand restoration work is underway to prepare for integrated stage level testing for the core stage of the SLS

launch vehicle. Restoration of primary test stand systems and design and construction of unique test article interface systems are required. This facility was last utilized to support the Boeing Company's Delta IV Common Booster Core stage in 2001.

The E-Complex has three test stands (seven positions) that provide development rocket component, subsystem, and engine testing for NASA, Department of Defense (DOD), and commercial customers. The E-1 test facility is currently being utilized to support flight acceptance testing for the AJ-26 engine for Orbital Science's Antares launch vehicle in support of the Commercial Resupply Services Program as well as providing development testing to Blue Origin in support of the Commercial Crew Development Program. The E-2 facility is conducting testing to mitigate operations risks for the new A-3 test facility. The E-3 facility is conducting tests on the main engine of the Johnson Space Center (JSC) Morpheus Lander in support of the Advanced Exploration Systems Program. The E-1 facility is slated for future testing in support of the SLS Advanced Booster Development Risk Reduction Program.

In addition to rocket propulsion activities, Stennis has evolved into a multi-disciplinary laboratory compromised of other resident federal and state agencies, engaged in space, environmental, and national defense programs. To meet the increasing NASA requirements as well as those of our resident agencies, NASA is well on the way to completing its request to the Federal Aviation Administration (FAA) to expand the current restricted air space and establish military operating areas (MOAs) over and around Stennis control lands. The expanded restricted air space and MOAs, coupled with our unique buffer zone of approximately 125,000 acres, the operational needs of NASA rocket and untethered propulsion system testing and tenant related activities, such as unmanned aerial vehicle (UAV) research and development programs, and the Department of Defense (DOD) training missions, will be achieved more effectively and efficiently.

MAJOR ISSUES

The Aging Infrastructure and cuts in preventive maintenance on 45 year old facilities is a concern. A number of facilities are showing fatigue and are in need of repair, renovation, and modification. The problem is being resolved through repair and mitigation funding and construction of facility resources. One major project underway is to upgrade the High Pressure Industrial Water pipeline to the A-1, A-2, and B-1/B-2 Test Stands. This project will reset the age of this system back to a "new" status, providing a critical capability to the test stands that will be supporting the Agency's future testing needs. In addition, the B-2 Test Stand is scheduled for a major overhaul in anticipation of future testing requirements with initial funding received in FY12.

The Funding Profile for Rocket Propulsion Test Program (funded in Space Operations) is a concern since it will not cover increases in the cost of required goods and services resulting from annual inflation (escalation). This will lead to a reduction in critical workforce and facility maintenance required to sustain test support.

KEY PERSONNEL

Richard J. Gilbrech, Director of NASA's John C. Stennis Space Center, serving near Bay St. Louis, MSI. Prior to this appointment, he served as Deputy Director of Stennis. Dr. Gilbrech began his NASA

career in 1991 at Stennis in the area of propulsion test technology. In 1995, he became Stennis National Aerospace Plane project manager, responsible for construction, activation, and operation of a facility to test actively cooled structures. Dr. Gilbrech accepted a six-month detail at the Johnson Space Center in Houston in late 2000, where he served as Technical Assistant to the Space Shuttle Program Manager. He then returned to Stennis as Deputy Director of Propulsion Testing. In 2003, Dr. Gilbrech was named manager of the Propulsion Integration Office, responsible for managing NASA's rocket propulsion test facilities. In late 2003, he relocated to Langley Research Center in Hampton, VA, to serve as a principal engineer in the NASA Engineering and Safety Center. He later served as Deputy of the NASA Engineering and Safety Center at Langley and as Deputy Director of the Center. In February 2006, Dr. Gilbrech was named Director of Stennis Space Center, serving in that role until joining NASA's Exploration Systems Mission Directorate at Headquarters in October 2007. He left NASA in November 2008 to work in industry and returned to NASA Stennis as Associate Director in April 2009. Gilbrech received a Bachelor of Science degree from Mississippi State University, and Master of Science and Ph.D. degrees in Aeronautics from the California Institute of Technology.

Kenneth Human, Associate Director of NASA's John C. Stennis Space Center. Prior to assuming his current position, Human served as Deputy Manager, External Integration Office, International Space Station Program, and was responsible for managing the Program's external interfaces and relations with customers, both within the U.S. and abroad. Human began his career with NASA as an attorney at Stennis Space Center in 1978, shortly after receiving his Juris Doctor degree from the Franklin Pierce Law Center and being admitted to the bar in Virginia. Human served as Chief Counsel at Stennis for 21 years. Human has also been admitted to the bar in Louisiana and Texas, and is a member of the American and Federal Bar Associations. He received his Bachelor of Arts degree in English literature from George Washington University in 1973. Human graduated from the Senior Executive Fellows fellowship program at the John F. Kennedy School of Government at Harvard University in April of 2005, and he also graduated from the Federal Executive Institute "Leadership for a Democratic Society" in March 1995. He completed the Senior Executive Service Leadership Program in 2004.

5.0 NASA BUDGET AND HISTORY OVERVIEW

INTRODUCTION

The Agency's budget history displayed below has been assembled drawing on data contained in the NASA History Volumes and Agency Operating Plans from the last decade. Unfortunately, records maintained by the Office of the Chief Financial Officer (OCFO) have been misplaced or lost as a result of personnel and systems changes and the NASA History Volumes have proven to be less than reliable data sources. There are discrepancies between the data taken from those volumes and selected records subsequently assembled by the OCFO. Until the OCFO completes its validation effort with the Department of Treasury, this "roughly right" reconstruction remains the most detailed reconstruction currently available.

Figure 5-1 reflects NASA's entire budget history in real Year $ TQ or *"Transition Quarter,"* reflecting the change in the definition of the fiscal year that occurred between 1976 and 1977. Although the graph below depicts a continual rise in resources, when comparing all years with FY2005, there is actually a considerable decrease in buying power from NASA's earlier Apollo years.

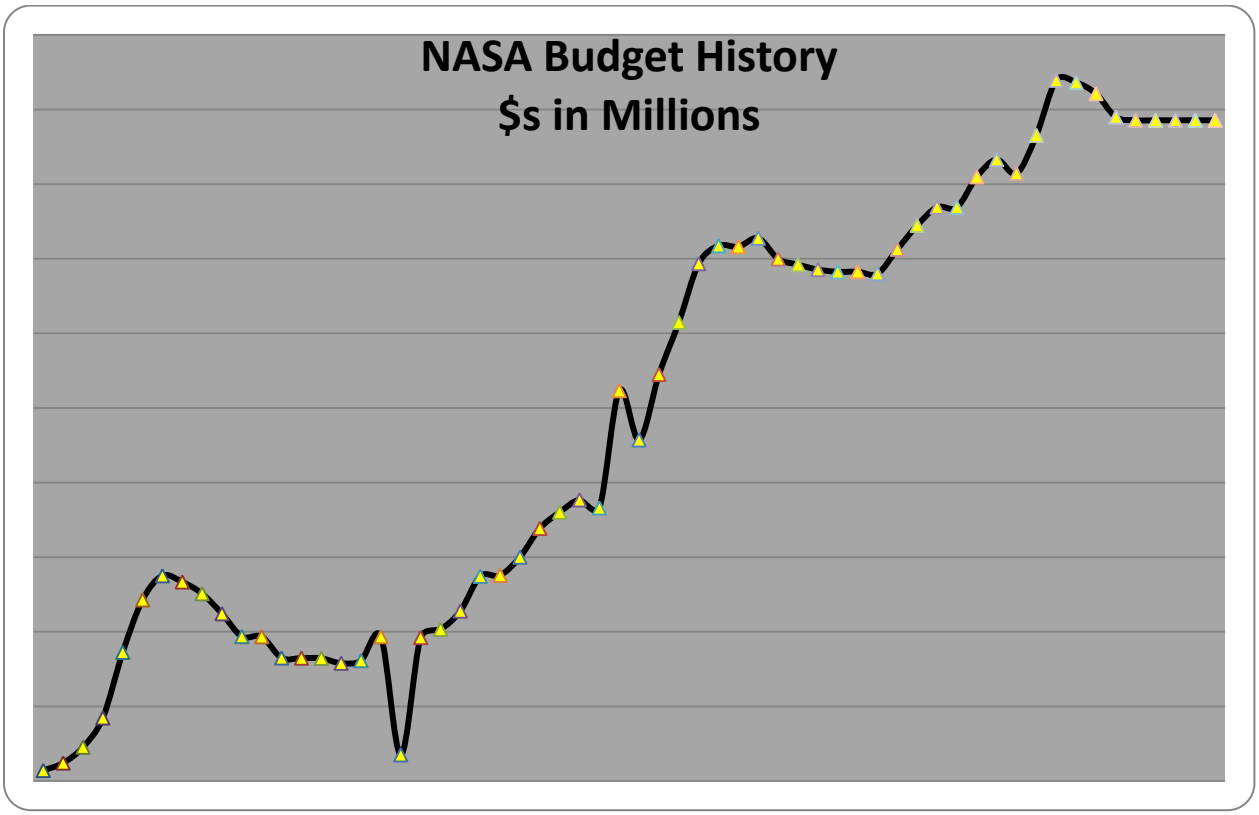


Figure 5-1: NASA Budget History in Real Year $

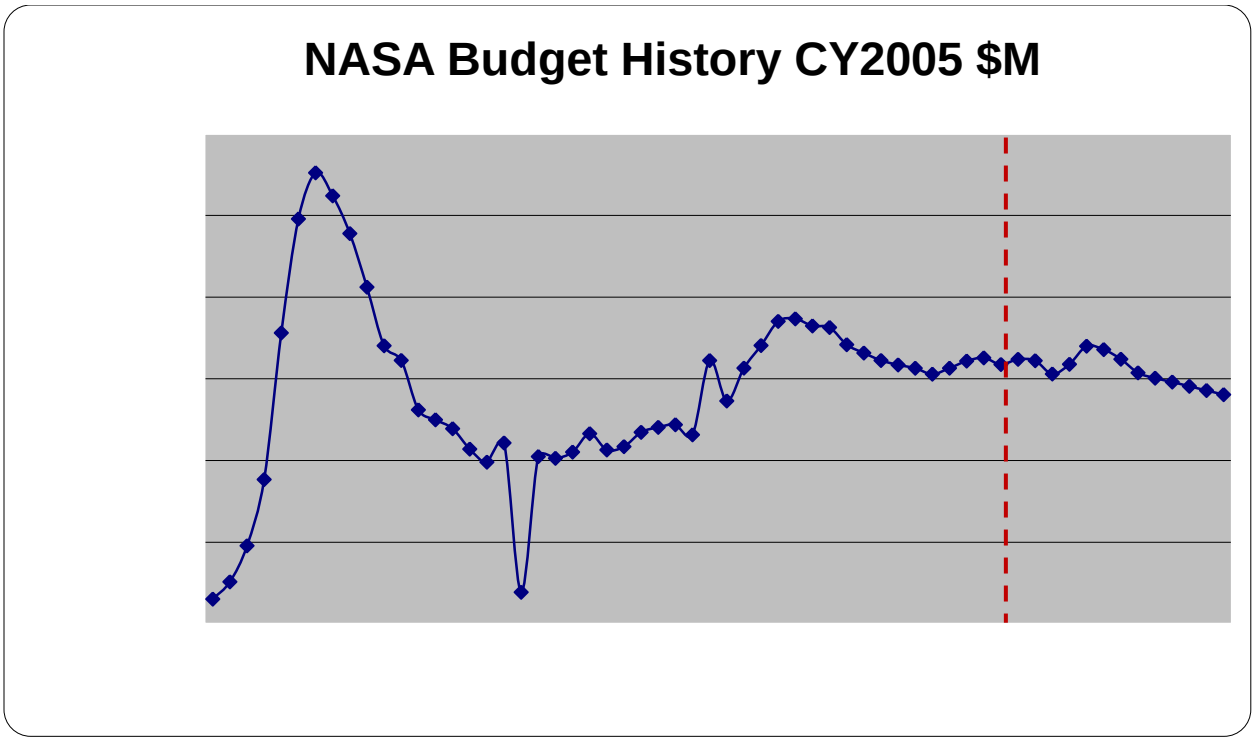


Figure 5-2: NASA History in Constant Year 2005 $

Figure 5-2 displays the same history in constant year 2005 dollars. The average annual budget from FY1959 to FY2012 in constant year 2005 dollars is $14.8B. Figure 5-3 displays the same budget in constant FY2005 dollars; we can see the fiscal stress points over the years. More importantly, since 2009, there is a steady decline in our annual budget due to the need to restrain federal spending. It should be noted that NASA appropriations have not kept pace with the inflation presented in the historical tables included in each of the President's Budgets since the early 1990s.

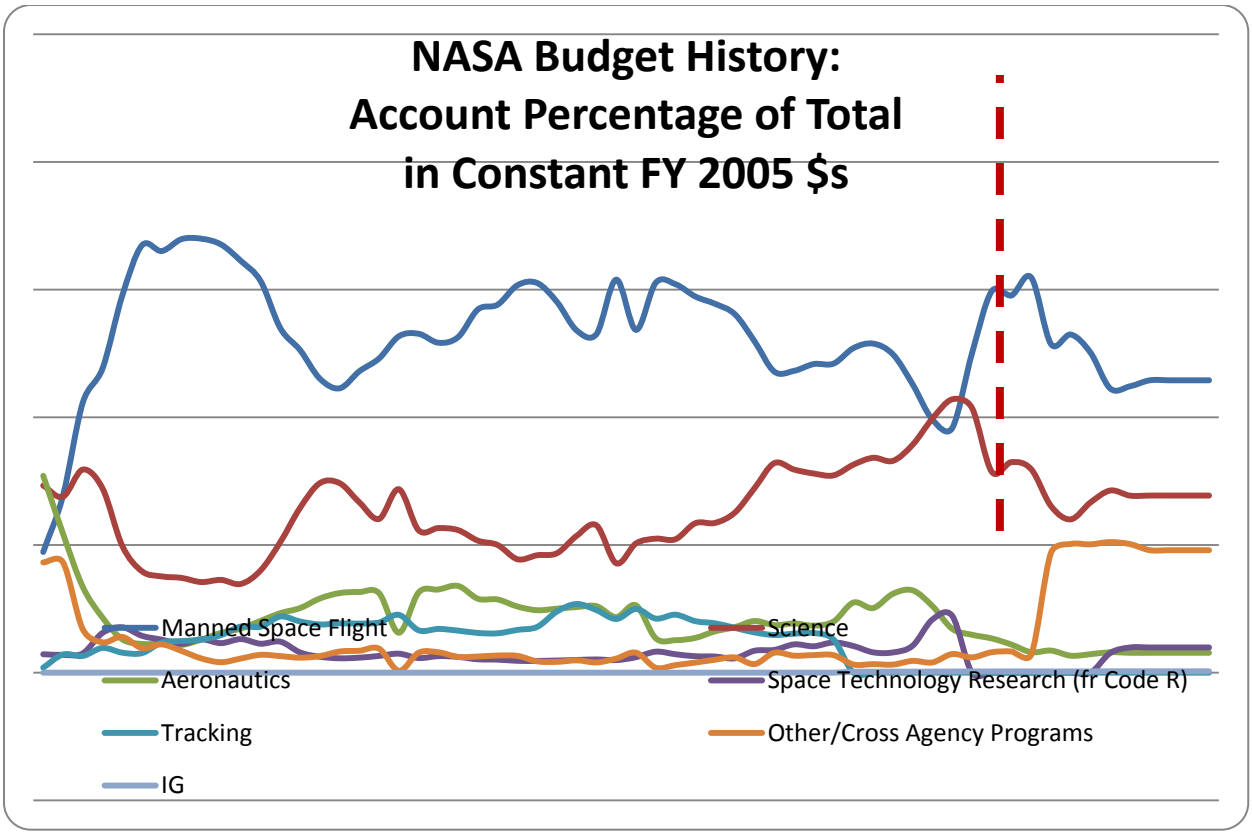


Figure 5-3: NASA History in Percentages Based on Constant Fiscal Year 2005$

Figure 5-3 shows each account over time as a percentage distribution to major accounts in Constant Year 2005 dollars. The dotted red vertical line shows the point in 2005 that serves as the baseline year for the budget in each year. Both Science and Human Exploration Operations combined investments constitute between 70 - 94 percent of NASA's budget in any given year, except in 1959 and 1960.

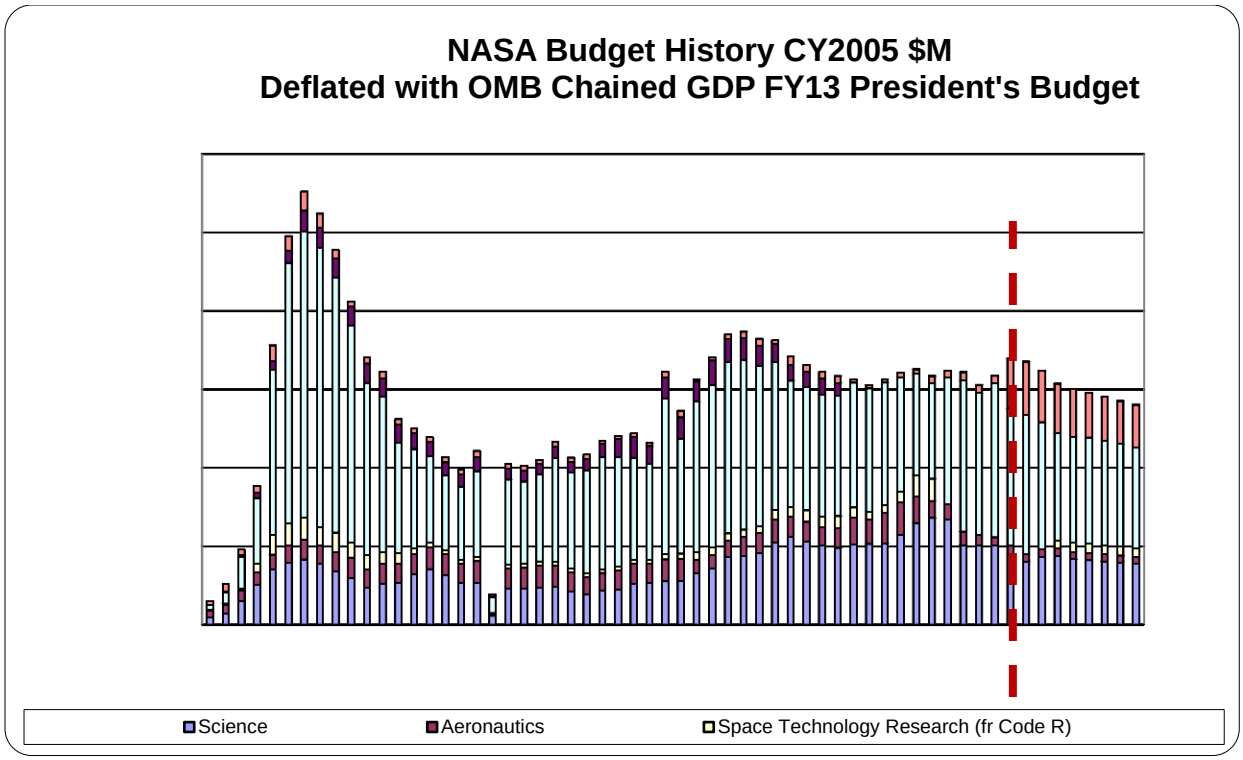


Figure 5-4: Constant Year 2005 $ View of Allocations to the Various Major Accounts

Figure 5-4 displays NASA's Budget history based on the nation's gross domestic product and deflators used to convert current dollar outlays to constant year 2005 dollars. The constant dollar deflators are based on chain-weighted (FY 2005 chained-dollars) price indices derived from the National Income and Product Accounts data. This graph is consistent with the previous graph, which shows the preponderance of our investments in both Science and Human Exploration Operations. Additionally, this also reflects when NASA began aggregating from other accounts such as the Cross Agency (CAS) and Headquarters Support, which includes Education (beginning in 2008). From FY2005, which serves as the base year, to the completion of FY12, NASA's average budget authority has experienced modest a decrease from $16.2B to $16.1B.

5.1 CURRENT ACCOUNT APPROPRIATIONS STRUCTURE

The current appropriations structure for FY 2012 is shown in Figure 5-4 and reflects a total budget of $17.77B for the year. Highlighted in yellow are the Appropriation account names which sums to NASA's total budget authority. Beneath the accounts and indented are the respective themes. The Science Appropriation includes five themes: James Webb Space Telescope (JWST), Earth Science, Planetary Science, Astrophysics, and Heliophysics. Space Technology is a relatively new account that began in FY2012. Currently, the Exploration and Space Operations combined make up the Human Exploration Operations (HEO) Mission Directorate. The remaining appropriations include Aeronautics, Education, Cross Agency Support, Construction and Environmental Compliance and Restoration, and the Inspector General.

The FY2013 continuing resolution (CR) levels in the 3rd column display the proposed NASA controls for operating under the "Continuing Appropriations Resolution 2013" dated September 10, 2012 and is in effect from October 1, 2012 through March 27, 2013. The terms of the FY2013 CR includes obligating at 100.6 percent of the FY2012 appropriation level; NASA chose to take a conservative approach in calculating our CR levels and did not include the above the board increase (ATBI) of 0.621 percent. NASA's planned FY2013 CR totals to $16.864B and is shown in the 3rd column of Table 5.1-1. NASA still retains transfer authority subject to reprogramming and NASA will not terminate or initiate new programs under the period of the CR. As a result of the uncertainty, NASA has chosen to run conservatively under the CR given the lean fiscal landscape. Typically, NASA only obligates three-quarters of the resources under the CR, which would equate to an annual rate of $13-14B. For the FY13 CR, NASA established account level controls by selecting the lower of the FY12 level, the FY13 request, and the House and Senate marks for FY 13, with a few exceptions (e.g., funding JWST at FY13 levels to maintain schedule).

($m)	FY 2012	Agency FY2013 CR Levels
Science*	$5,085	$4,862
Earth Science	$1,761	$1,761
Planetary Science	$1,500	$1,192
Astrophysics	$672	$659
JWST	$530	$628
Heliophysics	$622	$622
Aeronautics	$569	$569
Space Technology	$575	$575
Exploration	$3,767	$3,767
MPCV	$1,200	$1,200
SLS + EGS	$1,860	$1,860
Commercial Spaceflight	$406	$406
Exploration Research & Development	$302	$302
Space Operations*	$4,222	$3,723
Space Shuttle	$570	$71
International Space Station	$2,830	$2,830
Space and Flight Support	$822	$822
Education	$136	$100
Cross-Agency Support*	$2,994	$2,848
Center Management & Operations	$2,204	$2,093
Agency Management & Operations	$790	$754
Construction & Env Compliance & Remediation*	$385	$384
Construction of Facilities	$340	$340
Environmental Compliance & Restoration	$45	$45
Inspector General	$38	$37
NASA FY 2013*	$17,770	$16,864

***The total for FY 2012 is post-rescission, and does not include Above the Board Increase (ATBI=0.621%, as included in the House Bill). Totals may not add due to rounding**

Table 5.1-1: FY12 Appropriations Structure and FY 2013 CR Levels

6.0 NASA MAJOR MISSIONS

INTRODUCTION

NASA currently has more than two dozen major missions underway or planned among its four Mission Directorates, listed below:

Human Exploration and Operations Mission Directorate (HEOMD)

Science Mission Directorate (SMD)

Aeronautics Research Mission Directorate (ARMD)

Space Technology Mission Directorate (STMD) – *Note: at the time this document was created the Agency was in the process of restructuring the Office of Chief Technologist and setting up a separate Space Technology Mission Directorate*

This section profiles some of NASA's major missions. These missions are large-budget missions and/or high visibility. A description of these missions is provided, along with issues associated with the missions.

6.1 HUMAN EXPLORATION AND OPERATIONS MISSION DIRECTORATE (HEOMD)

The Human Exploration and Operations Mission Directorate (HEOMD) provides the Agency with leadership and management of NASA space operations related to human exploration in and beyond low Earth orbit (LEO). HEOMD also oversees low-level requirements development, policy, and programmatic oversight. The International Space Station, currently orbiting the Earth with a crew of six, represents the NASA exploration activities in LEO.

Exploration activities beyond LEO include managing Exploration Systems Development, Commercial Space Transportation, Human Space Flight Capabilities, Advanced Exploration Systems, and Space Life Sciences Research & Applications.

The directorate is similarly responsible for Agency leadership and management of NASA space operations related to Launch Services, Space Transportation, and Space Communications and Navigation in support of both human and robotic exploration programs.

The following describes some of HEOMD's major flight missions.

6.1.1 INTERNATIONAL SPACE STATION (ISS)

DESCRIPTION

The International Space Station (ISS) is a complex of research laboratories in low Earth orbit in which NASA and international astronauts conduct scientific and technological investigations in a space environment. The objective of the ISS is to support scientific research for human space exploration and other activities requiring the unique attributes of the space environment. ISS research is focused on science and technology development that will prepare human explorers to travel beyond LEO. The ISS serves as a platform for research activities that help achieve this goal. Research aboard the ISS is critical in order to accomplish the following:

- Understand the effects of space environments on the human body;
- Develop techniques for mitigating these hazards;
- Minimize the logistical burden of supporting humans far from Earth;
- Address remote medical emergencies; and
- Demonstrate enabling technologies for human exploration.

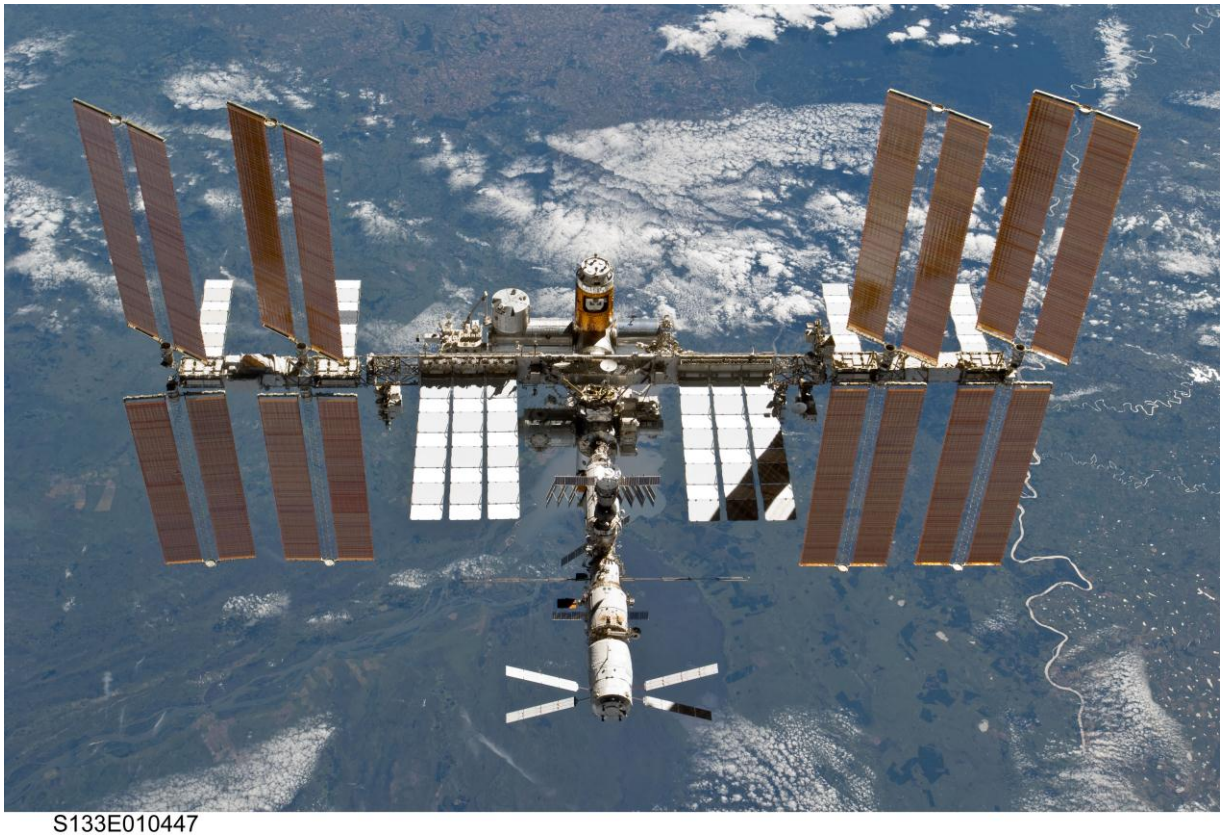


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Figure 6.1-1: The International Space Station.

The ISS Program represents an unprecedented level of international cooperation. The ISS International Partnership is composed of NASA, the Russian Federal Space Agency (Roskosmos), the Canadian Space Agency (CSA), the European Space Agency (ESA), and the Japan Aerospace Exploration Agency (JAXA). International participation in the program has significantly enhanced the capabilities of the ISS.

The ISS has completed assembly and has entered an intensive research phase through at least 2020. As an international partnership, the ISS is driving technological breakthroughs and scientific discoveries that enable future space exploration and realize benefits to our global societies. The strategic challenge now is to explore the benefits and opportunities of extending ISS utilization and operations to its original design life of 2028 through engaging our U.S. stakeholders and international partners.

The ISS represents an unparalleled capability for human space-based research that cannot be pursued on Earth, as well as a platform for the development of exploration technologies critical to NASA's future missions of exploration beyond LEO. It is a place to learn how to live and work in space over a long period of time, foster new markets for commercial products and services, and provide unique benefits to the citizens of the U.S. and the world.

The ISS supports research across a diverse array of disciplines, including high-energy

particle physics, Earth remote sensing and geophysics experiments, molecular and cellular biotechnology experiments, human physiology research, radiation research, plant and cultivation experiments, combustion research, fluid research, materials science experiments, and biological investigations. It is NASA's only long-duration flight analog for future human deep space missions, and provides an invaluable laboratory for research with direct application to the exploration requirements that address human risks associated with deep space missions. It is the only space-based multinational research and technology testbed available to identify and quantify risks to human health and performance, identify and validate potential risk mitigation techniques, and develop countermeasures for future human exploration. Research and development conducted aboard the ISS holds the promise of next-generation technologies, not only in areas directly related to NASA's exploration efforts, but in fields that have numerous terrestrial applications, as well. The ISS is critical to NASA's future missions of exploration beyond LEO.

On August 31, 2011, NASA finalized a cooperative agreement with the Center for the Advancement of Science in Space (CASIS) to manage the portion of the ISS that operates as a U.S. National Laboratory. CASIS, located in the Space Life Sciences Laboratory at Kennedy Space Center in Florida, serves as an independent, nonprofit research management organization responsible for ensuring the Station's unique capabilities are available to the broadest possible cross-section of U.S. scientific, technological, and industrial communities. CASIS is developing and managing a varied R&D portfolio based on U.S. national needs for basic and applied research; establishing a marketplace to facilitate matching research pathways with qualified funding sources; and stimulating interest in using the national lab for research and technology demonstrations. During its first year of operations, CASIS released three requests for proposals in the areas of Advancing Protein Crystallization Using Microgravity, Materials Testing in the Extreme Environment of Space, and Hyperspectral Imaging for Commercial Product Development. CASIS is finalizing its permanent Board of Directors and pursuing a new Executive Director.

In order to realize the full potential of the Station's capabilities, the platform is serviced by a fleet of operational international vehicles provided by Japan, Europe, and Russia. However, NASA is committed to launching cargo and crew on spacecraft built by American companies as soon as possible. NASA is very pleased with the progress our commercial space industry partners have made and continue to make in the development of crew and cargo transportation systems. Space Exploration Technologies (SpaceX), the first U.S. commercial cargo vehicle, successfully launched and berthed with the ISS on October 7, 2012, and Orbital Sciences Corporation (Orbital), the second U.S. commercial cargo vehicle, is in its final stages of development and testing, preparing for its first demonstration launch in the coming months. Our partners in the commercial crew program are meeting planned milestones and vehicles are under development to ensure continued robust operations of the ISS. American commercial crew transportation and emergency return services will enable the U.S. to fly its own astronauts to and from the ISS, end our sole reliance on foreign governments, increase the ISS crew complement to seven from six, enable increased ISS research utilization, and allow NASA to focus on deep space exploration.

The ISS continues to be a very healthy system, operating well within prudent technical

margins, and consistently demonstrating outstanding steady-state performance that meets or exceeds prior engineering estimates. While systems were originally specified to be both reliable and maintainable, the operational experience NASA and its partners are gaining is providing invaluable information on reliability and maintainability standards for future application to spacecraft design and mission planning. As in any complex system deployed in an extreme environment, occasional component outages or failures are to be expected and are replaced or repaired under a rigorous maintainability program.

The ISS operations are financially lean and efficient. Operations costs are monitored constantly to ensure a safe and functional spacecraft and are independently reviewed and critiqued by the agency through the Standing Review Board process. At this point in the program and into the future, transportation costs for crew and cargo exceed operations costs.

The ISS represents two extraordinary assets that have never before existed in the history of human space exploration: an experienced international partnership encompassing Canada, Europe, Japan, Russia, and the U.S., and a permanently crewed, full-service space station in LEO. Our ability to continue working together as a global team while making the best applied use of our assets will pace the future progress of space exploration and expansion of benefits on Earth.

FY 2013 Budget Request

Budget Authority ($ millions)	FY 2011 Actual	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017
International Space Station Program	2,713.6	2,829.9	3,007.6	3,177.6	3,170.9	3,212.8	3,234.3

Table 6.1-1: Budget Request for ISS Program

Issues

NASA faces strategic challenges and opportunities ahead as we continue to sustain and productively utilize the ISS.

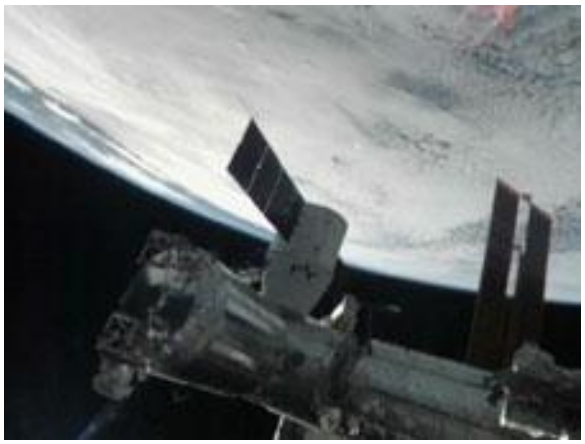
- Current NASA research budgets and commercial funding via CASIS will only allow development of a small fraction of the high priority items in the recent NRC Decadal Studies.
- Major technology demonstrations require significant cooperative funding that cross organizational management and funding lines.
- ISS is relying on U.S. industry to provide cargo resupply, return, and disposal services, as well as crew transportation and emergency return services. While there are still challenges ahead, the recent success of the SpaceX flight is a harbinger of the potential for procuring transportation services from private entities.

Commitment to extend the ISS beyond 2020 to 2028 requires engagement during the upcoming PPBE 2015 process and discussions within the international partnership.

6.1.2 COMMERCIAL SPACEFLIGHT DEVELOPMENT

DESCRIPTION

NASA is committed to launching cargo and crew on spacecraft built by American companies as soon as possible. These efforts are good for NASA, the American taxpayer, and the U.S. economy. American commercial transportation systems will enable the United States to fly cargo and crew to and from the International Space Station (ISS), end our sole reliance on foreign governments, potentially increase the ISS crew complement to seven from six, enable increased ISS research utilization, enable U.S. global competitiveness in the commercial space launch industry, and allow NASA to focus on deep space exploration.



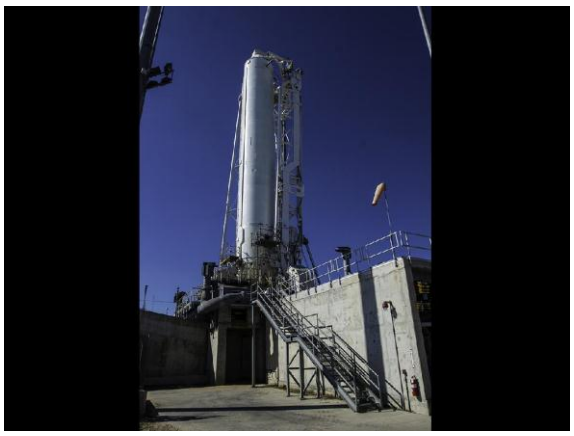


Figure 6.1-2: SpaceX Dragon at ISS (top) and Orbital Sciences Corporation's Antares on Its Launch Pad (bottom)

To facilitate the development and demonstration of commercial space transportation systems, NASA is partnering with U.S. industry in a non-traditional approach, providing technical and financial resources for the development of commercial space transportation systems that private industry will own and operate. Once the systems are demonstrated and available for purchase, NASA becomes a customer, contracting for transportation services for crew and cargo to the ISS.

In 2006, NASA implemented the Commercial Orbital Transportation Services (COTS) initiative to enable development and demonstration of U.S. cargo transportation capabilities.

NASA used its Space Act Authority to enter into partnership agreements. With this approach, NASA supported the emerging providers by providing financial investment and technical support. Commercial partners were responsible for a portion of the funding necessary to demonstrate the capabilities and were allowed to keep intellectual property rights to their designs. NASA was not required to pay for any milestone until the milestone was successfully completed and approved by NASA.

In August 2006, NASA selected two commercial partners to demonstrate their transportation capabilities: SpaceX and RocketPlane Kistler. RpK missed several technical and financial milestones, leading NASA to terminate the agreement in October 2007. NASA conducted a second competition for the remaining funds and selected Orbital Sciences in February 2008. In a separate competitive procurement for cargo transportation services to the ISS, NASA awarded two contracts to SpaceX and Orbital procuring in total 20 missions to the ISS through 2015.

On May 31, 2012, SpaceX completed its final COTS demonstration mission, accomplishing all objectives and clearing SpaceX to begin commercial resupply service missions to the International Space Station in October 2012. SpaceX conducted the historic flight within 11 months of the final space shuttle flight, minimizing the gap in the U.S. space station cargo transportation capability. This partnership between NASA and SpaceX successfully demonstrated the ability of a commercial partner team to develop complicated space systems that help NASA meet its needs while strengthening U.S. industrial capability and competitiveness. Orbital Sciences is following close behind with their development and demonstration activities, with test flight of its Antares launch vehicle and demonstration mission to ISS with their Cygnus spacecraft planned in the months ahead.

In 2009, NASA began commercial crew initiatives to stimulate the private sector to develop and demonstrate human spaceflight capabilities that could ultimately lead to the availability of commercial human spaceflight services for both commercial and government customers. Those initiatives focused on maturing designs of elements of a crew transportation system. Partners matured their subsystems and spacecraft designs during two Commercial Crew Development (CCDev) efforts beginning in 2010 and projected to be complete by the end of 2012.

On August 3rd, 2012, NASA announced three new agreements with American commercial companies to design and develop the next generation of U.S. human spaceflight capabilities. Known as Commercial Crew Integrated Capability, or "CCiCap," these newly signed agreements will enable advances that are intended to ultimately lead to the availability of commercial human spaceflight services for government and commercial customers. Under CCiCap, industry partners

will mature their crew transportation capabilities as fully integrated systems, including the crew spacecraft, launch vehicle, ground systems, and mission control capabilities. The agreements commence with a 21-month base period that will run from August 2012 through May 2014, which includes completing major design efforts and risk reduction demonstrations, propulsion testing, abort tests, and landing tests. This 21-month period will lead to a critical design review level of maturity for two of these companies. The agreements also include proposed optional milestones beyond the base period, which NASA may fund incrementally, as needed. Current CCiCap partners include The Sierra Nevada Corporation, SpaceX, and The Boeing Company.

NASA is committed to ensuring that the requirements, standards, and processes for crew transportation system certification for missions to the ISS are held to the same or equivalent safety standards as other government human spaceflight initiatives. NASA certification will cover all aspects of a crew transportation system, including: development, test, evaluation, and verification; program management and control; flight readiness certification; launch, landing, recovery, and mission operations; sustaining engineering, and maintenance/upgrades. To ensure NASA crew safety, NASA certification will validate technical and performance requirements, verify compliance with requirements at the subsystem, process, and safety levels, validate that the crew transportation system operates in the appropriate environments, and quantify residual risks.

NASA has determined that FAR-based contracts are needed for ISS service missions and has decided to begin the initial certification efforts immediately to enable the earliest possible crew transportation. If NASA were to delay certification activities, the development of industry's capabilities could eventually reach the point where any changes necessary to meet NASA requirements would not be technically feasible or affordable, potentially extending our reliance on foreign systems.

To mitigate these risks, NASA is moving forward immediately with plans to compete and award two to four FAR-based fixed-price contracts in Certification Phase 1 that will begin early NASA-managed certification activities. These contracts are referred to as Certification Products Contract(s) (CPCs). The deliverables will include early life-cycle certification products (alternate standards, hazards analysis, and verification, validation, and certification plans). The period of performance will be approximately 15 months, with an expected award date in February 2013. CPC awards will not exceed $10 million per award.

At the conclusion of the CPC, NASA anticipates that more than one commercial provider will have achieved the technical maturity of an integrated critical design state to enable a Phase 2 competition for the Certification Contract. A separate, formal solicitation (RFP) will be released for the Phase 2 Certification Contract. Under NASA's planned strategy, the Phase 2 Certification Contract will include development, test, evaluation, and certification activities enabling NASA to assess the system capability for performing ISS missions in compliance with NASA requirements to ensure NASA CCP mission and safety objectives are achieved. To provide an incentive to any commercial provider who is successful in achieving Certification, the Phase 2 contract will include, as options, a nominal number of crewed missions to the ISS following successful Certification. NASA believes that having more than one contractor

through Phase 2 would provide significant advantages for ensuring safety and cost effectiveness. The ultimate number of awards will be driven by technical maturity, funding availability, and mission needs.

Phase 2 Certification activities will then lead to a competitive acquisition for the provision of commercial ISS transportation services using FAR-based, fixed-price contracts, similar to the manner in which NASA has contracted for commercial cargo services. Based on the information the Agency has received to date and assuming reasonable budget levels and technical progress, we believe that this acquisition strategy can enable services beginning in the 2017 timeframe. This estimate takes into consideration not only the schedule plans of our current industry partners, but also the NASA certification work described above.

FY 2013 BUDGET REQUEST

Budget Authority ($ millions)	FY 2011 Actual	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017
Commercial Spaceflight Development	606.8	406.0	829.7	829.7	829.7	829.7	829.7

Table 6.1-2: Budget Request for Commercial Spaceflight Development

ISSUES

While U.S. private industry and NASA have made tremendous strides in the area of commercial cargo, most notably in SpaceX's successful demonstration flight to the International Space Station (ISS) in May 2012, there is not a consensus among NASA's stakeholders that public-private partnerships are appropriate for development of crew transportation systems to LEO. Questions linger regarding the business case for commercial crew transportation, safety, NASA oversight, and cost. Consequently, the budget requests put forward by NASA have been consistently reduced. Compared to the original Commercial Crew Program FY11 President's Budget Request, appropriations have been reduced by over 50 percent. This has forced the Agency to delay the projected readiness level of commercial crew transportation systems by two years and reduce the number of competitors that NASA would have preferred to maintain in the early phases. The current operating lifetime for the ISS is 2020 and further budget cuts to the Commercial Crew Program could delay the operational date to close to the ISS end of life, unless the ISS lifetime is extended beyond 2020.

6.1.3 EXPLORATION SYSTEMS DEVELOPMENT

DESCRIPTION

Exploration Systems Development (ESD) is a division within the HEO Mission Directorate that has been charged to manage the development and integration of the nation's next generation of human exploration systems.

The programs within ESD that will provide the initial capability for crewed exploration missions beyond low Earth orbit (LEO) are Orion Multi-Purpose Crew Vehicle (MPCV) program, Space Launch System (SLS) program, and Ground Systems Development and Operations (GSDO) program.

- The Orion program is developing the vehicle that will carry a four-person crew beyond LEO, provide emergency abort capability, sustain the crew while in space, and provide safe re-entry from deep space return velocities.
- The Space Launch System (SLS) program is developing the heavy-lift vehicle that will launch the crew vehicle, other modules, and cargo for these missions.
- The Ground Systems Development and Operations (GSDO) program is developing the necessary launch site infrastructure to prepare, assemble, test, launch, and recover the SLS and Orion flight systems.

ESD's responsibilities are to provide insight and oversight of the programs to the HEOMD, to manage interfaces between programs, and track cross-program risks, as well as ensure cross-program integration is occurring.

ESD maintains a sharp focus on affordability and seeks to address cost savings measures through strategic requirements development, management approaches, and procurement strategies. To that end, ESD is pursuing "light touch" integration and employs a lean staff at HQ with strategic reach back to centers, including a small number of FTEs at HEOMD to lead critical activities. The majority of workforce is drawn from within Orion, SLS, and GSDO Programs, and, as appropriate, some center assets are used to directly support ESD level activities.

Figure 6.1-3: Space Launch

The flight test milestones driving the ESD schedule include:

- Exploration Flight Test-1 (EFT-1) in 2014; an uncrewed, two-orbit, high-energy-entry test mission that will obtain critical vehicle performance data needed to confirm detailed design of the Orion spacecraft.
- Exploration Mission-1 (EM-1) in 2017; the first uncrewed launch of Orion on the SLS heavy-lift rocket.
- Exploration Mission-2 (EM-2) in 2021; the first crewed launch of Orion and SLS.

6.1.3.1 ORION MULTI-PURPOSE CREW VEHICLE (MPCV)

Orion was designated as NASA's Multi-Purpose Crew Vehicle (MPCV) in May 2011. While Orion's shape resembles its Apollo-era predecessors, its capabilities are far more advanced. It will be the safest, most sophisticated spacecraft ever built, and it will be flexible enough to take us to a variety of destinations.

Orion features dozens of technology advancements and innovations that have been incorporated into the spacecraft's subsystem and component design. It includes both crew and service modules, a spacecraft adaptor, and a revolutionary launch abort system that will significantly increase crew safety. Orion's unique life support, propulsion, thermal protection, and avionics systems, in combination with other elements, will enable extended duration deep space missions. These systems have been developed to facilitate integration of new technical innovations as they become available in the future.

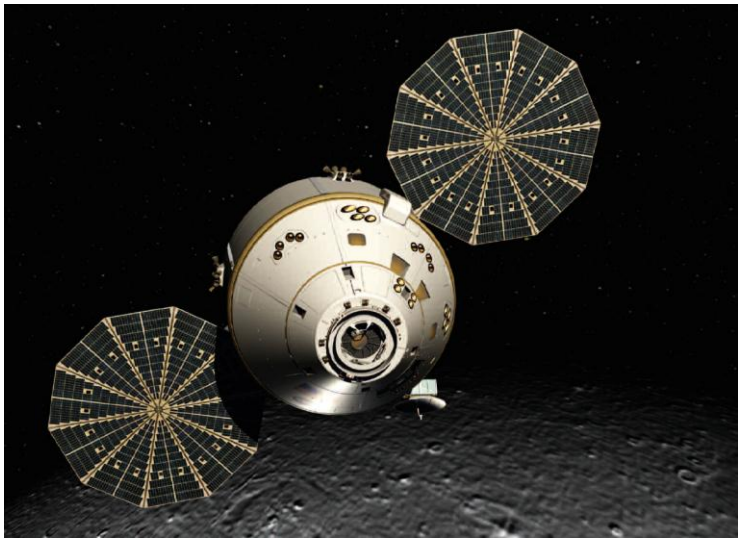


Figure 6.1-4: Illustration of Orion

Orion has been rigorously tested as engineers prepare it for a journey beyond LEO. A successful test launch at the White Sands Missile Range in New Mexico of the vehicle's launch abort system was completed to verify the escape capability of Orion in the event of emergency on the launch pad. A series of rigorous acoustic and modal tests on the Orion ground test vehicle at Lockheed Martin's test facilities in Denver validated Orion's ability to withstand the harsh environments of launch, abort, re-entry, and spaceflight.

In order to simulate the final phases of landing, the spacecraft's parachutes have been proven reliable through a series of tests at the Yuma Army Proving Grounds. In order to simulate Orion's landing conditions, tests in both the ocean and at NASA's Hydro Impact Basin have recreated how Orion will behave during its final splashdown in the Pacific Ocean. All of

these will play a role in the upcoming flight test of Orion.

Exploration Flight Test-1 (EFT-1)
Exploration Flight Test-1, an uncrewed mission planned for 2014, will see Orion travel farther into space than any human spacecraft has gone in more than 40 years. EFT-1 data will influence design decisions, validate existing computer models, and innovate new approaches to space systems development, as well as reduce overall mission risks and costs.

The Orion flight test vehicle is comprised of five primary elements, which will be operated and evaluated during the test flight.

1. The Launch Abort System (LAS) - propels the Orion Crew Module to safety in an emergency during launch or ascent.
2. The Orion Crew Module (CM) - houses and transports NASA's astronauts during spaceflight missions.
3. The Service Module (SM) - contains Orion's propulsion, power, and life support systems.
4. The Spacecraft Adaptor and Fairings - connects Orion to the launch vehicle
5. The Multi-Purpose Crew Vehicle to Stage Adaptor (MSA) – connects the entire vehicle structure to the kick stage of the rocket.

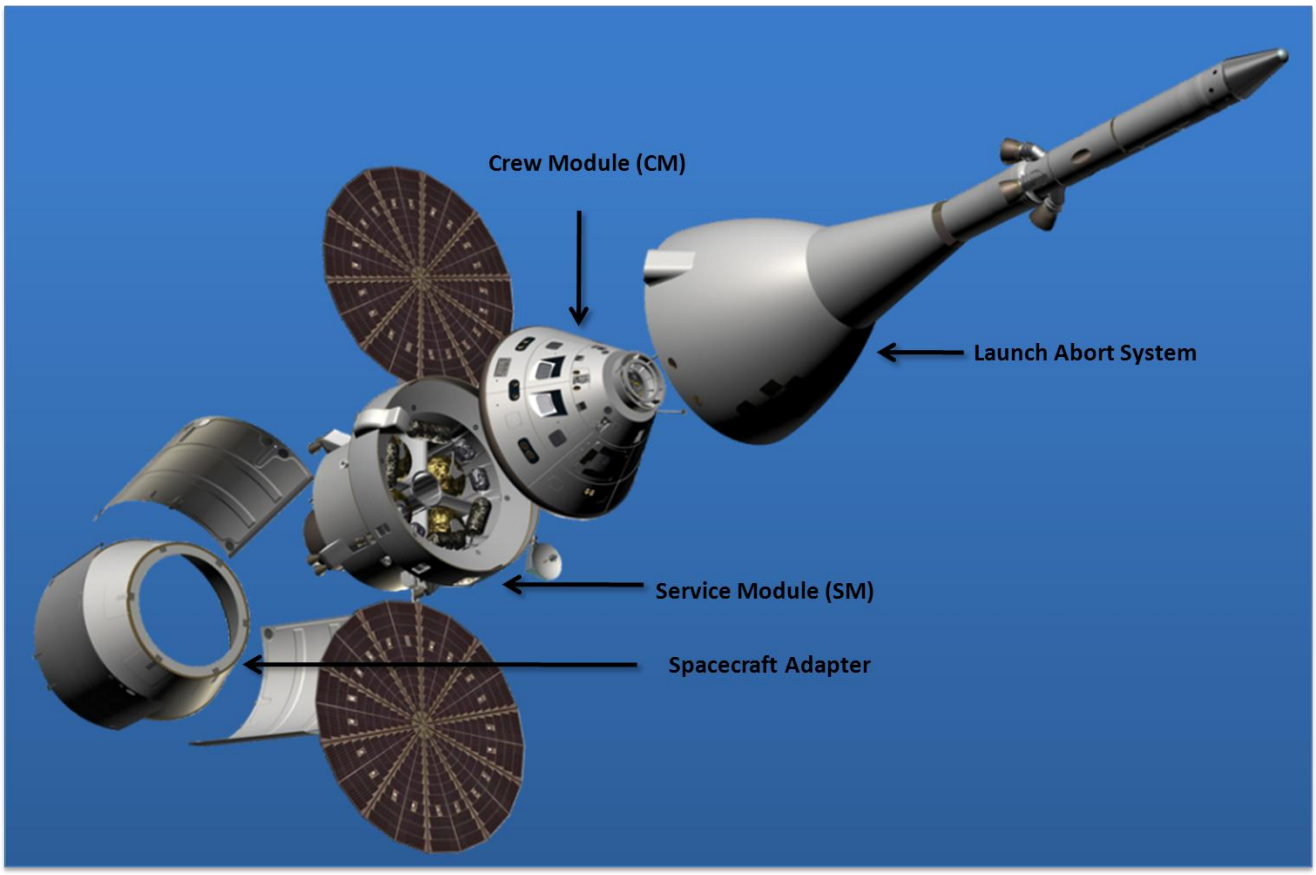


Figure 6.1-5: Orion: Expanded View

The uncrewed EFT-1 flight will take Orion to an altitude of approximately 3,600 miles above Earth's surface, more than 15 times farther than the International Space Station's orbital position. By flying Orion out to those distances, NASA will be able to see how Orion performs in and returns from deep space journeys.

The first Orion spaceflight vehicle will be integrated with the Delta IV Heavy, a rocket built and operated by United Launch Alliance. While this launch vehicle will provide sufficient lift for the EFT-1 flight plan, a much larger, human-rated rocket will be needed for the vast distances of future exploration missions beyond LEO.

After the test flight, Orion will reenter the atmosphere at a speed of over 20,000 miles per hour, returning to Earth faster than any current human spacecraft. As Orion reenters the atmosphere, it will endure temperatures up to 4,000º F — higher than any human spacecraft since astronauts returned from the moon. Orion will land in the water and be recovered. This test will provide engineers with invaluable data on Orion's performance in every phase of launch, re-entry, and landing.

Figure 6.1-6: Illustration of Orion High Velocity Return

Summary

Orion will utilize advances in propulsion, communications, life support, structural design, navigation, and power, drawing upon more than 50 years of extensive spaceflight experience of NASA and its industry partners. With destinations including near-Earth asteroids, our own moon, the moons of Mars and eventually Mars itself, the Orion spacecraft is designed to meet the evolving needs of our nation's deep space exploration program for decades to come.

FY 2013 Budget Request for Orion

FY 2013 President's Budget Request ($ Millions)	FY 2012 Actual	FY 2012 Enacted	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017
The Orion Spacecraft	1,200	1,200	1,028.2	1,028.2	1,028.2	1,028.2	1,028.2

Table 6.1-3: Budget Request for Orion

6.1.3.3 SPACE LAUNCH SYSTEM (SLS)

NASA's Space Launch System, or SLS, is an advanced, heavy-lift launch vehicle, which will provide an entirely new capability for science and human exploration beyond Earth's orbit. The Space Launch System will give the nation a safe, affordable, and sustainable means of reaching beyond our current limits of discovery. The Space Launch System vehicle configuration was announced in September 2011.

As NASA's commercial partners create an American supply line to the International Space Station, SLS will provide the transportation needed for NASA to reach further into our solar system. The SLS will carry the Orion Multi-Purpose Crew Vehicle, as well as important cargo, equipment, and science experiments to deep space. However, if needed, SLS will support backup transportation to the International Space Station.

Figure 6.1-7: Illustration of SLS Leaving Earth Orbit

Capabilities and Missions

SLS is designed to be flexible and evolvable to meet a variety of crew and cargo mission needs. Providing an evolvable architecture allows customization of the SLS to fit individual mission requirements, increasing capability with each configuration.

In 2017, the first SLS mission, Exploration Mission 1 (EM-1), will launch an uncrewed Orion spacecraft to demonstrate the integrated system performance of the SLS rocket and spacecraft prior to a crewed flight.

The second SLS mission, Exploration Mission 2 (EM-2), is targeted for 2021 and will launch Orion and a crew of up to four American astronauts.

The SLS will use proven hardware and cutting-edge tooling and manufacturing technology from the space shuttle and other exploration programs. This will significantly reduce development and operations costs. It will use a liquid hydrogen and liquid oxygen propulsion system, which will include the RS-25 engine from the Space Shuttle Program for the core stage and the J-2X engine for the upper stage. The SLS also will use solid rocket boosters for the initial development flights, while industry will compete to design advanced boosters based on performance requirements and affordability considerations.

Initial 70-metric-ton Rocket Development

The 70-metric-ton SLS will stand 321 feet tall, provide 8.4 million pounds of thrust at liftoff, weigh 5.5 million pounds, and carry 154,000 pounds of payload.

Towering over 200 feet tall with a diameter of 27.5 feet, the core stage will store cryogenic liquid hydrogen and liquid oxygen that will feed the RS-25 engines for the SLS. The SLS core stage will get its power from four RS-25 engines — former space shuttle main engines, which operated with 100 percent mission success during 135 space shuttle missions. Flight computer hardware and battery unit development are under way.

Two five-segment solid rocket boosters will be used for the first two 70-metric-ton flights of the SLS. The prime contractor for the boosters — ATK of Brigham City, Utah — has begun processing its first SLS hardware components in preparation for the initial qualification test planned for spring 2013.

The spacecraft and payload integration team is responsible for integrating the Orion spacecraft and payload with the SLS vehicle using structural adapters. The team also will procure and integrate an interim cryogenic propulsion stage to power the first two flights of the SLS, based on Boeing's Delta Cryogenic Second Stage used on the Delta IV family of launch vehicles. The interim cryogenic propulsion stage will boost the Orion spacecraft to the correct altitude and trajectory needed to send the spacecraft around the moon in order to check out vital systems during the initial test flights.

While work progresses on the initial 70-metric-ton SLS, the advanced development team is working on improving affordability, increasing reliability, and increasing performance needed to evolve the initial vehicle to configurations that can provide even greater lift capacity. This evolved, flexible approach can meet a variety of missions needed to carry crew and cargo of varying sizes. Configurations over 100 metric tons up to 130 metric tons are currently being studied.

130-metric-ton Rocket Development

The massive 130-metric-ton configuration will be the most capable, powerful launch vehicle in history. Towering a staggering 384 feet tall, it will provide 9.2 million pounds of thrust at liftoff and weigh 6.5 million pounds. It will be able to carry payloads weighing 286,000 pounds to orbit. This configuration will use the same core stage, with four RS-25 engines, as previous configurations.

The 130-metric-ton SLS will include an upper stage to provide additional power needed to travel to deep space. The upper stage, built by Boeing, will share common attributes with the core stage, such as its outer diameter, material composition, subsystem components, and tooling, to save cost and design time.

Two J-2X engines being developed by Pratt & Whitney Rocketdyne will power the upper stage. The J-2X is a highly efficient and versatile rocket engine — the first liquid oxygen and liquid hydrogen rocket engine to be developed in 40 years that will be certified to transport humans.

Summary

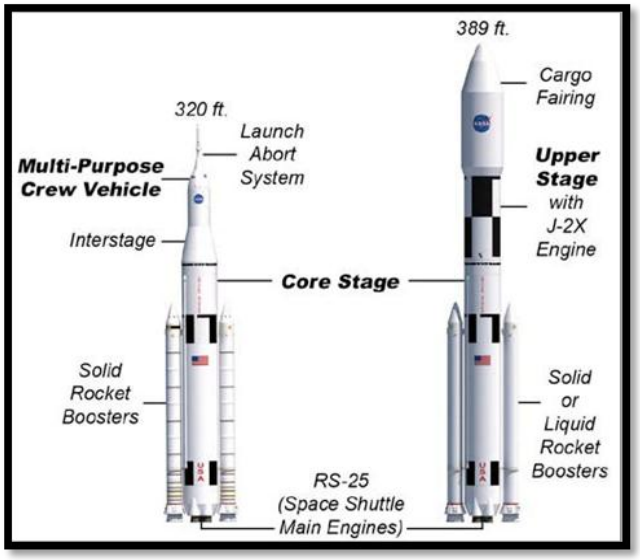


Figure 6.1-8: **70 metric-ton Initial Lift Capability in Crew Configuration and 130 metric-ton Evolved Lift Capability in Cargo Configuration**

The SLS will be NASA's first exploration-class vehicle since the Saturn V took American astronauts to the moon over 40 years ago. With its superior lift capability, the SLS will expand our reach in the solar system,

allowing astronauts aboard the Orion spacecraft to explore multiple, deep space destinations, including near-Earth asteroids, Lagrange points, the moon, and ultimately Mars.

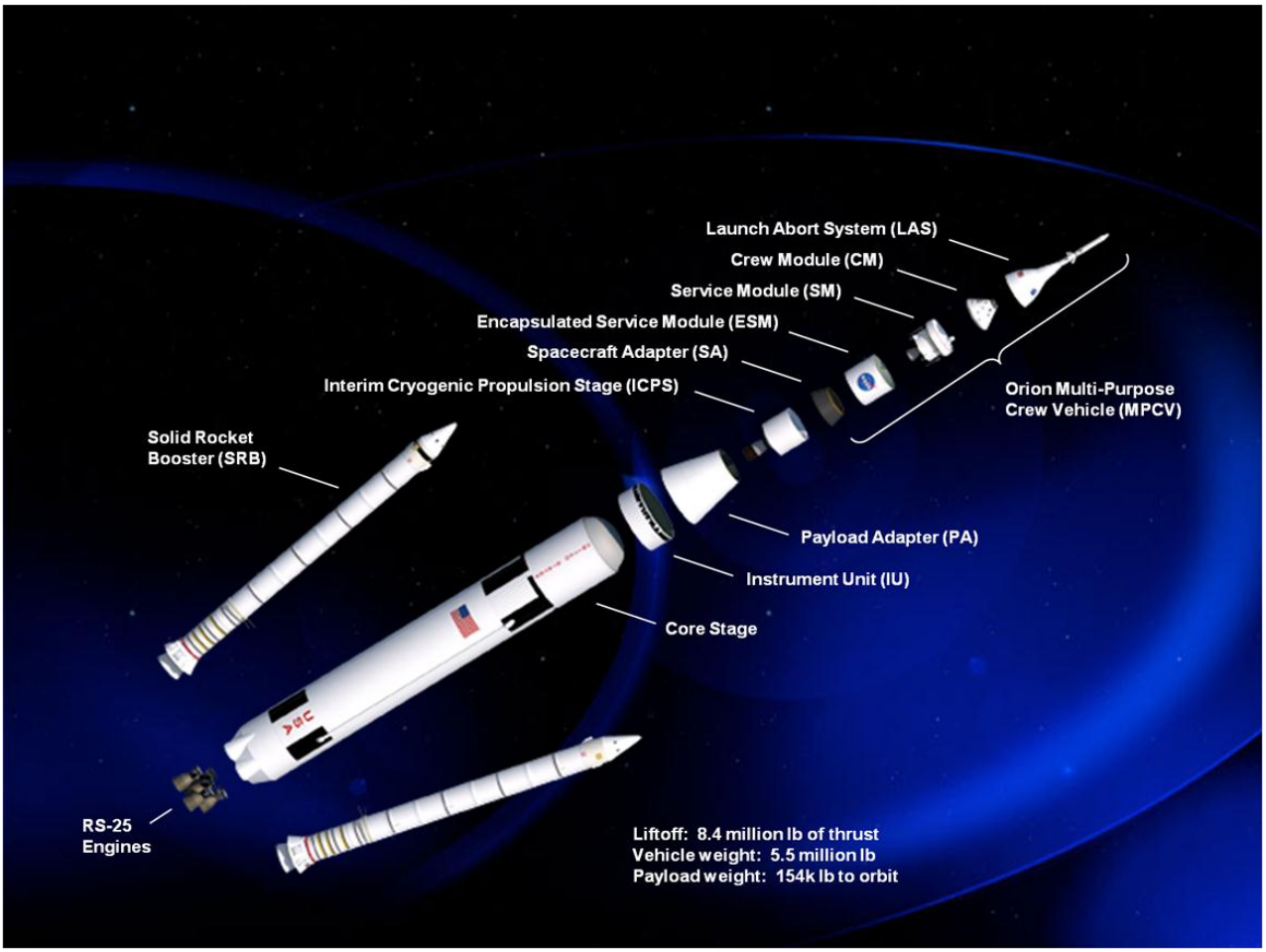


Figure 6.1-9: Initial Space Launch System (SLS) configuration (70mT to low Earth orbit), also referred to as SLS Block 1

FY 2013 BUDGET REQUEST

FY 2013 President's Budget Request ($ Millions)	FY 2012 Actual	FY 2012 Enacted	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017
Space Launch System	1,543.5	1,543.5	1,429.3	1,429.3	1,429.3	1,429.3	1,429.3

Table 6.1-4: Budget Request for Space Launch System

6.1.3.4 GROUND SYSTEMS DEVELOPMENT AND OPERATIONS PROGRAM (GSDO)

The Ground Systems Development and Operations Program (GSDO) was established to develop and use the complex equipment required to safely handle rockets and spacecraft during assembly, transport, and launch.

The program's mission is to prepare the Kennedy Space Center (KSC) to process and launch the next generation of rockets and spacecraft in support of NASA's exploration objectives by developing the necessary ground systems, infrastructure, and operational approaches.

Unlike previous work focusing on a single kind of launch vehicle, such as the Saturn V rocket or space shuttle, engineers and managers in GSDO are preparing infrastructure to support several different kinds of spacecraft and rockets that are in development. Products and systems devised at KSC could be used at other launch sites as well.

A key aspect of the program's approach to long-term sustainability and affordability is to make processing and launch infrastructure available to commercial and other government customers, thereby distributing the cost among multiple users and reducing the cost of access to space for NASA.

Working closely with those developmental projects, GSDO is overseeing efforts to use a catalog of spaceflight facilities at Kennedy. Some of the facilities already are being refurbished and modified for future use, most noticeably Launch Pad 39B. The launch pad hosted space shuttle launches throughout that program's 30 years, but its shuttle-specific facilities have been removed to allow four or more different kinds of rockets to lift off from the pad, including the SLS.

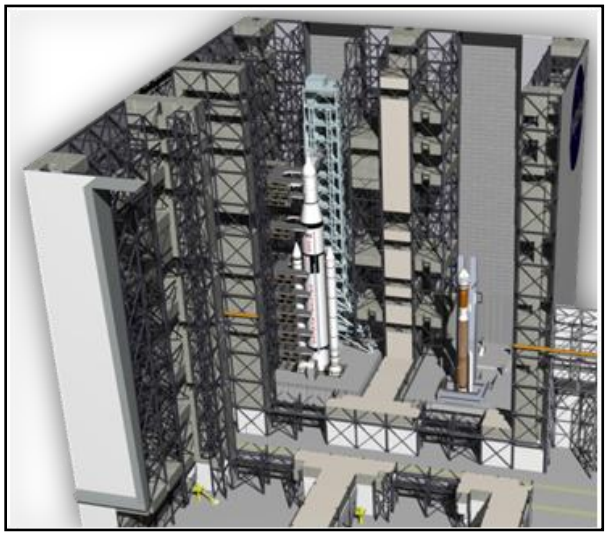


Figure 6.1-10: Kennedy Space Center Processing of Next Generation Spacecraft

Also in support of the SLS, the crawler-transporter, Vehicle Assembly Building, the Launch Control Center's Young-Crippen Firing Room 1, and the new mobile launcher are undergoing modifications for their new roles.

The Orion Multi-Purpose Crew Vehicle, which will carry the astronauts who will be launched into space on the SLS, will be processed in Kennedy's refurbished Operations and Checkout (O&C) building. The state of Florida previously provided $35 million for refurbishment of the O&C high bay, and the facility is fully operational and certified for its transition to Orion final assembly and checkout.

Three Teams

The GSDO Program focuses on three areas:

- Vehicle Integration and Launch
- Offline Processing and Integration
- Command, Control, Communications, and Range

The Vehicle Integration and Launch team focuses on the equipment, management, and operations required to safely connect a spacecraft with a rocket, move the launch vehicle to the launch pad, and successfully send it into space. The work entails use of many of the facilities unique to Kennedy Space Center, such as the 52-story Vehicle Assembly Building, the dual launch pads 39A and B, and the 3-mile-long runway at the Shuttle Landing Facility.

The group already is at work on the mobile launcher (ML), which recently was built and will be modified for the Space Launch System. The ML is a platform and tower designed to support the rocket and Orion and position connectors to the spacecraft, including a walkway astronauts will use to board Orion.

Figure 6.1-11: Mobile Launcher Leaving the Vehicle Assembly Building

The crawler-transporters that carried the Saturn V rockets and space shuttle to the launch pad for more than 40 years also will carry the next generation of launch vehicles and spacecraft to the launch pads. One of the transporters is being strengthened to support the large SLS, as well.

The Offline Processing and Integration team will develop ways to handle the Orion spacecraft, rocket stages, and launch abort system before they are all assembled into one vehicle. The work will take place in several facilities in Kennedy's industrial area, including the O&C Building, the Multi-Payload Processing Facility, the Launch Abort System Processing Facility, and others. The buildings were built specifically for the demanding processing work involved with preparing spacecraft for flight. Such preparations can include software loading, final assembly, and the loading of chemicals and propellants, depending on the spacecraft.

Another team is modernizing the Command Control Communications and Range systems involved in launching astronauts into space. In addition to bringing computers, tracking systems, and other networks up to date, the team is creating systems that can handle several different kinds of spacecraft and rockets. The computers, antennas, and software are expected to reduce the need for a large launch team.

Kennedy has a 50-year history of serving as our nation's gateway to exploring the universe. Taking the knowledge and assets of NASA's successful space past, the Ground Systems Development and Operations Program is determined to build a successful and diverse future in spaceflight.

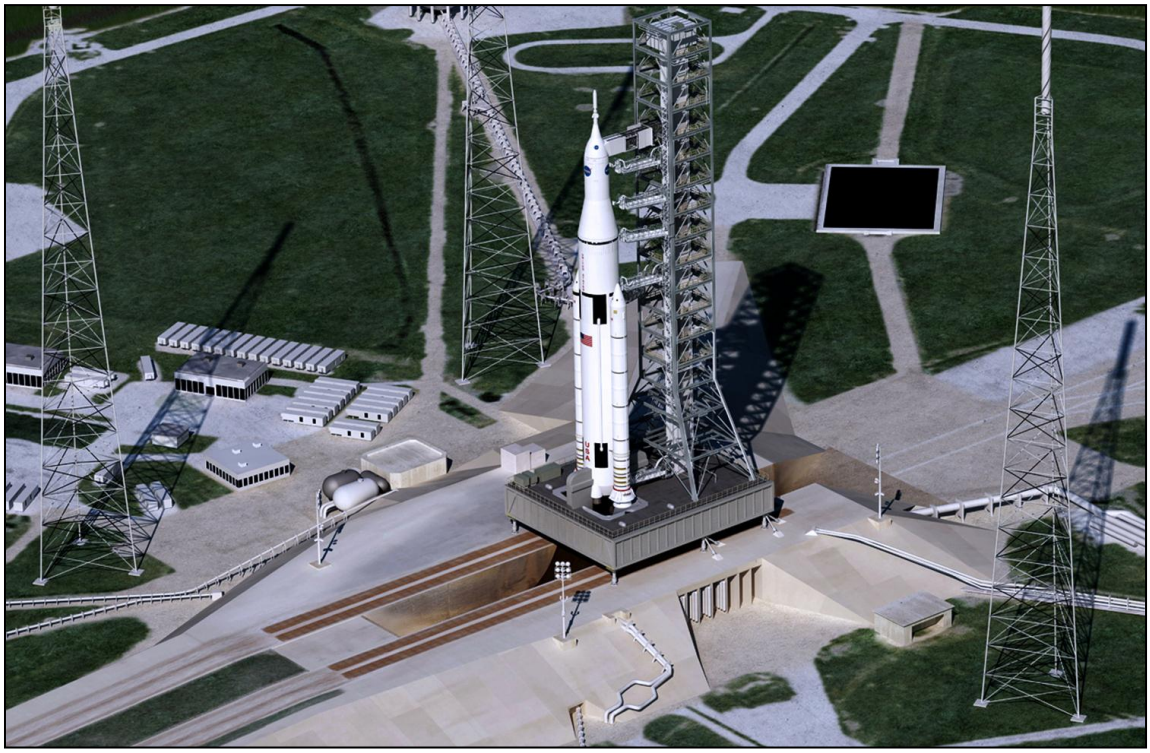


Figure 6.1-12: Illustration of SLS and Orion on the Mobile Launcher at Pad 39B

FY 2013 BUDGET REQUEST

FY 2013 President's Budget Request ($ Millions)	FY 2012 Actual	FY 2012 Enacted	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017
Ground Systems Development and Operations	484.5	484.5	445.6	445.6	445.6	445.6	445.6

Table 6.1-5: Budget Request for Ground Systems Development and Operations

6.1.4 SPACE NETWORK / TRACKING AND DATA RELAY SATELLITE SYSTEM

DESCRIPTION

The Tracking and Data Relay Satellite System (TDRSS) Network is designed as a highly automated user-driven and controlled system for supporting customer spacecraft tracking and data acquisition. Each TDRS can simultaneously provide up to two S-Band Single Access (SSA) Forward (SSAF) and Return (SSAR) services, two Ku-Band Single Access (KSA) Forward (KSAF) and Return (KSAR) services (with TDRS-8, 9, and 10 providing Ka-Band services as well), one Multiple Access (MA) Forward service, MA Return services, one-way Doppler and two-way Doppler and range services. With TDRS spacecraft located in three nodes around the Earth (the Atlantic Ocean region, the Pacific Ocean region, and the Indian Ocean region), customer spacecraft can attain coverage of 100 percent of their orbit. Currently, the geosynchronous constellation includes both first and second generation satellites, which will eventually be replaced with later generation spacecraft. TDRSS and the associated ground stations located at White Sands and Guam comprise the space network, which provides communications services for near-Earth customer satellites.

FY 2013 BUDGET REQUEST

Budget Authority ($ millions)	FY 2011 Actual	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017
Space Communications and Navigation	456.7	445.5	655.6	570.7	577.3	535.4	513.9

Table 6.1-6: Budget Request for Space Communications and Navigation/TDRSS

The TDRS replenishment effort is a major component of maintaining NASA's space network capabilities. The Agency is purchasing three third-generation TDRS (K, L, and M) to replace aging first-generation satellites that are 17 to 24 years old, well beyond their designed lifetimes. By early FY 2012, three spacecraft either failed or have been retired, and the remaining three first-generation spacecraft are increasingly showing signs of age-related failure. The three third-generation spacecraft will ensure adequate space network services to customers into the 2020s. TDRS replenishment includes limited modifications to network ground facilities to support the new third-generation satellites. Total commitments require seven spacecraft (six operational and one on-orbit spare) in order to meet National and Civil space mission need.

The TDRS fleet supports tracking, data, command, voice, and video services to the ISS, space science and Earth science missions, and other government agency users. The total mission load is predicted to increase, which will require additional satellites to be added to the fleet. Reliability analyses predict that the existing fleet may be unable to support NASA and other U.S. government customer missions by FY 2016. Some national customers began a formulation program called Transformational Satellites (TSAT) to meet their planned need. This would have reduced this community's need for TDRSS support. Due to funding and other constraints, this program was canceled, leading to an agreement with NASA to build

additional TDRS spacecraft as a stopgap bridge from TSAT to meet projected national mission needs. NASA began acquiring two third-generation spacecraft, TDRS-K and TDRS-L, in FY 2007. TDRS-K is scheduled for launch in December 2012; TDRS-L is scheduled for launch in February 2014. Adding these two spacecraft to the TDRSS fleet will ensure continuity of service for NASA and other U.S. government customer missions through at least FY 2016. Maintaining capacity beyond FY 2016 required initiating the TDRS-M acquisition early in FY 2012 for launch opportunity in FY 2016; adding TDRS-M will extend capacity into the 2020s. NASA also has a fixed-price option to purchase TDRS-N, but has not yet exercised that option.

The major contract for TDRS replenishment was competitively awarded to Boeing Space Systems, Inc. in El Segundo, CA, December 2007. It is a fixed-price-plus-incentive-fee contract for TDRS-K and -L, and includes modifications to TDRSS ground systems at White Sands, NM to support these third-generation spacecraft. The contract also includes fixed-price options for TDRS-M and N. In November 2011, NASA exercised the fixed-price-plus-incentive-fee option on the Boeing contract for TDRS-M. TDRS-K and -L completed their Systems Integration Review, and are on track for launch in December 2012 and February 2014, respectively.

The principal near-term risk for TDRSS is that the remaining first-generation spacecraft may cease to operate before TDRS-K, -L, and -M are launched. This would result in a capacity shortfall that would have some impact on the space missions that rely on TDRSS for space network services. This risk begins to lessen in December with the launch of TDRS-K.

ISSUE DESCRIPTION

Several issues exist for the TDRSS and are listed below.

1. NASA has not identified funding for launch services for TDRS-M. This will not be an issue for NASA missions until 2018 if partner migration is complete. It is not apparent that a plan for such a migration has been drafted – no such plan has been shared with NASA. If migration is not completed, the need for TDRS-M on orbit is projected to occur in 2016. Our partner has indicated an intention to migrate from TDRSS, but their projected use of the system at the mission level shows no upcoming decline.
2. Funding for the TDRS-N spacecraft and launch vehicle has not been identified. Again, if partner migration is completed, then NASA has no immediate need for TDRS-N. Replenishment would not be needed until the 2022 timeframe, by which time NASA plans to begin deployment of a successor system. If partner need continues, then the existing contract option with Boeing must be exercised by November 2012. Continuously updated reliability estimates incorporating spacecraft performance and health data are performed to assist in this analysis. Current known requirements for the existing and planned mission set clearly show a need for the procurement of TDRS-N. The current contract option offers this spacecraft at a cost to the government that will never be matched in a new, competitive procurement.
3. TDRSS provides mission-critical communications services to NASA as well as other U.S. government missions. Operations costs are covered by NASA for FY 2012-2014 despite significant

reduction in partner reimbursable funding. Partner funding has covered about 95 percent of TDRSS operations costs in recent years. Per agreement, major partner funding ends in 2013 even though the partner will continue to use TDRSS. Operations and maintenance costs are largely insensitive to partner demand; costs do not decrease significantly if a customer leaves. The TDRSS funding reduction defers current maintenance and terminates all sustainment activities on the ground infrastructure. This is manageable because a new ground segment sustainment activity has been approved and funded to replace obsolete and unsustainable equipment. Operations costs for FY 2015 and out have not been resolved; NASA will work them as part of the PPBE 2015 budget cycle.

4. NASA has begun formulation activities for TDRS follow-on capability with a goal of reducing cost by at least half by leveraging promising new technologies (e.g., optical communications, software defined radios, and advanced communications protocols). NASA will initiate a next generation communication relay satellites study to identify alternatives (e.g., hosted payloads, commercial services, distributed apertures, other orbits). Potential new services may include: optical communications/alternative frequencies, Delay Tolerant Networking or other types of networking protocols, satellite cross-links, and higher data rates.

Figure 6.1-13 below summarizes projected TDRSS Single Access service capacity. As mentioned above, mission commitments (for both NASA and partners) require seven spacecraft (six operational and one on-orbit spare) in order to meet mission need.

Figure 6.1-13: Artist's Rendering of TDRSS-K, Planned for Launch in December 2012.

6.2 AERONAUTICS RESEARCH MISSION DIRECTORATE (ARMD)

The Aeronautics Research Mission Directorate (ARMD) works to solve critical challenges that still exist in the nation's air transportation system: air traffic congestion, safety, and environmental impacts.

With world-class federal, industry, and academic partners, ARMD conducts research and technology development activities that increase the capacity, efficiency, and flexibility of the national airspace, and that support growth of the economy and jobs.

Nearly every aircraft today has NASA-supported technology on board that helps the vehicle fly more safely and efficiently. This work continues with new near-, mid- and far-term goals for substantially reducing fuel consumption, emissions, and noise, which are all critically important to enabling the Next Generation Air Transportation System. ARMD's research goals and objectives are aligned with the National Aeronautics Research and Development Policy and Plan.

ARMD's research portfolio includes the Fundamental Aeronautics Program, for improving aircraft performance and efficiency; the Airspace Systems Program, for improving air traffic management from gate to gate; the Aviation Safety Program, for improving aircraft and system-wide safety; the Integrated Systems Research Program, for maturing technologies and assessing the integrated benefits of promising technologies at the systems level; and the Aeronautics Test Program, for ensuring availability of state-of-the-art aeronautics research capabilities through the strategic management of NASA's aeronautical ground and flight test facilities and skills. For more detail on the activities conducted within each ARMD program, refer to Section 4.4.

The ARMD's major research activities described in this section are organized within three major mission thrusts: 1) enabling full Next Generation Air Transportation System (NextGen) capability, 2) enabling high efficiency and low environmental impact aircraft, and 3) enabling safe integration of new, advanced vehicles into the NAS. All ARMD's research is planned and conducted with the ultimate purpose of meeting system-level goals answering questions of how the technology will perform in a real-world, relevant environment, i.e, the national air transportation system. ARMD's major missions will enable game-changing advancements in aviation that benefit the nation.

6.2.1 ENABLING FULL NEXTGEN CAPABILITY

6.2.1.1 DESCRIPTION

The Next Generation Air Transportation System (NextGen) is a transformation of the nation's air traffic control system to support continued growth, higher efficiency, and reduce the environmental impact of aviation operations. NextGen is being implemented via a multi-agency, public-private partnership led by the Federal Aviation Administration (FAA). NASA's Aeronautics Research Mission Directorate (ARMD) supports this partnership by enabling the ultimate realization of NextGen through pioneering research and advanced technologies that allow much higher levels of air traffic system automation to overcome fundamental human performance limitations. Automation provides air traffic controllers, pilots, and other airspace users with more accurate real-time information about the nation's airspace, weather, and routing, and allows aircraft to safely fly closer together on more fuel-efficient routes to increase capacity, reduce delay, and minimize fuel burn, noise, and greenhouse gas emissions. ARMD is also

pursuing advanced methods for verifying and validating the safety of these new, complex automation systems and the human–automation interfaces that are involved.

ARMD works in close partnership with the FAA and other partners to ensure its research results are useful, relevant, and adaptable as today's air traffic system transitions to NextGen. ARMD and the FAA utilize Research Transition Teams to ensure this adaptation is well planned and managed. ARMD also brings key technologies into Advanced Technology Demonstrations (ATD) to prove out complex new capabilities in partnership with the FAA, the airlines, and other key stakeholders.

ATD-1 is an integrated set of software-based technologies to manage arriving aircraft from descent through runway landing. Multiple integrated ATD-1 simulations were conducted successfully in 2012 using the Dallas/Ft. Worth and Los Angeles airport data sets with active FAA controllers and airline pilots, providing additional information about ATD-1 efficiency and its impact on aviation operations. Results from these studies are being used to plan additional ATD-1 experiments in 2013.

In 2013, NASA will collaborate with the FAA to select the site for the ATD-1 flight trials, as well as generate the integrated cross-agency demonstration plan and development of a more robust ATD-1 integrated system based on experiments already conducted. To plan for a full-fledged ATD-1 field demonstration in the 2016-2017 timeframe, NASA is pursuing partnerships with industry in order to determine operational, scheduling, and traffic-flow parameters and requirements.

Automation such as that developed for ATD-1 involves complex, flight-critical systems, which must be certified for safety. Therefore, ARMD is developing automated capabilities that can be applied early in the system lifecycle for validation and verification (V&V). As part of the System-wide Safety Assurance Technologies Project, we completed an early prototype of a static code analyzer that can methodically review a large, complex software system for errors without needing to run the code. Future work will scale this capability so that it can handle much larger software systems (over one million lines of code), such as those typically found on today's aircraft.

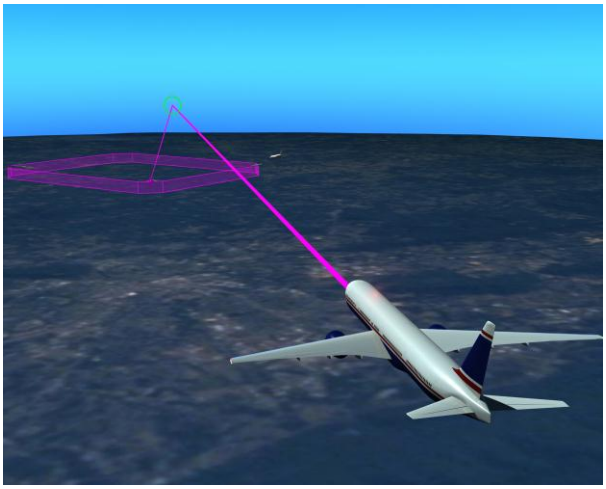


Figure 6.2-1: ARMD and its partners are developing advanced automation tools that provide more real-time information to pilots and controllers

6.2.1.2 ISSUES

The successful implementation of NextGen is crucial to the modernization of our nation's air transportation system and to the long-term health of our aviation industry. ATD-1 is a highly visible NASA effort supporting this modernization. Conducting a successful ATD-1 flight demonstration requires close coordination with a broad collection of stakeholders, including multiple program organizations in the FAA, air carriers, airport authorities, and the aviation industry. Synchronizing ATD-1 with the FAA's fielding of NextGen capabilities is important to the successful demonstration of the operational benefit of ATD-1 technologies and so requires active risk management and mitigation.

6.2.2 ENABLING HIGH EFFICIENCY AND LOW ENVIRONMENTAL IMPACT AIRCRAFT

6.2.2.1 DESCRIPTION

Achieving industry-endorsed national-level goals to reduce the environmental footprint of aviation is a top concern facing industry and federal agencies. Through in-house research and partnerships, ARMD is working on the fundamental understanding and new concepts needed to not only reduce fuel consumption, but to simultaneously reduce the emissions from the fuel that is used and minimize aircraft noise near increasingly busy airports. Translated into numbers, the challenge is to develop technology by 2020 that cuts fuel consumption in half, reduces the area of objectionable noise around airports to one-sixth of what it is today, and reduces nitrous oxide emissions to half that of the newest aircraft flying today. This will require not only advanced energy-efficient aircraft and operations, but also affordable renewable fuels or alternative energy propulsion systems. From both risk and timeframe perspectives, these technologies are well beyond typical industry investment horizons.

ARMD is planning a flight test campaign to obtain detailed measurements of the chemical exhaust components from large jet engines operating on alternative jet fuels. The ACCESS, or "Alternative Fuel Effects on Contrails and Cruise EmiSSions" tests, will consist of a highly instrumented research chase plane being flown in close proximity behind a NASA DC-8 aircraft with engines running on several different alternative fuels.

The data obtained will help characterize the effects of alternative fuels on engine particle and gas emissions at cruise altitudes. The data will also examine the evolution (growth and changes in composition/microphysical properties) of exhaust and contrail particles as the plume ages and becomes mixed with background air (measurements both close to and far away from the engine). Further, this test has a goal to investigate the role of soot (black carbon) concentrations/ properties, fuel sulfur, and gas emissions in regulating contrail formation and the microphysical properties of

ice particles. This investigation will be done using data from the DC-8 flight and by taking data in air traffic corridors where commercial aircraft cruise.

ARMD is also exploring ways to meet efficiency challenges in aircraft 20 to 30 years from now. Researchers in our Environmentally Responsible Aviation (ERA) Project are exploring advanced design options for large civil transport aircraft, new propulsion concepts, and other technologies worth pursuing due to their potential for dramatically reducing noise, fuel consumption, and emissions. The project has focused on technologies that have been proven in the laboratory setting and are ready to be integrated into more complex systems to demonstrate the true value to aircraft designs.

One of these demonstrations has been developed in cooperation with Boeing to demonstrate a collection of technologies into a system referred to in the aerodynamics community as Active Flow Control (AFC). This concept uses small devices located at the aircraft skin to produce favorable perturbations to the air flowing past the aerodynamic surface. In the laboratory environment, the concept can be used for various applications, but it has not been integrated into a commercial aircraft yet because of technology maturity. During the first phase of ERA, the capability of AFC to increase the effectiveness of the rudder on a vertical tail by up to 50 percent was demonstrated in sub-scale experiments. This effect can be projected to enable future aircraft designs to have smaller tails to reduce fuel consumption due to smaller and lighter components. Furthermore, the Boeing/NASA team concluded through integration analysis of the projected benefit, manufacturing costs, and maintenance requirements that the integrated technology solution provides substantial economic and environmental value.

During the second phase of ERA, the Boeing/NASA team will demonstrate system maturity by conducting a flight test on a Boeing 757 aircraft as part of the ecoDemonstrator program. This will be a demonstration of an AFC system integrated into the vertical tail. Flight test conditions will be flown and completed by 2015 to demonstrate the capability of the system in flight. To prepare for the flight tests, a full-scale vertical tail was removed from a 757 to be tested in the National Full-scale Aerodynamics Complex (NFAC) in California during 2013 to assess the full-scale characteristics of the system prior to flight.

Figure 6.2-2: NASA's DC-8 aircraft will be used in flights to characterize emissions from alternative fuels

6.2.2.2 ISSUES

National research goals to achieve emissions and efficiency improvements are aggressive and represent a significant challenge. A major issue to achieving these goals is managing risk as we transition from laboratory and ground-based results to large-scale experiments needed to successfully transition these very complex technologies. Partnerships with other federal agencies and industry are a critical aspect of this research.

The ACCESS flight test is expected to occur in two phases over the course of FY13 and FY14; however, the test schedule may be affected by other Agency missions and priorities that require use of the Agency aircraft. In addition, the complexity of the integration of the required advanced instrumentation adds complexity which threatens fully meeting the test objectives as well as test schedules.

The issues of scaling the AFC system to full-scale operational size and capability will be addressed via parametric investigation during full-scale vertical tail testing in the NFAC wind tunnel in 2013. A challenge remains in integrating the AFC system and its power source with other aircraft systems, such as the flight control system in a relevant flight test environment.

6.2.3 ENABLING SAFE INTEGRATION OF NEW, ADVANCED VEHICLES INTO THE NAS

6.2.3.1 DESCRIPTION

The nature of aviation continues to change as newer, more advanced aircraft are designed and built. Unmanned aircraft systems (UAS) and low boom supersonic aircraft are just two examples of advanced vehicles that are at the forefront of aviation technology and a focus of ARMD research. However, in order for these technologies to reach full market potential,

they must be safely integrated into the National Airspace System (NAS).

Before integration can occur, existing rules, regulations and standards must be developed or modified by the Federal Aviation Administration (FAA). Extensive safety studies, simulations and test flights to generate reliability data are just a few of the tools the FAA must have to modify and develop those regulations and standards. ARMD works very closely with the FAA to understand their requirements for enabling safe integration of advanced vehicles and then works to develop the high-confidence technical concepts and data that can support decision making.

ARMD's UAS Integration into the NAS Project is helping to enable safe integration of new, advanced vehicles into the NAS. The change of paradigm from a pilot in the aircraft to a pilot on the ground has generated significant challenges to the FAA for integration. Working in close partnership with the FAA, the Department of Defense (DOD) and industry, the UAS Project has identified five major research areas that address the technical barriers preventing UAS access: communications between the aircraft and its ground control station as well as the pilot and air traffic controller; the interface between the human (e.g., pilot) and the machine (e.g., ground control station); interoperability of air traffic control separation assurance procedures with sense and avoid technology; certification of the vehicles for airworthiness and safety of flight; and developing an integrated testing environment. Data and recommendations generated by the project will be provided directly to the FAA. With this kind of information, the FAA will be able to make informed decisions about the regulations and rules required for safe integration.

To provide the relevant integrated environment, NASA is developing a Live, Virtual, Constructive – Distributed Environment (LVC-DE) capability that ties together existing Air Traffic Control (ATC) simulation tools with live flight assets, allowing for concepts to be tested in an integrated but safe and efficient manner. A key feature of the LVC-DE is its distributed nature, which will allow NASA facilities to connect to FAA, DOD, and industry partners. The ability to connect to assets across the nation reduces the costs of running simulations and flight tests by removing the need for all components to be co-located and providing access to components from partner organizations, such as high fidelity ATC workstations and UAS ground control stations.

A prototype of the LVC-DE was successfully tested during a joint FAA, DOD, NASA, and industry demonstration during August 2012. The FAA supplied the ATC environment and each of the participants provided manned and unmanned aircraft position updates each from different facilities across the nation. Further tests are planned for FY2013 to integrate aircraft with prototype communication equipment into the LVC-DE in anticipation of data gathering simulations in FY2014.

The other types of aircraft seeking a new market are those that fly faster than sound over land. The key barrier to achieving commercially viable supersonic flight over land is a sonic boom quiet enough to be acceptable to communities on the ground. Such aircraft would enable large reductions in travel time that add value to business travelers, cargo shippers, National Security, and the traveling public. Opening this new market will lead to maintaining or increasing aviation's impact on U.S. Gross Domestic Product (GDP) and will contribute to high value employment in a technology area that is seeing rising competition on global scale.

ARMD's High Speed Project has successfully developed design and analysis tools that integrate multiple design disciplines at higher fidelities to investigate aircraft configurations that simultaneously achieve low sonic boom and high efficiency flight. These accomplishments provide the critical building block upon which larger-scale, integrated systems testing could be based. Such system-level testing using a specially designed demonstrator aircraft could show unequivocally the possibility for efficient supersonic aircraft with sonic boom noise low enough to allow overland flight with minimal community impact.

Results expected by 2015 include the completion of large-scale wind tunnel validation tests providing data on complex aircraft configurations with propulsion system effects. These results will be compared to predictions of aircraft boom levels and flight efficiency.

Figure 6.2-3: ARMD uses its Ikhana unmanned aircraft to flight-test technologies that could enable safe integration into the national airspace

6.2.3.2 ISSUES

Carefully planned and vetted policy, standards, and certification criteria are necessary to support the introduction of advanced vehicles into the NAS. Because the FAA is the ultimate decision maker on whether a new vehicle can be integrated, it is crucial that work conducted on advance vehicle designs by ARMD is closely coordinated with the FAA. In the case of the UAS Project, because the FAA is the ultimate customer of the research results, understanding their requirements is necessary for success.

In addition, scaling up the results of testing is an issue for further implementation of advanced vehicles. Having the ability to demonstrate, at relevant scale, the real possibility of efficient, supersonic, low sonic boom aircraft design will provide a basis for development of a noise-based standard for overland flight. This will, in turn, open market opportunities for U.S. industry.

6.3 SPACE TECHNOLOGY MISSION DIRECTORATE (STMD)

Space Technology enables future human and scientific exploration, just as current and past mission successes were supported by technology investments.

Space Technology Mission Directorate (STMD) technologies have high potential for offsetting mission risk, reducing cost and advancing existing capabilities, thereby enabling more challenging missions. Progress is ensured through a steady cadence of solicitations and ground and flight demonstrations.

This approach provides NASA and the aerospace industry with a sustainable pipeline of technology advances. Space Technology spurs innovation through small businesses, prizes and challenges, and through providing suborbital flights for technology demonstrations.

In managing its investments, STMD employs a portfolio approach that spans a range of discipline areas and technology readiness levels (TRL), from concept study to flight demonstration. STMD facilitates infusion of available and new technology into operational systems that support specific human-exploration missions, science missions, and aeronautics.

Significant progress in technology areas such as space power systems, entry, descent, and landing systems, propulsion, radiation protection, and cryogenic fluid handling are essential for human exploration beyond low Earth orbit.

6.3.1 TECHNOLOGY DEMONSTRATION MISSIONS

6.3.1.1 Description

6.3.1.1.1 TECHNOLOGY DEMONSTRATION MISSIONS (TDM)

Technology Demonstration Missions (TMD) matures and demonstrates crosscutting technologies, preparing them for rapid infusion into future human exploration and science missions. The goal of this program is to bridge the gap between early technology development and mission infusion by maturing revolutionary, system-level space technologies and demonstrating these technologies in a relevant operational environment (ground, air, suborbital, or orbital regime). STMD flight projects reduce risk and enhance capabilities for NASA's Exploration and Science missions by demonstrating advanced technologies allowing for mission infusion.

TDM provides frequent opportunities for demonstration through competitive solicitations. TDM is working with NASA Centers and Mission Directorates, aerospace industry providers and other domestic and international partners to demonstrate technologies that have the potential to benefit multiple NASA missions, other government agencies, and the aerospace industry.

6.3.1.1.2 Laser Communications Relay Demonstration (LCRD)

Laser Communications Relay Demonstration (LCRD) will demonstrate and validate a reliable, capable, and cost-effective optical communications technology. Optical communications technology provides data rates up to 100 times higher than today's radio communication systems. These higher

bandwidth capabilities are necessary for future human and robotic space missions. The technology is directly applicable to the next generation of NASA's space communications network. After the demonstration, the developed space and ground assets will be qualified for use by near-Earth and deep space missions requiring high bandwidth and a small ground station reception area. The demonstration will use lasers to encode and transmit data at rates 10 to 100 times faster than radio – or at the same data rate as today's fastest RF radios, but using significantly less mass and power. The investigation will enable a variety of robust future science and exploration missions – providing a higher data rate, and delivering more accurate navigation capabilities with reduced size, weight and power requirements.

6.3.1.1.3 Deep Space Atomic Clock (DSAC)

Deep Space Atomic Clock (DSAC) validates a miniaturized mercury-ion atomic clock that is 10 times more accurate than today's ground based clocks used for spacecraft navigation systems. This project element will demonstrate ultra-precision timing in space and its benefits for one-way radio-based navigation. Precision timing and navigation is critical to the performance of a wide range of deep space missions and has the potential to improve the nation's next generation GPS system. The Deep Space Atomic Clock will be orders of magnitude smaller, lighter and more stable than any other atomic clock flown in space. This NASA Technology Demonstration Mission will shift paradigms for navigating spacecraft to distant destinations, enabling the collection of more data with higher precision and autonomous radio navigation for time-critical events such as orbit insertion or landing. This mission will deliver the next generation of deep space radio science.

6.3.1.2 SOLAR SAIL DEMONSTRATION (SSD)

Solar Sail Demonstration (SSD) deploys and operates a solar sail with an area seven times larger than ever flown in space. It is potentially applicable to a wide range of future space missions, including serving as an advanced space weather warning system to provide more timely and accurate notice of solar flare activity. This technology also could allow for propellant-less deep space exploration missions. The National Oceanic and Atmospheric Administration (NOAA) is collaborating with NASA and L'Garde Inc. on the demonstration. The L'Garde Technology Demonstration Mission solar sail will have seven times the area (1200m^2) of the largest sail ever flown before in space. At just over 70 pounds, this solar sail demonstrator will weigh 10 times less than the largest sail ever flown in space. The L'Garde solar sail will produce a maximum thrust of approximately 0.01 newton, which is roughly equivalent to the weight of a "pink packet" of artificial sweetener. Although the instantaneous thrust is extremely small, the continual accrual of this thrust will enable the solar sail to navigate to locations unreachable with current technologies. This solar sail demonstrator is a truly propellant-less method of spacecraft propulsion.

6.3.1.2.1 Cryogenic Propellant Storage and Transfer (CPST)

Cryogenic Propellant Storage and Transfer (CPST) demonstrates the capability of in-space long-term storage and the microgravity transfer of cryogenic propellants, essential for transportation on deep space exploration missions. Cryogenic propellant storage and transfer is the most critical Space Technology demonstration for human exploration. Beyond the initial development of Space Launch System and the Orion Multi-Purpose Crew Vehicle (Orion MPCV) currently underway

within the Exploration account, the next essential architecture element to extend human presence beyond low Earth orbit is the development of a long-duration cryogenic propulsion stage. The cryogenic propulsion stage must be capable of performing long-term storage (greater than six months) and transferring cryogenic propellants, such as liquid oxygen and liquid hydrogen. Creating this capability relies on the successful demonstration of the Cryogenic Propellant Storage and Transfer project element.

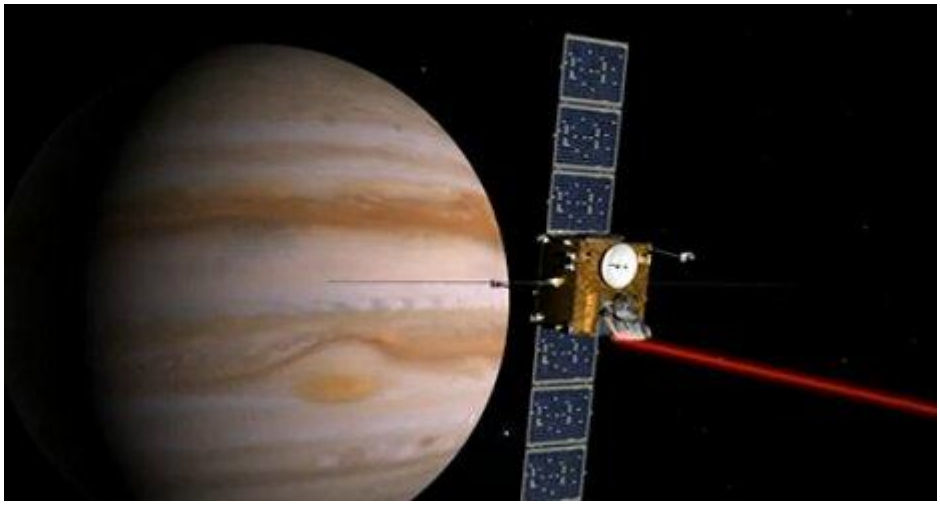


Figure 6.3-1: Laser Communications Relay Demonstration mission successfully completed its Mission Concept Review in September

FY 2013 BUDGET REQUEST FOR TECHNOLOGY DEMONSTRATION MISSIONS (THE FLIGHT ACTIVITY IS AN ELEMENT OF THIS PROJECT)

Budget Authority ($ Millions)	FY 2011 Enacted	FY 2012 Enacted	FY 2013	FY 2012	FY 2013	FY 2014	FY 2015
FY 2013 Request	50	144	227	248	238	235	219

Table 6.3-1: Budget Request for Technology Demonstration Missions

6.3.1.3 ISSUES

The flight projects funded by this program are still in varying stages of formulation so individual budgets are not final. As such, life cycle costs and launch schedules will be determined following critical design review.

6.3.2 EARTH SCIENCES

6.3.3 LANDSAT DATA CONTINUITY MISSION (LDCM)

6.3.3.1 DESCRIPTION

The Landsat Data Continuity Mission (LDCM) will provide continuity with the 40-year-long Landsat land-imaging data set that began with Landsat 1 in 1972. Data from this family of spacecraft represent the world's longest series of continuous space-based observations of Earth's surface. For NASA, LDCM measurements will directly support research in the important areas of climate, carbon cycle, ecosystems, water cycle, biogeochemistry, and Earth surface/interior. The Landsat program, extended by LDCM, also serves the practical needs of government, industry, military, and education users in the U.S. and around the world in applications such as agriculture, land use planning and monitoring, support of disaster response, and water use monitoring. A collaboration between NASA and the U.S. Geological Survey (USGS), LDCM will provide moderate-resolution (15 m–120 m, depending on spectral wavelength) measurements of Earth's surface in the visible, near-infrared, short wave infrared, and thermal infrared. The LDCM satellite payload consists of two science instruments—the Operational Land Imager (OLI) and the Thermal InfraRed Sensor (TIRS). These two sensors will provide seasonal coverage of the global landmass to detect and characterize multi-decadal land cover change in concert with historic Landsat data.

LDCM includes evolutionary advances in technology and performance. The OLI will be able to detect cirrus clouds and conduct coastal zone observations. The TIRS will improve the capability and quality of thermal infrared imaging. Additionally, LDCM will increase by nearly half the daily number of scenes returned to the USGS data archive compared to Landsat 7, increasing the probability of capturing cloud-free scenes for the global landmass.

Figure 6.3-1: LDCM Spacecraft

FY 2013 BUDGET REQUEST FOR LDCM

Budget Authority ($ Millions)	Prior	FY 2011 Actual	FY 2012 Estimate	FY 2013 Request	FY 2014	FY 2015	FY 2016	FY 2017	BTC	LCC Total
FY 2013 Request	541.2	166	159.3	54.7	2.1	2.1	2.2	2.3	1.3	931.2

Table 6.3-1: Budget Request for LDCM

6.3.3.2 ISSUES

LDCM – also known as Landsat 8 – was scheduled to launch in December 2012 but has been rescheduled for February 2013 due to two problems that came to light during integration testing. Both of these are now believed to have been resolved, and the spacecraft is entering the final testing phase. It is expected that this thermal-vacuum testing will be successfully completed by the end of November and that the spacecraft will be shipped to the launch site for final processing in December. LDCM's launch could be delayed by a year or more if the project is unable to launch in February 2013. Rescheduling LDCM to launch later in 2013 is difficult because the launch manifest for 2013 is full.

The current operational Landsat missions (Landsat 5 and Landsat 7) are in tenuous shape. However, Landsat 7 is still providing data and current fuel reserves are sufficient to last to the projected launch date of Landsat 8. USGS suspended imaging activities of Landsat 5 in November 2011 and is working to devise a means of extending the mission. If these efforts fail, the satellite will be at the end of a remarkable 27-year operational life. Landsat 7 was launched in 1999 and continues to operate even though it is eight years beyond its five-year design life, but with a lower-level data quality due to a partial instrument failure.

The Administration's National Space Policy calls for Department of the Interior (DOI) to assume responsibility for the Landsat Program, with NASA to act as DOI's agent for spacecraft procurement and launch services in compliance with DOI/USGS requirements and funding.

Although Congress provided $2.0 million in FY2012 to the USGS for Landsat 9 program development, Congress also requested that the Administration re-examine how to proceed with obtaining less costly Landsat data in the future. Accordingly, the Office of Science and Technology Policy (OSTP) began working with USGS, NASA, and the National Oceanic and Atmospheric Administration (NOAA) to examine options and requirements for future Landsat missions, while addressing performance, cost and risk. Nominal funding is provided in FY2013 for the USGS to continue to work with OSTP, NASA, and NOAA to examine options for providing land remote sensing data in a cost effective manner. We expect to know more about these potential options in the coming months.

6.3.4 ORBITING CARBON OBSERVATORY-2 (OCO-2)

6.3.4.1 DESCRIPTION

Orbiting Carbon Observatory (OCO)-2 will be NASA's first dedicated Earth remote sensing satellite to study atmospheric carbon dioxide (CO_2) from space. OCO-2 will collect global measurements of atmospheric CO_2 with the precision, resolution, and coverage needed to characterize sources creating and sinks removing CO_2 on regional scales. OCO-2 data will also be used to study the causes of CO_2 variability with the seasons from year to year.

CO_2 is a small but critical constituent of the Earth's atmosphere that strongly absorbs heat radiation. Hence, CO_2 is one of several gases that trap heat near the surface of the Earth. These gases are known as greenhouse gases. Because of these fundamental physical characteristics of CO_2, substantial increases in the abundance of CO_2 will result in an increase in Earth's surface temperature.

Due to the growing use of fossil fuels since the beginning of the industrial age, the concentration of CO_2 has risen from about 280 parts per million to over 390 parts per million, and is continuing to increase at a rapid rate. Global ground-based measurements have observed an increase in atmospheric CO_2 concentration by almost 20 percent over the past 50 years - the most dramatic change in human history. CO_2 is temporarily removed from the atmosphere both by dissolution into the ocean and by exchanges with the terrestrial biosphere. The extent of absorption by these processes is not well known, and may change significantly as CO_2 concentrations and surface/ocean temperatures continue to rise. Through its observations of CO_2, OCO-2 is expected to greatly improve our understanding of the behavior of carbon in the ecosphere and its impact on it.

OCO-2 will be launched in July 2014 into a near-polar orbit that enables it to view the entire Earth every 16 days. It carries a single instrument with three spectrometers that will obtain the most precise measurements of CO_2 ever made from space.

Figure 6.3-2: OCO-2 Spacecraft

FY 2013 BUDGET REQUEST FOR OCO-2

Budget Authority ($ Millions)	Prior	FY 2011 Actual	FY 2012 Estimate	FY 2013 Request	FY 2014	FY 2015	FY 2016	FY 2017	BTC	LCC Total
FY 2013 Request	91.1	89.0	98.4	80.3	57.9	45.4	16.0	4.0	0	477.2

Table 6.3-2: Budget Request for OCO-2

6.3.4.2 ISSUES

The launch of OCO-2 has been delayed due to the need to choose a new launch vehicle after two successive failures of the launcher originally selected for it. The newly selected launch vehicle will be available for use by July of 2014. The increased costs of the new vehicle and the delay associated with its availability have caused the mission's cost to increase.

6.3.5 GLOBAL PRECIPITATION MEASUREMENT (GPM) DESCRIPTION

The Global Precipitation Measurement (GPM) mission is an international network of satellites that will provide the next-generation global observations of rain and snow. Building upon the success of the Tropical Rainfall Measuring Mission (TRMM), the GPM concept centers on the deployment of a Core Observatory carrying an advanced radar/radiometer system to measure precipitation from space and serve as a reference standard to unify precipitation measurements from a constellation of research and operational satellites. Through improved measurements of precipitation globally, the GPM mission will help to advance our understanding of Earth's water and energy cycle, improve forecasting of extreme events that cause natural hazards and disasters, and improve the accuracy and timeliness of precipitation information. It will also support climate studies and improve the quality of weather forecasting.

GPM, initiated by NASA and the Japan Aerospace Exploration Agency (JAXA), is an effort by a consortium of international space agencies, including the Centre National d'Études Spatiales (CNES), the Indian Space Research Organisation (ISRO), the National Oceanic and Atmospheric Administration (NOAA), the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT), and others. GPM achieves global coverage with frequent measurements by relying on both existing satellite programs and new mission opportunities from its partners. Each constellation member may have its unique scientific or operational objectives but each contributes microwave measurements to GPM for the generation and dissemination of uniform global precipitation products for worldwide user communities.

The U.S. GPM Core Observatory is scheduled for launch in February 2014. Its orbit will cover equatorial and mid-latitude regions of Earth up to 65 degrees, where most precipitation occurs.

Figure 6.3-3: GPM Core Observatory

FY 2013 BUDGET REQUEST FOR GPM

Budget Authority ($ Millions)	Prior	FY 2011 Actual	FY 2012 Estimate	FY 2013 Request	FY 2014	FY 2015	FY 2016	FY 2017	BTC	LCC Total
FY 2013 Request	504.8	133.6	92.9	88.0	66.2	19.1	18.1	10.2	0	932.8

Table 6.3-3: Budget Request for GPM

6.3.5.1 STATUS

At this time, the GPM Core spacecraft is entering testing with its instruments. This final development phase is proceeding without any significant issues toward shipment in late 2013 to Japan for launch processing and launch on a Japanese H-IIA rocket in February 2014.

6.3.6 EARTH VENTURE PROGRAM

6.3.6.1 DESCRIPTION

Earth Venture was introduced to NASA's Earth Science Program as part of a strategy to restore more frequent launch opportunities and to facilitate the demonstration of innovative ideas and higher-risk technologies. It is a scientifically broad-reaching program element that regularly solicits small-scale orbital and suborbital missions, and orbital instruments. Venture-class investigations complement the larger systematic missions identified in the Earth Science decadal survey, providing flexibility to accommodate scientific advances and new implementation approaches.

Venture-Class comprises three "strands":

- EVS (Earth Venture Suborbital): Suborbital/airborne investigations, with five-year durations from project initiation. These are typically complex sets of instruments flown on suitable suborbital platforms to address focused

sets of scientific questions. The first five EVS investigations were selected in FY2010. Solicitations will be issued every four years.

- EVM (Earth Venture Mission): Small complete missions; $150 million total cost. These can be small satellites or stand-alone payloads as part of a larger mission. The first EVM small mission, CYclone Global Navigation Satellite System (CYGNSS), was selected in 2012. CYGNSS is a constellation of microsatellites that will study ocean surface winds. Solicitations will be issued every four years.
- EVI (Earth Venture Instrument): Spaceborne instruments for flight on a Mission of Opportunity (MoO); $90 million total cost for development and operations. The first EVI instrument will be selected in 2012. Solicitations will be issued every 15-18 months.

In selecting Venture Class missions, instruments and suborbital investigations, priority is given to cost-effective, innovative missions rather than those with more demanding scientific and technological requirements. Maintaining a steady stream of opportunities for community participation in the development of innovative ideas is key to the success of Earth Venture. The selected investigations will be strictly held to schedule and cost guidelines to ensure the long-term viability of the program.

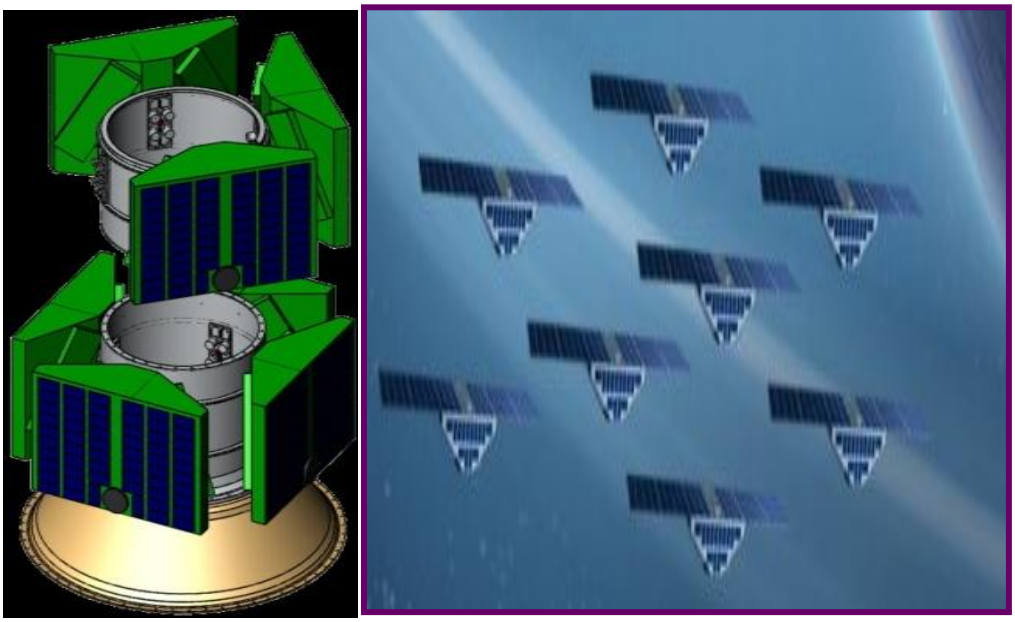


Figure 6.3-1: CYGNSS - First Earth Venture Small Mission

FY 2013 BUDGET REQUEST FOR VENTURE CLASS MISSIONS

Budget Authority ($ Millions)	Prior	FY 11 Actual	FY 12 Estimate	FY 13 Request	FY 14	FY 15	FY 16	FY 17	LCC Total
FY 2013 Request	6.3	32.0	53.6	106.2	173.6	190.1	167.1	188.9	Ongoing Program

Table 6.3-1: Budget Request for Venture Class Missions

6.3.7 STATUS

At this time, the first EVS missions are funded and in development or operations. The first EVM mission was recently selected, and the first EVI instrument is nearing selection, so this new program is on track and off to a good start. Affordable access to space continues to be a challenge for small, inexpensive missions.

6.4 PLANETARY SCIENCE

6.4.1 MARS SCIENCE LABORATORY (MSL)

6.4.1.1 DESCRIPTION

The Mars Science Laboratory (MSL) takes a major step forward in Mars exploration, both technically and scientifically, using a long-duration, radioisotope-powered rover, and 10 payload elements for definitive mineralogical and organics measurements and a new entry, descent, and landing system. MSL is already making progress on its primary scientific objective to explore and quantitatively assess a local region on Mars as a potential habitat for past or present life. MSL will lay the groundwork for future scientific missions, including Mars Sample Return, and will provide key information for human exploration.

MSL's Curiosity rover is making detailed measurements of element composition, elemental isotopes and abundance, mineralogy, and organic compounds to determine if Mars has, or has ever had, an environment capable of supporting life within the regions it will explore.

Curiosity has four main science objectives:

- Assess the biological potential of at least one selected site on Mars,
- Characterize the geology and geochemistry of the landing region at all appropriate spatial scales,
- Identify planetary processes relevant to past habitability, and
- Characterize the broad spectrum of the Martian surface radiation environment.

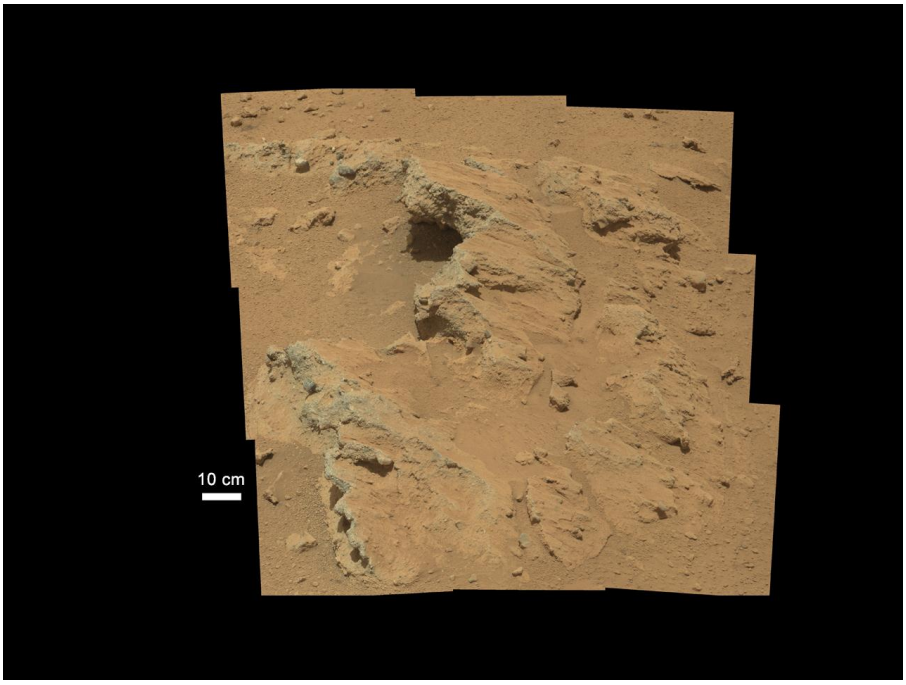


Figure 6.4-1: Curiosity image shows evidence of ancient streambed on Mars

FY 2013 BUDGET REQUEST FOR MSL

($ Millions)	Prior	Actual FY11	Enacted FY12	FY13	FY14	Total
FY 2013 Request	2,002.9	242.9	174.0	65.0	38.5	2,523.3

Table 6.4-1: Budget Request for MSL

6.4.1.2 STATUS

After launching from Cape Canaveral, FL, on November 26, 2011, Curiosity landed in Gale Crater, as planned, on August 6, 2012, a major success that was watched by millions of people around the world. The commissioning of Curiosity's systems, tools, and instruments continues; eight of Curiosity's ten instruments have been successfully tested on Mars, and the final two instruments are scheduled for their first science observations in the coming weeks. We expect that all of these initial activities will be completed on time. Curiosity is already reporting science results and making progress toward the science goals identified for its primary two-Earth year (one-Mars year) mission. NASA's Curiosity rover mission has found evidence that a stream once ran vigorously across the area on Mars where the rover is driving. There is earlier evidence for the presence of water on Mars, but this evidence — images of rocks containing ancient streambed gravels — is the first of its kind. In addition, the first Martian rock Curiosity touched presents a more varied composition than expected from previous missions; this rock also resembles some unusual rocks from Earth's interior. The rover team used two instruments on Curiosity to study the chemical makeup of the football-size rock called "Jake Matijevic." The results support some surprising recent measurements and provide an example of why identifying rocks' composition is such a major emphasis of the mission. Rock compositions tell stories about unseen environments and planetary processes. Curiosity will turn its attention in the coming months to its primary target, the central mound in Gale Crater, known as Mount Sharp. Stratification on Mount Sharp suggests that this mountain is a surviving remnant of an extensive series of deposits that were laid down after a massive impact that excavated Gale Crater more than three billion years ago. The layers offer a history book of sequential chapters recording environmental conditions when each stratum was deposited.

6.4.2 JUNO

6.4.2.1 DESCRIPTION

The overarching scientific goal of the Juno mission is to improve our understanding of the origin and evolution of Jupiter. However, as the archetype of giant planets, Jupiter can also provide knowledge that will improve our understanding of both the origin of our solar system and of planetary systems being discovered around other stars. The investigation focuses on the following four science objectives:

- Origin: Determine the oxygen-to-hydrogen ratio to determine water abundance and constrain core mass to decide among alternative theories of planetary origin.
- Interior: Understand Jupiter's interior structure and dynamic properties through mapping of its gravitational and magnetic fields, including internal convection and the size and mass of its core.

- Atmosphere: Map variations in atmospheric composition, temperature, and cloud opacity and dynamics, to depths greater than 100 bars, at all latitudes.
- Magnetosphere: Characterize and explore the three-dimensional structure of Jupiter's polar magnetosphere and auroras.

These objectives have been rated very highly in the National Academy of Sciences' Solar System Exploration Decadal Survey and Sun-Earth Connections Decadal Survey. The Astrophysics Decadal Survey identified the study of star formation and their planetary systems as well as giant and terrestrial planet birth and evolution as high priority. Juno fulfills key goals outlined in recent NASA and NRC studies.

Juno achieves the science objectives by using a simple spinning, solar-powered spacecraft to make global maps of the gravity, magnetic fields, and atmospheric composition of Jupiter from a unique elliptical polar orbit with a close perijove. The spacecraft carries precise, high-sensitivity radiometers, magnetometers, and gravity science systems. Juno's 32 orbits will extensively sample Jupiter's full range of latitudes and longitudes. From its polar perspective, Juno combines in-situ and remote sensing observations to explore the polar magnetosphere and determine what drives Jupiter's remarkable auroras.

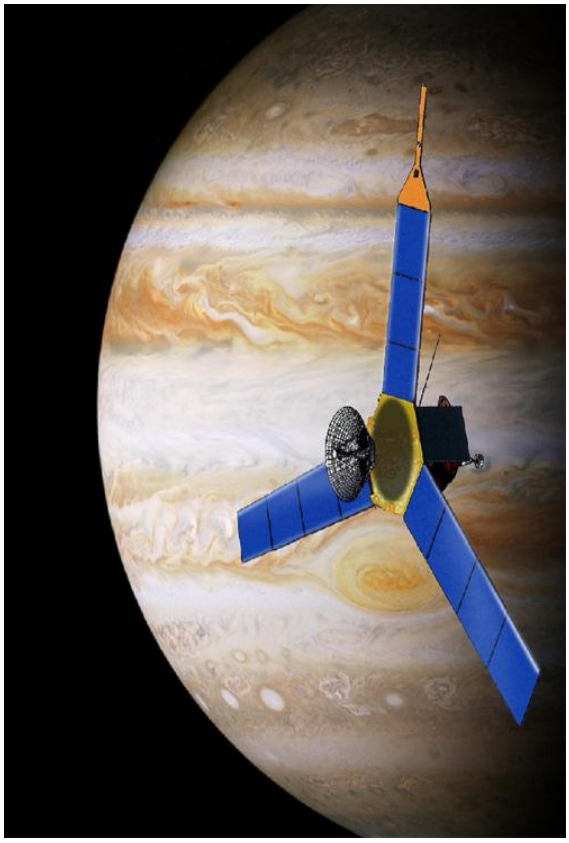


Figure 6.4-2: Artist's concept of Juno at Jupiter

FY 2013 BUDGET REQUEST FOR JUNO

Budget Authority ($ Millions)	Prior	FY 2011 Actual	FY 2012 Enacted	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	LCC Total
FY 2013 Request	743.1	189.2	31.2	17.8	18.1	21.8	29.9	33.4	22.3	1107.0

Table 6.4-2: Budget Request for Juno

6.4.2.2 STATUS

There are no major issues in the Juno project at this time. Juno launched successfully from Cape Canaveral, FL, on August 5, 2011, completing its development on time and under budget. It is currently in its cruise phase, preparing for a gravity assist speed boost from Earth via an Earth flyby in October 2013. Juno is expected to enter Jupiter orbit in July 2016 to begin its one-year primary mission. Once in orbit, the spacecraft will circle Jupiter 33 times, from pole-to-pole, and use its collection of eight science instruments to probe beneath the gas giant's obscuring cloud cover. Juno's science team will learn about Jupiter's origins, structure, atmosphere and magnetosphere, and look for a potential solid planetary core.

6.4.3 ORIGINS-SPECTRAL INTERPRETATION-RESOURCE IDENTIFICATION-SECURITY-REGOLITH EXPLORER (OSIRIS- REX)

6.4.3.1 DESCRIPTION

NASA will launch a spacecraft to an asteroid in 2016 and use a robotic arm to pluck samples that could better explain our solar system's formation and how life began. The mission, called Origins-Spectral Interpretation-Resource Identification-Security-Regolith Explorer, or OSIRIS-REx, will be the first U.S. mission to carry samples from an asteroid back to Earth. After travelling two years, OSIRIS-REx will approach the primitive, near-Earth asteroid designated 1999 RQ36 in 2018. Once within three miles of the asteroid, the spacecraft will begin six months of comprehensive surface mapping. The science team then will pick a location from where the spacecraft's arm will take a sample. The spacecraft gradually will move closer to the site, and the arm will extend to collect at least 60 grams of material for return to Earth in 2023. RQ36 is roughly the size of six football fields. The asteroid, little altered over time, is likely to represent a snapshot of our solar system's infancy. The asteroid is also likely to be rich in carbon, a key element in the organic molecules necessary for life. Organic molecules have been found in meteorite and comet samples, indicating some of life's ingredients can be created in space; scientists want to see if they also are present on RQ36.

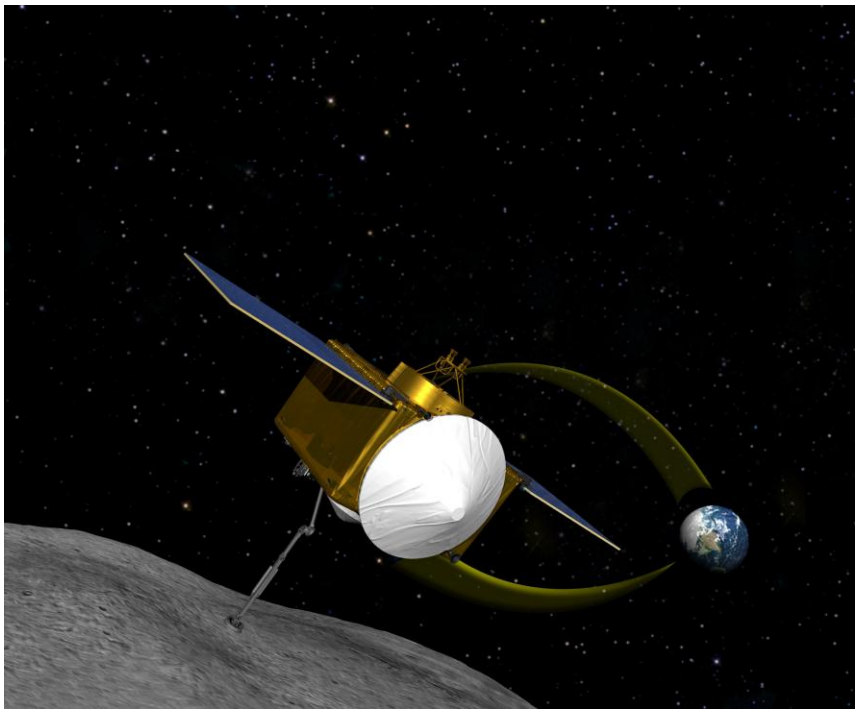


Figure 6.4-3: OSIRIS-REx at RQ36

OSIRIS-REx will perform the following:

- Return and analyze a sample of pristine asteroid soil in an amount sufficient to study the nature, history, and distribution of its constituent minerals and organic material;
- Map the global properties, chemistry, and mineralogy of a primitive carbonaceous asteroid to characterize its geologic and dynamic history and provide context for the returned samples;
- Document the texture, morphology, volatile chemistry, and spectral properties of the regolith at the sampling site at scales down to the sub-centimeter;
- Accurately measure the "Yarkovsky effect" on a potentially hazardous asteroid and constrain the asteroid properties that contribute to this effect; and
- Characterize the integrated global properties of a primitive carbonaceous asteroid to allow for direct comparison with ground-based telescopic data of the entire asteroid population.

The Yarkovsky effect is a small push caused by the sun on an asteroid as it absorbs sunlight and re-emits that energy as heat. The small push adds up over time, but it is uneven due to an asteroid's shape, wobble, surface composition and rotation. For scientists to predict an Earth-approaching asteroid's path, they must understand how the effect will change its orbit. OSIRIS-REx will study the orbit of asteroid RQ36 to ascertain its trajectory and devise future strategies to mitigate possible Earth impacts from celestial objects.

The planned launch date for OSIRIS-REx is in September 2016. The mission is completing its preliminary design, and will be confirmed

to begin final design and fabrication in mid-2013. As part of the on-going preliminary design effort, the OSIRIS-REx team updated the Design Reference Mission to provide additional operations time at the asteroid. The OSIRIS-REx launch period, asteroid departure date, and Earth return date remain the same as scheduled, but the OSIRIS-REx flight dynamics team is now planning an October 15, 2018, rendezvous date at the asteroid instead of the original plan of December 16, 2019. The mission will study the asteroid for about two years, globally mapping the surface from distances of 5 kilometers to 0.7 kilometers. The spacecraft cameras and instruments will photograph the asteroid and measure its surface topography, composition, and thermal emissions. Radio science will provide mass and gravity field maps. This information will help the mission team select the most promising sample site, from which it will collect and return to Earth at least 60 grams of pristine material from asteroid RQ36. The sample return will use a capsule similar to that which returned the samples of comet 81P/Wild on the Stardust spacecraft, allowing the sample to return and land at the Utah Test and Training Range in 2023. The capsule will then be transported to JSC for processing by a dedicated research facility. Subsamples will be made available for research to the world-wide science community.

FY 2013 BUDGET REQUEST FOR OSIRIS-REX

($ Millions)	Prior	Actual FY 2011	Enacted FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	BTC	Total
FY 2013 Request	0.0	4.9	110.2	137.5	228.7	224.2	202.1	44.9	0.0	952.7

Table 6.4-3: Budget Request for OSIRIS-REx

6.4.3.2 STATUS

On August 21, 2012, the Spitzer Space Telescope performed infrared observations of the OSIRIS-REx target asteroid 1999 RQ36 and on September 17 and 18, 2012, the Hubble Space Telescope Wide Field Camera-3 (HST) performed complementary photometric observations. These observations marked two of the final opportunities for OSIRIS-REx scientists to obtain detailed information about 1999 RQ36 before the mission launches in 2016. HST will provide one more set of images this coming winter.

6.4.4 MARS ATMOSPHERE AND VOLATILE EVOLUTION (MAVEN)

6.4.4.1 DESCRIPTION

NASA will launch the Mars Atmosphere and Volatile EvolutioN, or MAVEN, mission to orbit Mars. MAVEN will explore how the sun may have stripped Mars of most of its atmosphere, turning a planet once possibly more hospitable to microbial life into a cold and barren desert world.

MAVEN will be the first mission dedicated to exploring the upper atmosphere of Mars. Previous missions to Mars have shown us that the atmosphere and climate have changed over time and found evidence of abundant liquid water on the surface in

ancient times, though not today. Scientists want to know what happened to the water and where the planet's thick atmosphere went. The MAVEN mission will study the nature of the red planet's upper atmosphere, how solar activity contributes to atmospheric loss, and the role that escape of gas from the atmosphere to space has played through time.

MAVEN will launch from Cape Canaveral, FL, during a three-week period that begins on November 18, 2013. The trip to Mars takes 10 months, and MAVEN will go into orbit around Mars in September 2014. It will take five weeks for the spacecraft to get into its final science-mapping orbit, test the instruments, and test science-mapping sequences. After this commissioning phase, MAVEN has a one-Earth-year primary mission during which it will make its key measurements. Although launch opportunities exist approximately every 26 months, MAVEN's science is solar-cycle dependent. With the November 2013 launch, science will be gathered around the period of maximum solar activity, thus optimizing science return.

MAVEN will carry three instrument suites:

- Particles and Fields Package (PFP), built by the University of California at Berkeley Space Sciences Laboratory, contains six instruments that characterize the solar wind and the ionosphere of the planet.

- Remote Sensing Package, built by the University of Colorado at Boulder Laboratory for Atmospheric and Space Physics, will determine global characteristics of the upper atmosphere and ionosphere.

- Neutral Gas and Ion Mass Spectrometer (NGIMS), built by NASA Goddard, will measure the composition and isotopes of neutral gases and ions.

The MAVEN orbit will be elliptical. At its closest point to the planet, it will be 150 kilometers (93 miles) above the surface. At this altitude, the spacecraft will pass through the upper atmosphere on each orbit and can sample the gas and ion composition directly. At its highest point, it will be more than 6000 km (3728 miles) above the surface and can carry out ultraviolet imaging of the entire planet. This combination of detailed point measurements and global imaging is a powerful way to understand the properties of the upper atmosphere.

The altitude in the MAVEN orbit will be lowered for five "deep-dip" campaigns during the mission. In each deep dip, the spacecraft will take measurements that will provide information down to the top of the well-mixed lower atmosphere, giving scientists a full profile of the top of the atmosphere.

Figure 6.4-4: MAVEN at Mars

FY 2013 BUDGET REQUEST FOR MAVEN

($ Millions)	Prior	Actual FY 2011	Enacted FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	Total
FY 2013 Request	58.4	160.6	245.7	146.4	37.6	17.3	5.3		671.2

Table 6.4-4: Budget Request for MAVEN

6.4.4.2 STATUS

MAVEN is currently in the Assembly, Test, and Launch Operations (ATLO) phase. The spacecraft is being assembled and tested at Lockheed Martin, and the science instruments and relay radio payload are being delivered and integrated with the spacecraft.

Observatory-level testing will begin, and the assembled MAVEN observatory will be delivered to the Kennedy Space Center for launch processing in August 2013. After MAVEN is installed in the Atlas V fairing, it will be mated to the rocket at the Cape Canaveral Air Force Station in time for the opening of its launch period on November 18, 2013. The MAVEN Project is on budget and on track for completion, testing, and launch on schedule.

6.5 HELIOPHYSICS

6.5.1 MAGNETOSPHERIC MULTISCALE PROJECT (MMS)

6.5.1.1 DESCRIPTION

The Magnetospheric Multiscale (MMS) mission is a Solar Terrestrial Probes mission comprising four identically instrumented spacecraft that will use Earth's magnetosphere as a laboratory to study the microphysics of three fundamental plasma processes: magnetic reconnection, energetic particle acceleration, and turbulence. The disconnection and reconnection of the plasma and magnetic field lines takes place in a narrow boundary layer within Earth's magnetosphere called the diffusion region. The four satellites will be launched on a single launch vehicle and will fly in a tetrahedral (pyramid) formation, allowing them to capture the three-dimensional structure of the reconnection sites they encounter. MMS is scheduled to launch no later than March 2015.

MMS will focus on answering the following fundamental open questions:

- What determines when reconnection starts and how fast it proceeds?
- What is the structure of the diffusion region?
- How do the plasmas and magnetic fields disconnect and reconnect in the diffusion regions?
- What role do the electrons play in facilitating reconnection?
- What is the role of turbulence in the reconnection process?
- How does reconnection lead to the acceleration of particles to high energies?

Figure 6.5-1: MMS Spacecraft (Instrument Suite Deck View)

FY 2013 BUDGET REQUEST FOR MMS

($ Millions)	Prior	FY 2011 Actual	FY 2012 Enacted	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	BTC	LCC
FY 2013 Request	356.8	150.8	170.3	168.3	157.6	42.9	20.4	12.5	2.9	1082.6

Table 6.5-1: Budget Request for MMS

6.5.1.2 ISSUES

MMS is a complex project with four spacecraft, 25 instruments on each spacecraft, and multiple international partners, including Japan, Austria, Sweden, and France. The four spacecraft are being developed in parallel, which is a management challenge. Although the schedule is holding and the schedule reserves remain at levels consistent with NASA mission requirements, the cost reserves have been diminished. Due to mission conflicts with use of the facilities at GSFC, the MMS thermal vacuum testing will be performed at the Naval Research Lab (NRL) thermal vacuum facility. The additional costs and risks associated with testing at a different facility have been covered by releasing HQ Unallocated Future Expense (UFE) to the project. However, HQ is now left with diminished UFE, and the project has Integration and Test (I&T) and observatory environmental testing to complete. In addition, with current cost estimates and its funding reserve liens, the project will approach its Project Management Agreement, the agreement with NASA HQ to which the project manages, but will still meet the Agency Baseline Commitment, the commitment to OMB and Congress.

6.5.2 SOLAR PROBE PLUS (SPP)

6.5.2.1 DESCRIPTION

Solar Probe Plus (SPP) will be an extraordinary and historic mission, exploring what is arguably the last region of the solar system to be visited by a spacecraft, the sun's outer atmosphere or corona as it extends out into space. This Living With a Star (LWS) mission will use seven Venus flybys over nearly seven years to gradually shrink its orbit around the sun, coming as close as 3.7 million miles (5.9 million kilometers) to the sun, well within the orbit of Mercury and about eight times closer than any spacecraft has come before. During its unprecedented close-up study of the sun, SPP will endure 2600-degrees Fahrenheit, supersonic solar particles, and intense radiation. This mission has been the top priority of the heliophysics science community for over five decades.

The mission has five science investigations, (http://solarprobe.jhuapl.edu/spacecraft/instruments.php), which were selected competitively from the scientific community.

This mission is still in formulation and is scheduled to be reviewed for confirmation to start development in 2014. The mission is scheduled to launch in 2018.

SPP has three science objectives:

1. Trace the flow of energy that heats and accelerates the solar corona and solar wind.
2. Determine the structure and dynamics of the plasma and magnetic fields at the sources of the solar wind.
3. Explore mechanisms that accelerate and transport energetic particles.

Figure 6.5-2: Image of the Solar Plus Project

FY 2013 BUDGET REQUEST FOR SPP

($ Millions)	Prior	FY 2011 Actual	FY 2012 Enacted	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	BTC	LCC
FY 2013 Request	71.9	13.9	49.5	112.1	103.2	137.1	229.3	215.2	176.7	N/A

Table 6.5-2: Budget Request for SPP

6.5.2.2 ISSUES

There are no major issues in the SPP project at this time, but it has some complexities that are being addressed as the design matures.

- Technology Maturity: The project plans to bring the key technology development items to Technology Readiness Level (TRL)-6 by the end of Phase B.
- Launch Vehicle Enhancements: The base Atlas V 551 launch vehicle is insufficient to meet the mission requirements. The project is working with vendors to identify enhancements to meet launch energy requirements, including an upgrade to the third stage.
- Launch Window: Due to the unique mission design, the launch window in 2018 is 21 days, with a backup window that is about a year later. Therefore, the schedule will need to be closely managed as the project moves forward.

6.6 ASTROPHYSICS

6.6.1 STRATOSPHERIC OBSERVATORY FOR INFRARED ASTRONOMY (SOFIA)

6.6.1.1 DESCRIPTION

SOFIA is a unique airborne astronomical observatory, whose primary mission is to study many different kinds of astronomical objects and phenomena. SOFIA investigates star birth and death and the formation of new solar systems; it identifies complex molecules in space; and it observes planets, comets and asteroids in our solar system, as well as nebulae and dust in galaxies. The infrared light of these objects is only partially visible from the ground due to water vapor in Earth's atmosphere. However, at high altitudes, the influence of water vapor is negligible, allowing better observation of these astronomical objects. SOFIA's reconfigurability and flexibility ensures the integration of cutting edge technology and the ability to address emerging scientific questions.

NASA and the Deutches Zentrum für Luft- und Raumfahrt (DLR), Germany's Aerospace Research Center and Space Agency, are working together to develop and operate SOFIA, a Boeing 747SP aircraft that was modified to accommodate a 2.5 meter reflecting telescope.

Figure 6.6-1: SOFIA in Flight with Telescope Door Open

The SOFIA observatory project objectives are listed below:

- *Study the universe in the infrared spectrum.* Flying at altitudes between 41,000 and 45,000 feet, SOFIA makes infrared observations high above most of the infrared-absorbing water vapor in the atmosphere. Its observations span the full range of infrared wavelengths, from 0.3 – 1600 microns. SOFIA is used to study interstellar clouds, star and planet formation, activity in the center of the Milky Way, and the composition of planets and comets in our solar system.

- *Create an open opportunity for the entire international astronomical community.* During the first few years (observing cycles) of the SOFIA program, observing time will be divided between General Investigator observations, engineering time, guaranteed time for the instrument teams, and Director's Discretionary Time.
- *Provide a unique and exciting platform for Education and Public Outreach.* Educators from across the United States and Germany participate on-board during SOFIA science flights and thereby learn about infrared astronomy. They share this knowledge with colleagues and students in order to inspire the next generation of leaders in science, technology, engineering, and mathematics.

SOFIA is the largest airborne observatory in the world, and it makes observations that are impossible for even the largest and highest of ground-based telescopes. The modified Boeing 747SP airliner flies its missions from NASA Dryden Flight Research Center's Aircraft Operation Facility during what is expected to be a 20-year lifespan. SOFIA will soon be NASA's only far-infrared mission, as Spitzer cryogens have been depleted and Herschel's cryogens will be exhausted by 2013. SOFIA is capable of enabling "Great Observatory" class astronomical science.

FY 2013 Budget Request for SOFIA

($ Millions)	Prior	Actual	Enacted	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	BTC	Total
FY 2013 Request	812.4	79.9	84.2	85.5	88.0	88.0	86.0	85.9	1,593.1	3,002.9

Table 6.6-1: Budget Request for SOFIA

6.6.1.2 Issues

SOFIA has had a history of schedule slips and cost overruns since its inception in 1996. In 2006, NASA completely re-structured the program, providing NASA Program Managers with much greater control over technical decisions and resource allocations. After the restructuring, program performance against cost and schedule milestones improved dramatically. SOFIA has met all of its Level 1 requirements for observatory capability and is making progress toward its stretch goals. Recently, the program has appointed a joint U.S.-German SOFIA Pointing Optimization Team to study telescope pointing performance and to make recommendations for improvements, some of which have already been implemented on the observatory. SOFIA is currently at the beginning of its first science cycle, and the Program has faced many challenges in balancing the twin goals of functioning as an operating observatory while simultaneously completing system development.

6.6.2 Kepler

6.6.2.1 Description

The Kepler mission is a Discovery Program mission, and is the first NASA mission aimed specifically at trying to find Earth-sized planets orbiting stars similar to our own sun. Kepler, launched in March 2009, is

specifically designed to survey the distant stars in this region of the Milky Way galaxy to detect and characterize rocky planets in or near the "habitable zone" of their host star. The habitable zone encompasses the distances from a star where liquid water can exist on a planet's surface. As time progresses, smaller and smaller planets with longer and longer orbital periods will begin to emerge from the data.

Kepler's specific objectives include: determine the frequency of terrestrial and larger planets in or near the habitable zones of a wide variety of spectral types of stars; determine the distribution of planet sizes and their orbital semi-major axes (half the longest diameter of the orbit); estimate the frequency and orbital distribution of planets in multiple-stellar systems; and determine the distributions of semi-major axis, albedo, size, mass, and density of short-period giant planets.

In FY 2012, Kepler completed its third year of science operations. Kepler observations have resulted in numerous scientific discoveries and the project has released a substantial data set to the astronomical community. The Kepler prime mission will be completed in November 2012. NASA has accepted the recommendation of the 2012 Senior Review to extend the mission through 2016, with a further review in 2014.

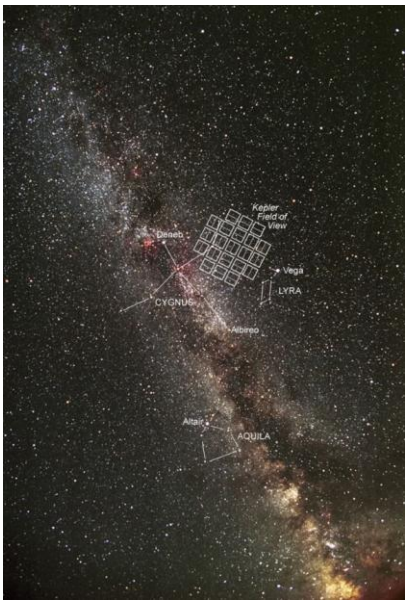


Figure 6.6-2: Kepler Field of View (Portrait)

FY 2013 BUDGET REQUEST FOR KEPLER

Budget Authority ($ Millions)	Prior	FY 2011 Actual	FY 2012 Enacted	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	BTC	Total
FY 2013 Request	562.4	16.8	19.6	13.6	0.2	0.0	0.0	0.0	0.0	612.6

Table 6.6-2: Budget Request for Kepler

6.6.2.2 ISSUES

The Kepler science mission has been extended from three years to a possible seven years. The Kepler Project requested the extension in order to overcome the fact that stars fluctuate in brightness somewhat more than expected, making it more difficult to discern the tiny signatures of Earth-sized planets. The discovery of Earth-like planets and a statistical survey of them is the prime objective of the Kepler mission. Progress toward discovery of Earth-like planets will be monitored. Also, the reaction wheel assemblies, which maintain the orientation of the telescope, have experienced episodes of anomalous friction. One assembly has failed, and has been replaced in normal operations by a redundant assembly. The operating conditions for the operating reaction wheels have been modified in an effort to extend their lifetime. Data collection and data mining are being pursued

in order to more sensitively identify signatures of increased friction and possibly impending failure.

6.6.3 JAMES WEBB SPACE TELESCOPE (JWST)

6.6.3.1 DESCRIPTION

The James Webb Space Telescope (JWST) is a NASA strategic mission to study many problems in astronomy and astrophysics as diverse as imaging the earliest stars and galaxies to form after the Big Bang to the remote examination of the atmospheres of exoplanets. JWST was rebaselined on September 2011 following the report from the Congressionally initiated Independent Comprehensive Review Panel that recommended several changes in how the Program was managed and funded. JWST is expected to launch in 2018.

JWST is a logical successor to the Hubble Space Telescope (HST), extending beyond Hubble's capabilities by virtue of its larger mirror and by looking into the near and mid-infrared spectrum, where the highly red-shifted early universe can be better observed.

JWST is optimized for infrared astronomy, with some capability in the visible range. It will have a 6.5-meter-diameter, segmented, adjustable primary mirror. JWST's instruments are:

- Near Infrared Camera (NIRCam);
- Mid Infrared Instrument (MIRI);
- Near Infrared Spectrograph (NIRSpec); and
- Fine Guidance Sensor (FGS)/Near Infrared Imager and Slitless Spectrograph (NIRISS).

NIRSpec and MIRI are collaborations with the European Space Agency (ESA), and FGS/NIRISS is being provided by the Canadian Space Agency. The telescope is scheduled to launch in 2018. Its operational location is the L2 Lagrange point. The JWST Ground Operations, Science Support Center, and archives will be at Space Telescope Science Institute (STScI) in Baltimore, MD.

Figure 6.6-1: JWST Full-Scale Test Membrane

FY 2013 BUDGET REQUEST FOR JWST

($ Millions)	Prior	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	BTC	LCC
FY 2013 Request	3,013.7	515.3	530.6	627.6	659.1	646.6	621.6	571.1	1,649.5	8,835.0

Table 6.6-1: JWST Budget Runout

6.6.3.2 ISSUES

JWST is a large, highly complex mission, both technically and managerially. Two of JWST's instruments, MIRI and FGS/NIRISS, have been delivered to GSFC for Integration and Test. The University of Arizona's Near-Infrared Camera (NIRCam) and the European Space Agency's Near-Infrared Spectrograph (NIRSpec) have experienced delays. The Integrated Science Instrument Module (ISIM) integration and test flow has been adjusted to incorporate the late instrument deliveries without reduction in ISIM schedule reserves and with an acceptable level of mission risk. Further significant delays in the delivery of NIRCam or the NIRSpec instrument will require utilization of project schedule reserve and could make the ISIM the pacing item for the program (the current pacing item is the telescope itself). The NIRCam is experiencing cost overruns and schedule delays. To date, these overruns have been absorbed through the use of JWST Unallocated Future Expenditures reserve funds. In response to these conditions, NASA has increased its onsite personnel at the contractor (Lockheed-Martin) the University of Arizona is using to develop the instrument. NASA personnel have regular conversations with the Lockheed-Martin vice president-level management to ensure proper attention is given to this critical instrument's cost and schedule performance.

6.7 JOINT AGENCY SATELLITE DIVISION

6.7.1 GEOSTATIONARY OPERATIONAL ENVIRONMENTAL SATELLITE-R (GOES-R) SERIES

6.7.1.1 DESCRIPTION

The Geostationary Operational Environment Satellite – R (GOES-R) series is the next generation of National Oceanic and Atmospheric Administration (NOAA) geostationary satellites and is a collaborative development and acquisition effort between NOAA and NASA. NOAA defines requirements for the program based on user needs; budgets and funds program resources and contracts; manages the integrated NOAA/NASA Program Office; procures the ground segment; and operates the GOES-R series satellites. NASA procures the instruments, spacecraft and launch vehicles; launches the spacecraft; and manages the program system engineering and mission assurance activities. GOES-R will accomplish the following:

1. Leverage its advanced spacecraft and instrument technology to support expanded detection of environmental phenomena, resulting in more timely and accurate weather forecasts and warnings;
2. Provide continuous imagery and atmospheric measurements of Earth's Western Hemisphere and space weather monitoring; and

3. Function as the primary tool for the detection and tracking of hurricanes and severe weather.

The GOES-R series will continue the two-satellite system implemented by the current GOES series. The GOES-R series operational lifetime extends through December 2036.

GOES-R will fly the following instruments:

1. Advanced Baseline Imager (ABI);
2. Space Environmental In-Situ Suite (SEISS);
3. Solar Ultra Violet Imager (SUVI);
4. Extreme Ultra Violet / X-Ray Irradiance Sensors (EXIS);
5. Geostationary Lightning Mapper (GLM); and
6. Magnetometer (MAG).

In May of 2012 the GOES-R program conducted a successful KDP-C, thus moving the program into the implementation phase. The GOES-R program will complete its mission critical design review in November of 2012. All instrument flight models for the GOES-R mission are in some phase of integration, assembly and testing. The spacecraft completed its critical design review in April 2012. Also in April, the Atlas V 541 was selected as the launch vehicle for the GOES-R and GOES-S missions.

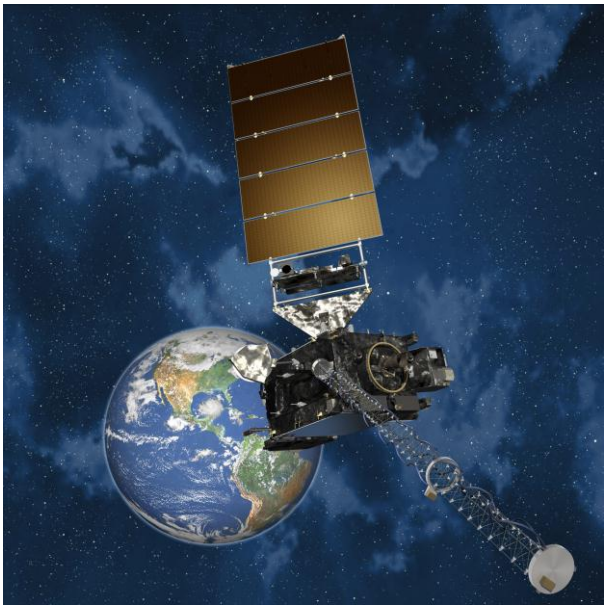


Figure 6.7-1: GOES-R Spacecraft

FY 2013 BUDGET REQUEST FOR GOES-R

NASA completes work on GOES-R on a reimbursable basis, and as such, the budget lies with NOAA.

6.7.1.2 ISSUES

The GOES-R program is experiencing increased programmatic risks for achieving the October 2015 launch readiness date for the GOES-R mission. Recent information from the spacecraft vendor indicates reduced schedule margins below the Goddard Space Flight Center standards for the GOES-R mission due to potential late delivery of reaction wheels, incorporation of Electrostatic Discharge protection, and expanded Radio Frequency (RF) compatibility testing. The GOES-R program also has limited FY12 uncosted carryover and low contingency levels that make the program more susceptible to potential budget reductions during the FY13 appropriations process. Technically, issues continue to surface during instrument assembly and test, but most have been resolved quickly with limited impact to instrument delivery schedules. One exception is the Geostationary Lighting Mapper (GLM), which has the least slack to spacecraft need date. Issues with GLM Electromagnetic Interference/Capability (EMI/EMC) testing, which have since been resolved, significantly reduced the instrument's schedule slack.

6.7.2 JOINT POLAR SATELLITE SYSTEM (JPSS)

6.7.2.1 DESCRIPTION

The Joint Polar Satellite System (JPSS) is the next generation of National Oceanic and Atmospheric Administration (NOAA) polar orbiting environmental monitoring satellites. JPSS is a joint mission with the NOAA. NOAA maintains overall program responsibility for developing, funding, and implementing JPSS. NASA is the acquisition agent for the flight and ground segments and is the systems integrator of JPSS on behalf of NOAA on a reimbursable basis, with program activities led by the Program Offices at the Goddard Space Flight Center. The JPSS program inherited flight and ground assets from the cancelled National Polar-orbiting Operational Environmental Satellite System (NPOESS) program.

The JPSS mission will accomplish the following:

- Increase the accuracy and reliability of weather forecasting capabilities especially for severe weather and tropical cyclones;
- Improve use of polar-orbiting satellite data for ocean and coastal applications; and
- Continue and enhance our long-term environmental data sets to facilitate long term climate monitoring and prediction.

JPSS will fly the following instruments:

- Visible/Infrared Imaging Radiometer Suite (VIIRS);
- Advanced Technology Microwave Sounder (ATMS);
- Cross-Track Infrared Sounder (CrlS);
- Ozone Mapping and Profiling Suite (OMPS);
- Clouds and Earth's Radiant Energy System (CERES); and
- Total Solar Irradiance Sensor (TSIS).

JPSS will fly the following user services:

- Advanced Data Collection System (ADCS); and
- Search and Rescue Satellite (SARSA1).

JPSS is set to deploy and operate through FY 2028. It consists of five satellites: the Suomi National Polar-orbiting Partnership (Suomi NPP), JPSS-1, JPSS-2, Free Flyer-1 and Free Flyer-2. The VIIRS, ATMS, CrIS, OMPS and CERES instruments will be accommodated on JPSS-1 and -2, while the TSIS, A-DCS and SARSAT instruments will be accommodated on the Free Flyer satellites.

The Suomi NPP satellite, formerly known as the NPOESS Preparatory Project (NPP), was developed as a way to assure continuity of key observations from NASA's Earth Observing System (EOS) and to demonstrate technologies for NPOESS. The satellite was successfully launched in October 2011, and NOAA will use the satellite's data for its operational weather forecasting models. On-orbit checkout of the Suomi NPP satellite is now complete. Calibration and validation of the sensors is underway, and the JPSS program has assumed operational control. In May 2012, the National Weather Service started to use the NPP ATMS data in their operational forecast models. For the JPSS-1 satellite, the spacecraft is currently being built and the instrument vendors continue to make progress in manufacturing and testing.

FY 2013 BUDGET REQUEST FOR JPSS

NASA's efforts on JPSS are performed on a reimbursable basis, and as such, the budget lies with NOAA.

7.7.2.2 ISSUES

Congress has expressed concern about the JPSS cost. JPSS-1 spacecraft delta-critical design review is scheduled for December 2012, and a JPSS-1 Flight (spacecraft, instruments and launch vehicle) delta-critical design review is set to follow in January to address any technical issues that may have arisen as part of the build of its sophisticated spaceflight hardware. There is currently sufficient budget and schedule margin for any anticipated issues relating to the JPSS-1 mission.

7.0 MISHAP INVESTIGATIONS AND CONTINGENCY PLANS

INTRODUCTION

NASA conducts mishap investigations in accordance with NPR 8621.1B, NASA Procedural Requirements for Mishap and Close Call Reporting, Investigating, and Recordkeeping in order to improve safety. This section provides an overview of mishap investigation policy and objectives, basic terminology, and mishap classification levels. The section also describes the mishap investigation process, center mishap preparedness and contingency plans, and program mishap preparedness and contingency plans. Finally, this section presents a summary of NASA's "Type A" mishaps during the period January 2008 until June 2012.

7.1 OVERVIEW

NPR 8621.1B describes the policy to report, investigate, and document mishaps, close calls, and previously unidentified serious workplace hazards to prevent recurrence of similar accidents. The NPR also describes the method for correctly conducting a mishap investigation and the appropriate level of detail and resources required for the investigation.

The objective of mishap and close call investigations is to improve safety by identifying what happened, where it happened, when it happened, why it happened, and what should be done to prevent recurrence and reduce the number and severity of mishaps.

The safety investigation is not to be used to direct or justify disciplinary action for mishaps or close calls. These investigations are focused primarily on safety aspects of the workplace and determining the root cause of the mishap. Root cause analysis is a specific analysis that identifies all relevant organizational factors and is used by the investigating authority to evaluate all applicable data in determining why a mishap occurred.

A collateral mishap investigation may occur if it is reasonably suspected that a mishap resulted from criminal activity, or if the Agency wants to assess accountability to determine if negligence was a factor. NASA has the flexibility to exercise the option of performing more than one type of investigation for a mishap.

7.2 BASIC TERMINOLOGY OF MISHAPS

7.2.1 MISHAP

NASA defines a mishap as any unplanned event that results in at least one of the following:

- Injury to non-NASA personnel caused by NASA operations.
- Damage to public or private property (including foreign property) caused by NASA operations or NASA-funded development or research projects.
- Occupational injury or occupational illness to NASA personnel.
- NASA mission failure before scheduled completion of the planned primary mission.
- Destruction of or damage to NASA property.

7.2.2 CLOSE CALL

A close call is an event in which there is no injury or only minor injury requiring first aid

and/or no equipment/property damage or minor equipment/property damage (less than $1000), but which possesses a potential to cause a mishap. Although not strictly a mishap, the investigation of close calls is also an important component in the mishap prevention process.

7.3 CLASSIFICATION OF MISHAPS

NASA requires that all mishaps and close calls are investigated. The safety office at the various NASA centers has this responsibility for ensuring that mishap data is entered into the Incident Reporting and Information System (IRIS). The IRIS database is the primary repository for mishap information and is used for tracking and updating incident cases, including providing corrective action summary, lessons learned, and other pertinent safety incident information.

The severity of the personnel injury and the direct cost of the mishap or close call (property damage and/or mission failure) determine the classification level of the mishap or close call and the corresponding type of investigation to be conducted. Table 7.3-1 details the specifics of mishap classification.

Due to the nature of research and operations performed by the Agency, NASA does not consider some test failures to be mishaps. The criteria for determining whether a test failure is a mishap are described in the NPR 8621.1B. However, the classification of an event as a test failure is generally limited to failure of components that are subject to normal wear with regularly scheduled maintenance, failure of test articles that are not flight hardware, or failure during a test where the failure is a reasonably predicted or possible outcome.

Other destruction or damage to public or private property is not considered a mishap if it is due to weather related events (hurricane, lightning, tornado, tidal wave, tsunami, water spout, ice/snow loads) or natural phenomenon (flood, landslide, earthquake, meteoroid landing, or volcanic eruption).

NASA property damage or personnel injuries that are the result of vandalism, riots, civil disorders, or felonious acts such as arson or sabotage are not considered NASA mishaps. These incidents are reported and investigated in accordance with procedures under NPD 9800.1, NASA Office of Inspector General Programs, and NPR 1600.1, NASA Security Program Procedural Requirements.

There may be cases when a mishap or close call is felt to be a high-visibility event. In these cases, any one of a number of NASA officials may elevate the mishap classification level of investigation to the classification level that he/she deems appropriate; in addition, he/she may request the appropriate appointing official to form a Mishap Investigation Board. The NASA officials empowered to do this are the following: the Administrator, Associate Administrator, Mission Directorate Associate Administrator, Chief, Safety and Mission Assurance, the Designated Agency Safety and Health Official who is the Chief Health and Medical Officer, Center Director, or the Assistant Administrator, Office of Infrastructure and Administration.

Classification Level & Type of Investigation	Property Damage	Injury
Type A Mishap	Total direct cost of mission failure and property damage is $2M or more, **or** Crewed aircraft hull loss has occurred, **or** Occurrence of an unexpected aircraft departure from controlled flight (except high performance jet/test aircraft such as F-15, F-16, F/A-18, T-38, OV-10, and T-34, when engaged in flight test activities).	Occupational injury and/or illness that resulted in: A fatality, **or** A permanent total disability, **or** The hospitalization for inpatient care of three or more people within 30 workdays of the mishap.
Type B Mishap	Total direct cost of mission failure and property damage of at least $500K, but less than $2M.	Occupational injury and/or illness has resulted in permanent partial disability, **or** The hospitalization for inpatient care of one to two people within 30 workdays of the mishap.
Type C Mishap	Total direct cost of mission failure and property damage of at least $50K, but less than $500K.	Nonfatal occupational injury or illness that caused any workdays away from work, restricted duty, or transfer to another job beyond the workday or shift on which it occurred.
Type D Mishap	Total direct cost of mission failure and property damage of at least $1K, but less than $50K.	Any nonfatal OSHA recordable occupational injury and/or illness that does not meet the definition of a Type C mishap.
Close Call	An event in which there is no equipment/property damage or minor equipment/property damage (less than $100), but which possesses a potential to cause a mishap.	An event in which there is no injury or only minor injury requiring first aid, but which possesses a potential to cause a mishap.

Table 7.3-1: NASA Classification of Mishaps and Close Calls

NASA has precise criteria for the classification of Mishaps and Close Calls.

7.4 Overview of the Mishap Investigation Process

NASA uses a well-defined process common to many investigative bodies. Specifically, the process is divided into three phases: the Pre-field phase, the Field phase, and the Post-Field phase. These are described immediately below.

Pre-Field Phase

- Prepare for the investigation.

Field Phase

- Verify mishap site is safe and secured and evidence is preserved.
- Gather physical evidence and facts.
- Interview witnesses.

Post-Field Phase

- Review and analyze data.
- Draw conclusions and document findings.
- Generate recommendations.

- Develop mishap report.

At the inception of a Type A/B or High Visibility incident, a Mishap Investigation Board is appointed in accordance with NPR 8621.1B requirements for the level of investigation necessary. Mishap Investigation Boards are comprised of a Chairperson, Ex-Officio, and normally two or four additional voting members. Advisors/consultants are included depending on the technical aspects of the incident, but are not considered voting members of the board.

Endorsing officials are comprised of the Chief, Safety and Mission Assurance, the Chief Engineer, and the Chief Health and Medical Officer. Mishap Boards are also required to have representatives from the Office of Chief Counsel and the Public Affairs Office. All mishap reports and related information are reviewed by the Office of General Counsel, OIIR, Office of Communications, Office for International Traffic in Arms Regulations (ITAR) and Export Administration Regulations (EAR) requirements and other Sensitive But Unclassified criteria.

NPR 8621.1B Appendix C provides an outline of the notional timeline (Figure 7.4-1) for a mishap from the time the incident occurs until the report is authorized for public release and corrective action plans are completed. Generally, the full mishap process can take up to 145 days or more. However, there are several instances where Appointing Officials have directed that boards take less time (30 days) to complete the report depending on the severity of the mishap.

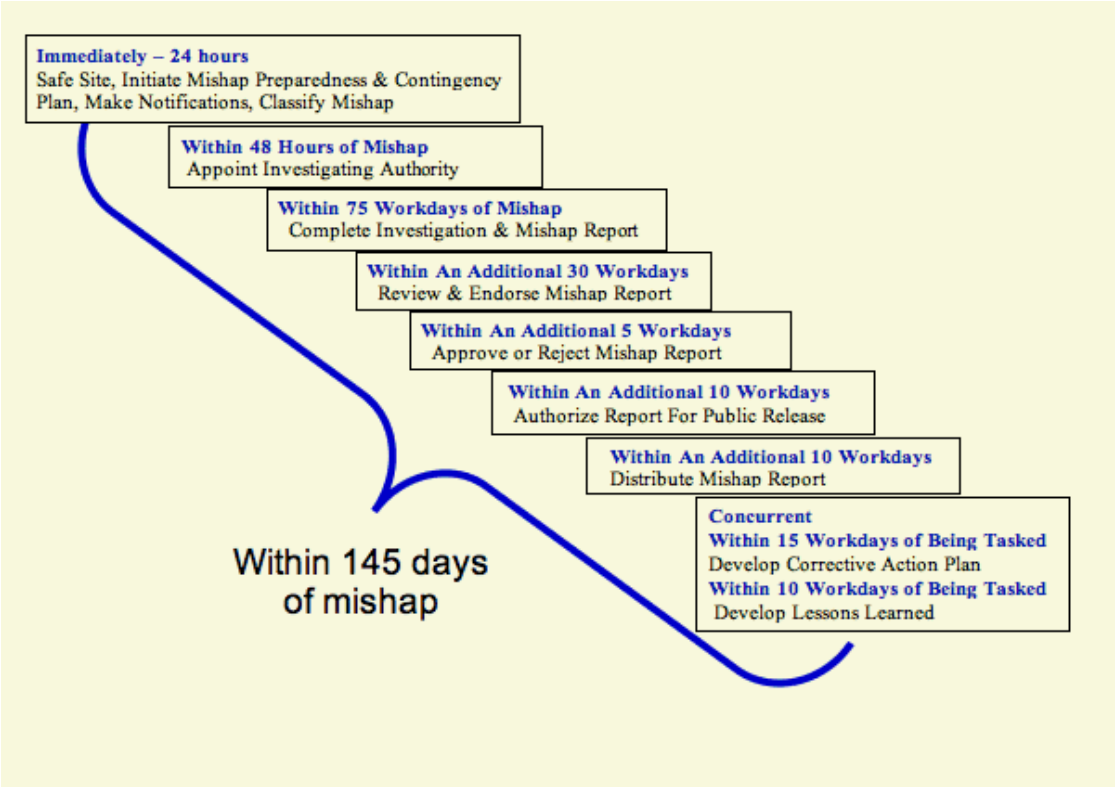


Figure 7.4-1: NASA Mishap Investigation Process Notional Timeline

The NASA Mishap Investigation Process is thorough and comprehensive.

NASA requires that within 24 hours of the incident notification is made to all authorities. The Center Safety Office ensures that the event and preliminary information is recorded in the IRIS database. Notification to NASA Headquarters, Office of Safety and Mission Assurance is also required within the first 24 hours. Within 48 hours, the formal Mishap Investigation Board is appointed and begins the investigation phase.

At the onset of a mishap, the Center implements their Mishap Preparedness and Contingency Plan, which describes roles and responsibilities of safety, security, and emergency response personnel as well as management contact information. Additional detail on the Center Mishap Preparedness and Contingency Plan is addressed in the following section.

The Mishap Investigation Board completes the investigation and written report within 75 days. Additional time for investigation may be required, in which case, an extension can be granted from the Office of Safety and Mission Assurance. The Mishap Investigation Board is responsible to the Appointing Official for disseminating timely information on mishaps and is required to issue a 30-day status report of Board activity and factual information. This 30-day status report is also included in the IRIS database.

NASA uses Mishap Investigation Specialists from the NASA Safety Center to assist in facilitating the mishap process. This support includes reviewing the mishap report for consistency and adherence to the NPR 8621.1B requirements.

NASA also requires that boards present their findings in a formal out brief to endorsing officials and the appointing official of the Mishap Investigation Board. Once the mishap report is endorsed, it is then authorized for public release and distribution.

At any time during the investigation, if certain safety critical information is required to be sent, the Mishap Investigation Board Chair will issue a Mishap Warning Action Response which is distributed to NASA Safety and Mission Assurance management and personnel, Center Directors, and Agency officials. In addition, the board must provide a 30-day status report using the template provided in NPR 8621.1B. The status report will only contain factual information of the board's progress.

Appropriate organizations responsible for alleviating any and all safety concerns found during the course of the investigation are required to provide a Corrective Action Plan. This plan is approved by the appointing official and recorded in the IRIS database. Any Lessons Learned resulting from the investigation are developed and input to the NASA Lessons Learned Information System (LLIS).

7.5 Center Mishap Preparedness and Contingency Plans

NPR 8621.1B requires that the Assistant Administrator, Office of Infrastructure and Administration and each Center Director develop a Center Mishap Preparedness and Contingency Plan. The plan describes the following:

- Local reporting policy and procedures, with current contact information.
- Relationship between the Center's Emergency Preparedness Plan and the Program Mishap Preparedness and Contingency Plans, and which has precedence during a specific emergency situation.

- All management responsibilities for establishing a mishap investigation.
- Procedures for appointing the Interim Response Team for mishaps not covered in plans.
- Procedures to appoint a Mishap Investigation Team, or single investigator for Type C and D mishaps.
- The role of the Incident Commander.
- Procedure and location for impounding records and equipment and release procedures.
- List of Center Safety Office personnel and other critical specialists that assist in safeguarding the scene and evidence.
- Mishap report approval process for Type C and D mishaps and close calls.
- List of contractor support and on-site specialists, which can support mishap investigations.
- Schedule for mishap simulations and emergency response drills.
- Description of the information technology plan to provide computer data retrieval and data archive support to the investigating authority.
- Description of all necessary security clearances for investigating authority members.
- Description of the chain of custody process to secure and safeguard personnel effects and sensitive information related to injured or deceased individuals.
- An expiration date for the Mishap Preparedness and Contingency Plan.

7.6 Program Mishap Preparedness and Contingency Plans

NASA requires project/program managers to develop and concur in a Program Mishap Preparedness and Contingency Plan, which in many ways mirrors the Center's Contingency Plan. The Program Contingency Plan also addresses information specific to the program not covered in the Center's Contingency Plan. Specific concerns for programs that may be encountered include:

- Procedures for dealing with off-site mishaps.
- Special handling procedures for any hazardous materials in project/program hardware.
- Special emergency response procedures that may be required.
- Procedures for dealing with multiple agencies and jurisdictions, e.g., state, local, and federal.
- Procedures for collecting evidence in a foreign country.
- Transporting requirements for debris and other evidence associated with program hardware.

7.7 Summary of NASA's Type A Mishaps

The total number of Type A Mishaps suffered by NASA over the period of January 2004 until June of 2008 was 13. Table 7.3-1 below provides a list of these mishaps with a brief description of each.

Date of Mishap	Mishap Type	Responsible Organization	Mishap Title
2008			
3/5/08	Type B	ARC	Slip and Fall Building @N249 Shore Test Facility during simulation
3/14/08	Type B	SSC	Building 1100 Fire
4/11/08	Type B	GRC	Fixture Flange Fall resulting in injury
5/20/08	Type B	KSC	Pad A Mobile Launch Platform (MLP) Ladder fall and injury
5/31/08	Type A	KSC	STS-124 Pad 39A Launch Damage
6/19/08	Type B	ARC	T20-G Fall and injury
7/17/08	Type B	JPL	Duct Bank Collapse during excavation
8/2/08	Type B	JPL	Lemar Worker Construction Finger Injury
8/22/08	Type A	ARMD	Hybolt/SOAREX Launch Failure
9/9/08	Type B	JPL	Employee fall and injury
9/18/08	Type B	LaRC	National Transonic Facility (NTF) Fan Blade Damage
12/23/08	Type B	SSC	Landfill Cell 3 Liner Damage
2009			
2/2/09	Type B	JPL	MSL Rover Integrated Pump Assembly (RIPA) damage
2/24/09	Type A	SOMD	Taurus T8 Launch Vehicle Failed to Reach Orbit Resulting in Loss of Orbiting Carbon Observatory (OCO)
3/13/09	Type B	DFRC	Building 4833 inadvertent Deluge Release
4/2/09	Type B	SSC	Water Well Drill Rig Injury
4/23/09	Type B	JSC	Motorcycle/Car Crash Injury
5/2/09	Type B	KSC	Building K6-1193 Ladder Fall and Injury
5/15/09	Type B	MSFC	LN2 XRCF Vessel Damage
6/24/09	Type B	KSC	OV-104 Longeron Bridge Damage
8/10/09	Type B	KSC	Left Toe Amputation due to PPE
8/10/09	Type B	KSC	Overturned Seawall Construction Excavator
9/29/09	Type B	KSC	Contractor Employee Fall From Truck w/Injury
10/2/09	Type B	GSFC	Bldg 5 Broken Waterline w/Flood Damage
10/23/09	Type B	DFRC	F18 damage - Ingested FOD
10/30/09	Type B	KSC	Fall from Crane with Injuries
2010			
1/12/10	Type B	HQ	Injury to forearm requiring surgery

1/14/10	Type B	MAF	Fall into Elevator Pit w/Injury
1/19/10	Type B	KSC	Joy Compressor Room Trip and Injury
1/28/10	Type B	KSC	Launch Control Center Firex Leak w/Damage
2/8/10	Type B	JSC	Fall in Parking Lot w/Injury
3/5/10	Type B	KSC	Fall in Hallway w/Injury
4/28/10	Type B-High Visibility	WFF	Balloon Launch Failure (Australia)
4/29/10	Type B	KSC	Electrical Mishap/Injury at Building 01385 Demolition Project
6/7/10	Type B	KSC	Thumb Crushed between Magnets
6/14/10	Type B	JSC	Personnel Hearing Shift when Pressure Tubing Burst
6/18/10	Type B	MSFC	Freedom Star Inury
7/28/10	Type B	JSC	Building 32 Chamber B Air Quality Ladder Fall w/Injury
7/29/10	Type B	JSC	Finger Smash between Conduit and Wall
8/3/10	Type B	GSFC	Ladder Fall/Injury during Electrical Inspection
9/11/10	Type B	KSC	Fall/Injury
9/28/10	Type B	GSFC	Damaged Circuit Boards during inspection
9/29/10	Type B	HQ	Trip and Fall w/Injury
10/8/10	Type B	JPL	Fall from Scaffolding w/Injury
10/14/10	Type B	SSC	Fall/Injury in Building 1100
10/26/10	Type B	WSTF	Partial Finger Amputation on Punch Machine
10/28/10	Type B	WFF	Arm Injury on CNC Machine
2011			
1/12/11	Type B	MSFC	Slip and Fall on Ice w/Injury
2/3/11	Type B	MAF	Hip Injury
2/7/11	Type B	GRC	Building 86 Parking Lot Injury
3/4/11	Type A	SOMD	Glory Spacecraft Mission Failure
4/8/11	Type B	MSFC	Finger smashed by gearbox
5/24/11	Type B	GRC	45 Foot Fall from Structure w/Injury
6/28/11	Type B	GSFC	Bldg 35 Construction Injury
7/11/11	Type B	JPL	Trip and Fall Injury
7/28/11	Close Call-High Visibility	JPL	MSL Instrumentation subject to unintended loads
8/10/11	Close Call-High Visibility	JPL	Support equipment cable close call
8/13/11	Close Call-High Visibility	JPL	Drill Bit Assembly Installation close call
8/29/11	Type B	GSFC	Electrical Shock Injury at Building 2 Demoliton Site
9/1/11	Close Call-High Visibility	KSC	Personnel Exposure to Nitrogen Tetroxide (N2O4)
9/22/11	Type B	JPL	Fall w/Injury in Bldg. 125 Basement

10/8/11	Type B	JSC	SCTF Cooling Tower Hand Injury
10/17/11	Type B	MAF	Aerial Lift Fall w/Injury
11/16/11	Close Call-High Visibility	GSFC	Beam Irradiator Close Call
12/6/11	Type D-High Visibility	DFRC	ER-2 Oxygen Failure
2012			
4/11/12	Type B	JSC	Building 207 Parking Lot Car Crash w/injury
4/12/12	Type B	LaRC	Personnel Exposure to Chemical
4/27/12	Type B	LaRC	Eye Injury due to Overhead work
5/3/12	Type C-High Visibility	SMD	LADEE spacecraft damage
9/4/12	Type B	GSFC	Fall from Shuttle Bus w/Injury
10/1/12	Type B	GSFC	Construction Fall w/Injury

Table 7.7-1: Summary of NASA's Major Mishaps - January 2004 to June 2008

8.0 THE NASA WORKFORCE

INTRODUCTION

This section is organized as follows:

- Current Staffing: Demographics of the Civil Service
- Trends, Forecasts and Immediate Needs in Staffing: trend information over the past 15 years; forecasts for the next 15 years; current staffing gaps and surpluses
- Workforce Strategy and Integrated Management Systems
- Executive Resources (senior executives, senior scientific and professional, and senior level)
- Political Appointees and Other Discretionary Hires
- General Staffing Data (compensation, employee/labor relations, training, and development)

8.1 CURRENT STAFFING: DEMOGRAPHICS OF NASA'S CIVIL SERVANT WORKFORCE

At the end of FY 2012, NASA employed 18,210 civil servants,[4] which included 520 students. When analyzing average employment levels during FY 2012, this amounts to 17,945 Full-Time Equivalent (FTE) civil servant (CS) employees (including 267 student FTE), supported by many times that number in contractors. As of FY 2011, about 39,733 contractor personnel (in Work-Year Equivalents, or WYE) are located 'on-site' or 'near-site,' meaning that they are within 50 miles of a NASA-managed location. Together this group form what NASA calls its blended workforce. In addition, JPL has 4,769 WYE at this time.

NASA has the following types of civil servant employees, with details provided about each type later in the document:

8.1.1 TYPES OF EMPLOYEES [TOTAL OF 18,210 CIVIL SERVANTS]

- Senior Executive Service (SES) – 409 employees — discussed in Executive Resources section
- Senior Scientist/Technologist – 82 employees – see Executive Resources section
- Senior Level — 46 employees – see Executive Resources section
- General Schedule – 17,613 employees — discussed in General Staffing section
- Wage Grade (blue-collar technicians) – 14 employees – see General Staffing section
- NASA Excepted Service (NEX) – 10 employees – see General Staffing section
- Other (e.g., Expert Consultants) – 36 employees (e.g. members of the NASA Advisory Council)
- The Intergovernmental Personnel Act (IPA) Mobility Program provides for the temporary assignment of personnel between the Federal Government and state and local governments, colleges and universities, Indian tribal governments, federally funded research and development centers, and other eligible organizations.

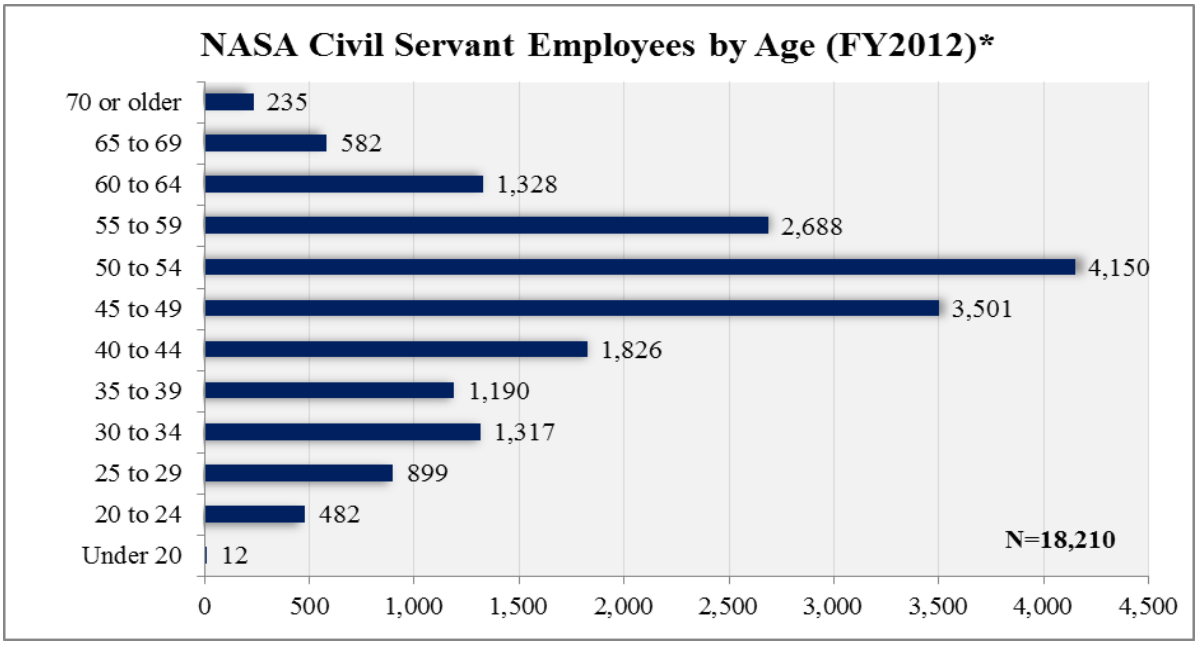
[4] Includes all employee types (e.g., full-time, part-time, students) and employees on extended leave

8.1.2 EMPLOYMENT TYPES

- Full-Time Permanent – 17,162 employees
- Part-Time Permanent – 99 employees
- Term – 342 employees (discussed in Legislative Authorities)
- Other Non-Permanent (e.g., temporary) – 87 employees
- Students – 520 employees

8.1.3 DEMOGRAPHICS

- NASA's workforce is 65 percent male (N=11,834) and 35 percent female (N=6,376)
- NASA's workforce is 74 percent white; 12 percent African-American; 6 percent Hispanic; 7 percent Asian or Pacific Islander, 0.70 percent Native American and 0.76 percent Multiracial
- 95 percent of NASA's workforce are permanent employees; 2 percent are term or other temporary employees
- 3 percent of NASA's workforce are students
- 11 percent of NASA's workforce are supervisors or managers; this amounts to an average ratio of 7.9 staff for each supervisor
- 53 percent of the scientific and engineering workforce have at least a Master's degree (35 percent MS, 18 percent PhD)
- As shown below, NASA today is predominated by a very experienced staff (average age is 50-54 years). The majority of civil servant employees at NASA fall within the GS 12-15 range, which amounts to 85 percent of the total civil servant workforce



Refers to total headcount

Figure 8.1-1: NASA Civil Servant Employees by Age (FY2012)

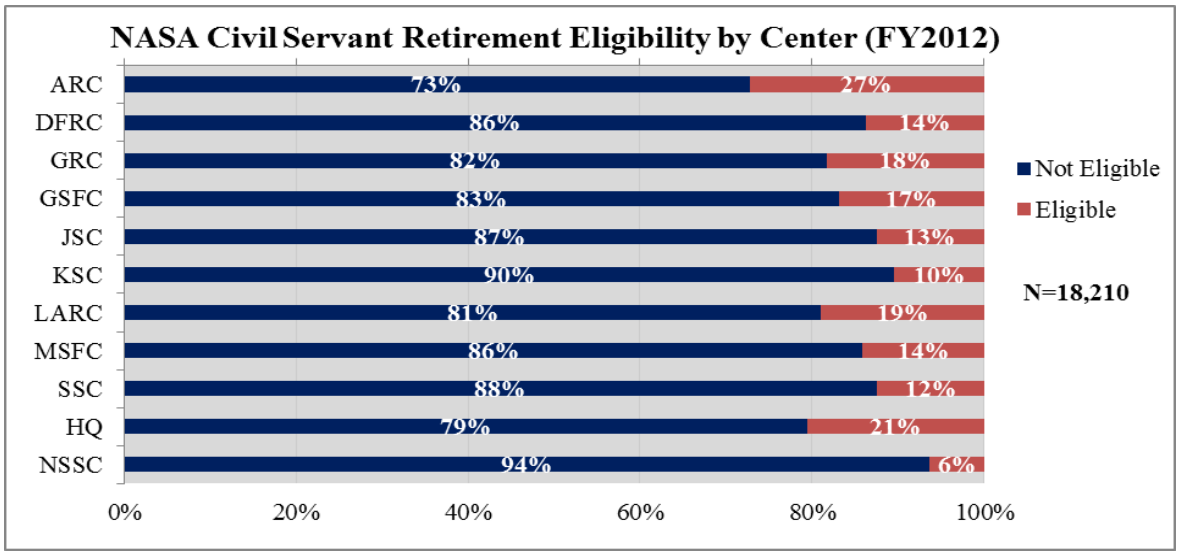


Figure 8.1-2: NASA Civil Servant Employees by Age (FY2012)

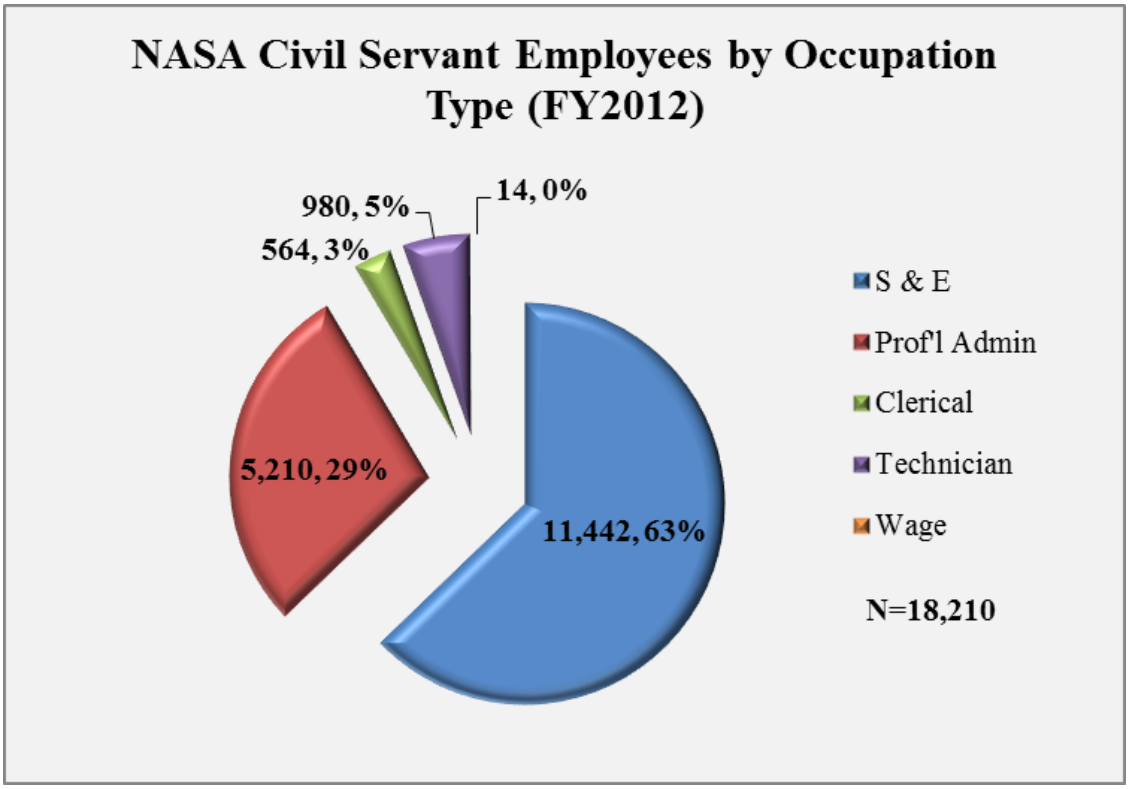


Figure 8.1-3: NASA Civil Servant Employees by Occupation Type (FY2012)

8.2 WORKFORCE TRENDS

8.2.1 HISTORICAL WORKFORCE SIZE

ARC	1,544	1,225	-20.66%
DFRC	575	553	-3.83%
GRC	2,164	1,659	-23.34%
GSFC	3,518	3,376	-4.04%
JSC	3,351	3,284	-2.00%
KSC	1,999	2,102	5.15%
LARC	2,572	1,907	-25.86%
MSFC	2,950	2,481	-15.90%
SSC	247	298	20.65%
HQ	1,318	1,182	-10.32%
NSSC	0	143	N/A
Agency	**20,238**	**18,210**	**-10.02%**

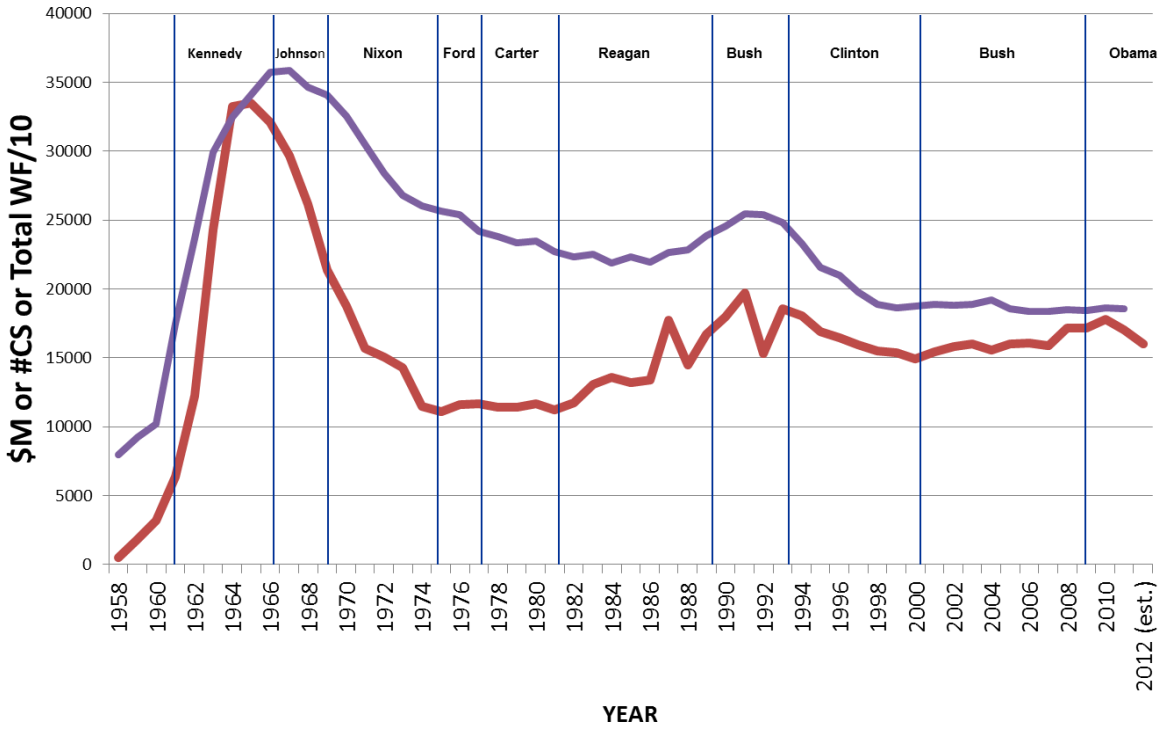
Table 8.2-1: NASA Headcount Comparison (FY1997 vs. FY2012)

Figure 8.2-1: Civil Servant and On- or Near-site WYE Trends (FY2007-FY2012) [5]

[5] This chart contains data only for on- and near-site contractor WYE performing recurring tasks, and not for offsite or prime contractors. NASA does not collect data on offsite or prime contractor WYE.

In terms of headcount, NASA civil servant employees have decreased by 10 percent since 1997. Decreases have varied widely from center to center. The greatest losses have occurred from the research centers; with the exception of Marshall Space Flight Center, the least losses have occurred from the spaceflight centers.

NASA's civil servant workforce has always been heavily leveraged with contractors (prime, support, other). After 1971, the relative proportion of contractor work has grown over time, but has recently started to decrease (see Figure 8.2-1). The current budgetary environment will continue to influence both civil servant and WYE totals by pushing both populations in a downward trend. More information on workforce forecasts can be found in the Workforce Forecast section.



Magenta = NASA Budget; Blue = Civil Servants

Figure 8.2-2: Number of Civil Servants and NASA Budget

As shown above, the number of civil servants (blue line) tracks fairly well with NASA's budget (magenta line). The number of civil servants does not correlate with the party of the President. The two major downturns in staffing were owed to a 1970s post-Apollo 'reduction in force' and a 1990s hiring freeze.

8.2.2 HISTORICAL WORKFORCE AGE DEMOGRAPHICS

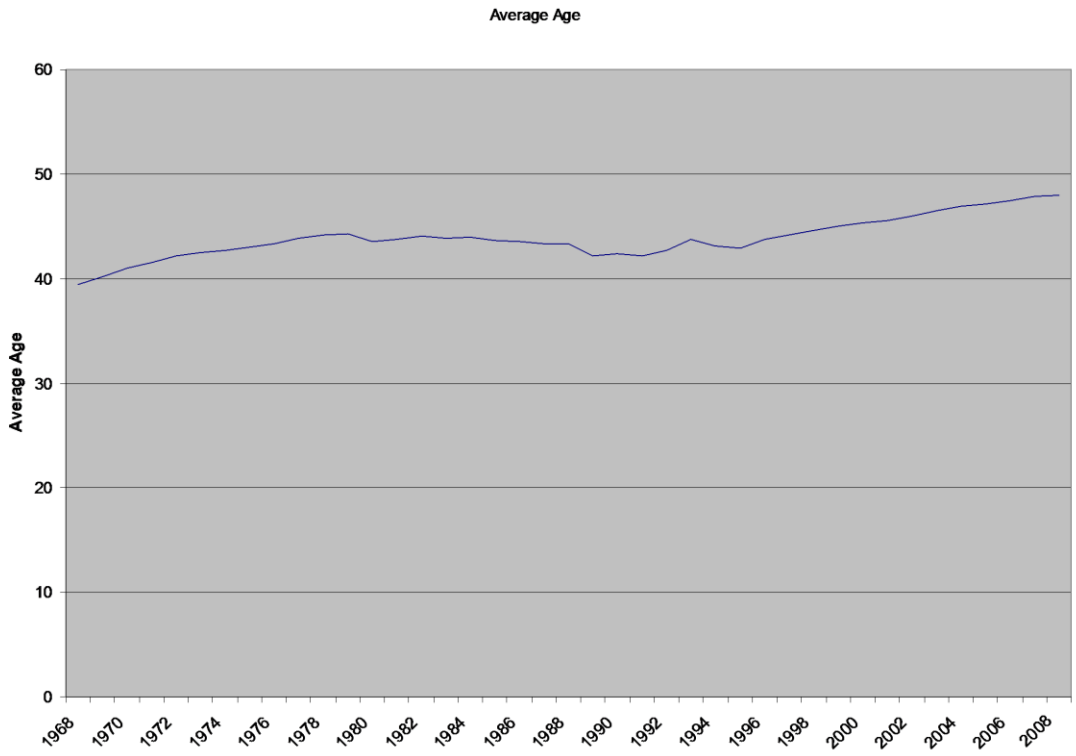
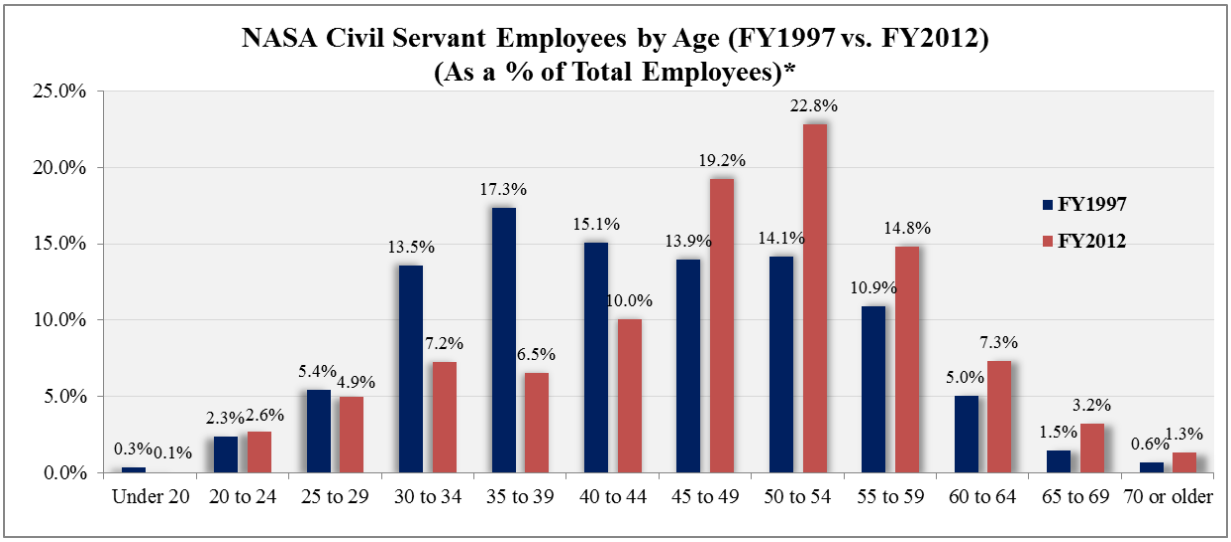


Figure 8.2-3: Average Age of NASA Workforce

The growth in civil servants in the late 1980s and early 1990s enabled the agency to mitigate and even reverse the persistent rise of the average age of the civil servant workforce. Unfortunately, the average age of NASA's employees has increased consistently in the past 15 years.

In addition, the number of people under 40 years of age has shrunk dramatically. The data below compares today's workforce to 1997, illustrating the changes in age since that time.



***Refers to civil servant headcount**
Figure 8.2-4: NASA Civil Servant Employees by Age

8.2.3 WORKFORCE FORECASTS

The following questions often arise in planning the NASA workforce:

- Does each NASA organization have the right number and type of workforce to perform the organization's work in the future?
- If not, what is the extent of the problem and what can and should we do about it?

NASA's workforce forecasts leverage a variety of tools and variables, including attrition projections, future budget projections, and FTE ceilings. Having a clear methodology and reporting on workforce forecasts helps to proactively plan for changes in the mission and address OMB and Congress' language in HR 2764 Appropriations:

"*NASA is encouraged to engage in long-term agency-wide workforce planning." The Administrator shall prepare a strategy for: a. minimizing job losses… b. equitably distribut[ing] tasks and workload between the Centers…. And c. [providing] overall projections of future civil service... workforce levels."*

8.2.4 SIZE OF CIVIL SERVICE WORKFORCE FY 2013-19

As with most organizations, it is often difficult to accurately develop long-term workforce forecasts. However, the Agency has developed a workforce strategy concerning the size of the civil service workforce that balances reductions in Agency budget and workforce demand with the need to maintain capabilities at each field center. The result is modest reductions in the size of the civil service workforce that started in FY 2012 and will continue through FY 2015, stabilizing thereafter (see Table 8.2-2 below).

Center	Total Ceiling*												
	FY2007	FY2008	FY2009	FY2010	FY2011	FY2012	FY2013	FY2014	FY2015	FY2016	FY2017	FY2018	FY2019
ARC	1,193	1,221	1,229	1,213	1,243	1,230	1,218	1,200	1,182	1,182	1,182	1,182	1,182
DFRC	488	535	545	541	559	555	551.3	551.3	551.3	551.25	551.3	551.3	551
GRC	1,562	1,619	1,619	1,644	1,662	1,652	1,628	1,595	1,571	1,571	1,571	1,571	1,571
GSFC	3,223	3,151	3,143	3,265	3,413	3,392	3,366	3,331	3,292	3,292	3,292	3,292	3,292
JSC	3,262	3,266	3,265	3,279	3,314	3,219	3,151	3,098	3,045	3,045	3,045	3,045	3,045
KSC	2,107	2,131	2,106	2,124	2,161	2,098	2,050	2,025	2,001	2,001	2,001	2,001	2,001
LaRC	1,839	1,901	1,891	1,908	1,946	1,928	1,911	1,881	1,853	1,853	1,853	1,853	1,853
MSFC	2,600	2,571	2,569	2,545	2,549	2,490	2,446	2,407	2,372	2,372	2,372	2,372	2,372
SSC	284	275	265	268	298	307	318	313	313	313	313	313	313
HQ	1,397	1,261	1,224	1,229	1,238	1,213	1,190	1,155	1,133	1,133	1,133	1,133	1,133
NSSC	121	132	146	146	146	145	145	142	139	139	139	139	139
Total	**18,076**	**18,063**	**18,002**	**18,162**	**18,529**	**18,229**	**17,974**	**17,698**	**17,452**	**17,452**	**17,452**	**17,452**	**17,452**

*Includes Reimbursable/Working Capital Fund

Table 8.2-2: Center FTE Ceilings FY2007-FY2019

8.2.5 PPBE Data Call To Assess Skill Gaps And Surpluses At Centers

During August-September 2012, the Office of Human Capital Management (OHCM) collected data from centers about the skills distribution and the skills gaps and surpluses that they anticipate by the end of FY 2014/beginning of FY 2015. The data call methodology included both quantitative and qualitative data collection, as well as interviews with each center. Uses of the data include: 1) Assessing the impact of PPBE 2014 budget formulation decisions on skills distribution and skills gaps and surpluses Agency-wide, 2) Informing the human capital programs and activity at both the center and Agency levels, and 3) Meeting reporting requirements of the Office of Personnel Management.

Based on analysis of the center's feedback of key skills amongst various NASA Classification Code (NCC) subgroups, trends that surfaced included:

- Continuing a multi-year trend, headcount levels are expected to diminish for Technicians (-59) and Quality Assurance (-12), Administrative (-59), and Clerical (-47) skills.
- Some headcount decline is planned for Management (-42).
- In the science skill areas, headcount growth is expected in Space Sciences (+14) and Earth Sciences (+7), while Life & Social Sciences (-20) is expected to shrink.
- Some headcount growth is expected in Contract & Procurement (+12) despite high attrition projections.

A breakdown of how the top skills centers will shrink or maintain/grow given the planned ceilings for FY2015, can be seen in the tables below:

TOP SKILLS CENTERS WILL SHRINK

NCC Subgroup	NCC Subgroup Name	Agency Head-count (7-14-12)	Preferred Headcount Distribution at End of FY14, given planned ceiling for FY15	Headcount Change Desired by Center (Delta)
300-399	Technical or Support	914	855	-59
601-604	Administrative	1653	1595	-59
500-599	Clerical/Asst & Related Suppt	595	548	-47
770	Management	2045	2004	-42
735	Data Systems & Analysis	1224	1203	-21
900-999	Life & Social Sciences	65	45	-20
695-699	Miscellaneous Specialty	205	192	-14
600	Pending Classification	16	4	-12
648-649	Quality Assurance	73	61	-12
715	Materials & Structures	829	818	-12
Other	*Other*	*5444*	*5404*	*-41*
Total		**13063**	**12727**	**-337**

Table 8.2-3: Top Skills Centers Will Shrink

TOP SKILLS CENTERS WILL MAINTAIN/GROW

NCC Subgroup	NCC Subgroup Name	Agency Head-count (7-14-12)	Preferred Headcount Distribution at End of FY14, given planned ceiling for FY15	Headcount Change Desired by Center (Delta)
701	Space Sciences	320	334	14
610-613	Contract & Procurement	716	728	12
605-609	Information Technology	395	402	7
702	Earth Sciences	286	293	7
710	Fluid & Flight Mechanics	962	968	6
795-799	Expert-Consultant-Grad Coop	85	88	3
730	Measurement & Instrumentation	782	785	3
660-665	Legal, Legislative & Patent	151	153	2
Other	*Other*	*1312*	*1316*	*4*
Total		**5009**	**5064**	**55**

Table 8.2-4: Top Skill Centers Will Maintain/Grow

8.3 WORKFORCE STRATEGY AND INTEGRATED MANAGEMENT SYSTEMS

8.3.1 WORKFORCE STRATEGY

Over the last decade, NASA's Workforce Strategy has been based on the principle that strong in-house capabilities are critical to NASA's long-term future, and, in order for the Agency to maintain these capabilities, the civil service workforce must be relatively stable at each field center location. Consequently, the contractor workforce has absorbed most of the fluctuations in workforce demand. In the same time period, the Agency has followed the principle that diversification of mission portfolios at each field center provides stability to the centers and enables the Agency to leverage workforce capabilities across mission lines. For example, centers that historically focused on aeronautics mission work have been assigned work by human exploration and space technology programs. Similarly, when the shuttle program was completed, centers primarily responsible for that program added research and development work in the HEO, Space Technology, and Science Mission areas.

In the last few years, NASA's budget has been under pressure, impacting funding for and timing of major programs. As a consequence, Agency leadership has adjusted the workforce strategy to reflect these new realities:

- Civil service workforce has been, and will continue to, reduce slowly in size, from over 18,300 FTE in FY 2011 to 17,400 FTE in FY 2015, but is planned to remain level thereafter.
- Reductions in FTE are shared among all centers based upon reduced replacement hiring, and also shared across almost all missions.

Another component of the NASA workforce strategy is full utilization of the civil service workforce. Because NASA's budget is in full cost, with labor funding embedded within mission accounts, it is important that missions plan for, and fund, all the civil service employees at each center. There is no separate labor fund to cover their salaries and expenses. This strategy drives workforce planning activities in the PPBE[6] process because it generates a requirement for Programs to assign centers a sufficient amount of work to fully utilize the number of FTE approved at each location. Furthermore, FTE at the Agency are distributed purposefully across missions, reflecting in part their demand for workforce as well as expected workforce supply and capabilities. This distribution impacts strategic acquisition decisions made by each mission since it influences the balance of civil service and contractor effort in each program.

Another key workforce strategy is a commitment to plan the workforce beyond this year's tasks. The five-year planning horizon in the Agency PPBE process ensures the Agency is planning workforce resources for multi-year programs that need lead time to determine and implement program plans and acquisitions. In planning across a five-year

[6] Beginning in FY07, NASA formally integrated workforce planning into its annual budget formulation process known as PPBE (Planning, Programming, Budgeting & Execution). The purpose of the integration was to assess how a collective set of potential program / budget decisions could impact institutional workforce resources, so that final decisions were sound from all perspectives.

horizon, the Agency also gains enough lead time to reshape the skill mix of its workforce, and requires its programs to improve their understanding of available and needed skills when making work assignments.

A final element of the Agency's workforce strategy is preservation of long-term national aerospace capability through maintenance of robust workforce pipelines and student programs. Despite modest reductions in the civil service workforce size, the Agency believes it is critical to hire talent on a continual basis. Refreshing the workforce through student programs and early career hiring will ensure that NASA's capabilities will be transitioned from one generation to the next, as well as bring in fresh ideas to spur innovation.

The Agency has developed a human capital strategy as a complement to the workforce strategy, focused on developing capabilities and attributes within the workforce to achieve any mission with which the Agency is charged. Key elements of the human capital strategy are as follows:

- Creating an environment that fosters innovation. Because NASA's mission success relies upon the ingenuity of its scientists, engineers, and business professionals, this element of the human capital strategy is supported by human capital and communication programs that encourage workforce to innovate in many different ways, including within their existing assignments, as well as in devising new applications for products and services, and spearheading brand-new innovations. Specific human capital programs supporting innovation include recognizing and rewarding innovation, and engaging and connecting the workforce.
- Providing Agency leadership in early career recruiting and hiring. This includes an Agency-wide university recruiting approach that encourages hiring from a diverse mix of geographies and institutions.
- Purposefully focusing on development of leaders and supervisors as a way to ensure NASA's priorities are demonstrated by all managers at the Agency. NASA leadership believes that preserving and strengthening the management cadre is critical to leading and reinforcing NASA's principles, achieving results, and making decisions in times when there are many competing priorities and constraints.

8.4 EXECUTIVE Resources

There are four types of executive positions at NASA:

- Political Appointees with Senate Confirmation (PAS),
- Senior Executive Service (SES),
- Senior Scientific and Professional (ST), and
- Senior Level (SL).

8.4.1 POLITICAL APPOINTEES WITH SENATE CONFIRMATION

There are four PAS positions: the Administrator, Deputy Administrator, Chief Financial Officer, and Inspector General.

8.4.2 SENIOR EXECUTIVE SERVICE (SES)

The SES is a separate government-wide personnel system for key managerial, supervisory and policy positions classified above GS-15. The SES is structured by two types of positions and four types of appointments:
Position Types:

- **Career Reserved —** to ensure impartiality, these positions must be filled by career (non-political) appointment.
- **General –** these high level positions (e.g., Associate Administrators, Center Directors) may be filled by any SES appointment type.

Appointment Types:

- **Career –** individuals, most often full-time permanent civil servants, are selected through a competitive process.
- **Non-career —** the Office of Personnel Management (OPM), with White House clearance, approves individual cases. *NASA today has five positions filled by non-career appointments.*
    - Positions filled by non-career SES appointment include the Administrator's Chief of Staff, the Deputy Chief of Staff, the Associate Administrator for Legislative and Intergovernmental Affairs, the Associate Administrator for Communications, and the Deputy Associate Administrator for Public Outreach.
- **Limited Term** – time-limited SES appointments for short-term, temporary needs between one and four years. These non-competitive appointments are approved by the Administrator. NASA has four in this category today.
- **Limited emergency –** nonrenewable 18-month term to meet urgent needs, approved by the Administrator under limited delegated authority, or by OPM. Currently, NASA does not have any executives in this category.

8.4.2.1 SES PAY

The pay range for SES in the government is tied to the Executive Schedule (EX) pay rates, which generally are adjusted annually in January. The current range is $119,554 to $165,300 (Executive Level III). However, NASA executives may be paid up to Executive Level II, currently $179,700, because NASA has earned Full Certification of its SES appraisal system under the government-wide pay-for-performance system. NASA has further divided the pay range between EX-III and EX-II into tiers, based on the level and impact of the position, as well as the executive's contributions. NASA completed a Tier Review of all SES positions in 2012 to ensure that all SES positions were placed in accurate pay ranges.

NASA has authority under the NASA Flexibility Act of 2004 to pay up to 10 executives in critical positions salaries up to the Vice President's rate of pay, currently $230,700. A total of six NASA executives currently are paid at the top rate.

NASA SES DISTRIBUTION:

		Employees	
Tier	Range	Headquarters	Centers
Critical Position Pay	$179,701 - $230,700	4	2
Tier 1	$175,001 - $179,700	17	9
Tier 2	$170,401 – $175,000	16	27
Tier 3	$165,301 - $170,400	8	18
Non-Tier	$119,554 - $165,300	82	226

Table 8.4-1: NASA SES Distributions

SES appointees' pay is based on their annually appraised performance. The SES performance appraisal period is from October 1 to September 30. Bonuses of 5 to 20 percent of salary may be awarded to Career and Limited Term SES appointees in December. NASA also nominates up to 9 percent of the Career SES/ST/SL appointees for government-wide Presidential Rank Awards of 20 percent and 35 percent of salary each year.

LIMITATIONS

- OPM (with Office of Management and Budget concurrence) allocates the total number of SES positions biennially.
- OPM must approve the managerial qualification of Career SES appointees.
- Career positions filled by new SES appointments must be advertised at least government wide.
- Career SES employees may not be reassigned involuntarily for the first 120 days after a new Administrator assumes office.

CEILING

OPM has allocated 476 SES positions to NASA. As of September 21, 2012, 409 of these positions were filled and 67 were vacant.

STATUS

In 2008, NASA reviewed all SES positions to assess their criticality and whether they continue to merit SES standing. NASA manages SES slots at the Agency level, providing maximum flexibility to the Agency. Since the 2008 review, NASA has continuously reduced the number of SES positions.

8.4.3 SENIOR SCIENTIFIC AND PROFESSIONAL (ST) AND SENIOR LEVEL (SL) POSITIONS

While the SES cover executive management positions, ST and SL positions are used to fill high level *technical* positions, and to recognize that the requirements and skills for these positions merit pay above the GS-15 level. Beginning in 2007, NASA established a new policy that required ST and SL employees be appointed for up to five years rather than on a permanent basis.

ST employees perform world-class research and development in physical, biological, medical, engineering sciences, or closely related fields. ST positions may be filled without competition. There is a requirement that supervisory activities must account for less than 25 percent of their time. **SL** employees provide technical expertise and advice of a world-class level. SL positions are filled through delegated examining, merit staffing, or accretion of duties.

ST/SL Pay. ST/SL pay is similar to SES pay. Salaries may be paid up to $158,500.

Ceiling: NASA currently has an OPM allocation of 152 ST/SL positions, with 128 filled and another 24 approved for staffing. An Agency Executive Resources Board reviews requests for positions and approves selections.

8.5 POLITICAL APPOINTEES AND OTHER DISCRETIONARY HIRING

Overall NASA currently has 17 political appointees. As stated above, there are four PAS positions: the Administrator, Deputy Administrator, Chief Financial Officer, and Inspector General. The other 13 political appointees are five non-career SES and eight 'Schedule C' appointees.

NASA has authority for nine non-career SES positions, but only five are presently filled. The Schedule C appointees are often Special Assistants, White House Liaison, or Legislative Affairs Specialists. They are policy-making positions below the executive level, and must report to another political appointee.

Other Discretionary Hires: NASA Excepted Personnel Authority (NEX): The Space Act authorizes up to 425 positions to be filled at the discretion of the NASA Administrator without applying normal civil service rules.

- Currently, 11 NEX positions are filled.
- Pay can be set up to the rate for Executive Schedule III, $165,300.
- Appointments usually are limited to three years or less, but may be extended indefinitely at the discretion of the Administrator.
- Authority may be used for scientific, engineering, or administrative positions. NEX appointments **cannot** be used for any position having duties that would qualify it for SES.
- The NASA Administrator has delegated to the Associate Administrator for Institutions and Management the authority to establish and approve NEX appointments.

LIST OF CURRENT POLITICAL APPOINTEES AT NASA (AS OF SEPTEMBER 21, 2012):

PAS (four authorized in law)

- Charles F. Bolden, Jr.- Administrator
- Lori B. Garver- Deputy Administrator
- Elizabeth M. Robinson- Chief Financial Officer
- Paul K. Martin- Inspector General

Non-Career SES (five filled of nine currently authorized by the White House)

- David Radzanowski- Chief of Staff
- Michael French- Deputy Chief of Staff
- L. Seth Statler-Associate Administrator for Legislative & Intergovernmental Affairs
- David Weaver- Associate Administrator for Communications
- Alan Ladwig- Deputy Associate Administrator for Public Outreach

Schedule Cs (eight on board – no specific allocation)

- Brett Silcox – Executive Officer, Office of the Administrator, GS-14 – 04/12/10
- James Terry Edmonds – Senior Advisor, Office of the Administrator, GS-15 – 08/14/11
- William Donovan – Special Assistant, Office of the General Counsel, GS-11 – 10/09/11
- Sarah Ramsey – Special Assistant, Office of the Administrator, GS-14 – 04/05/10
- Lauren Worley – Press Secretary, Office of Communications, GS-12 – 09/28/11
- Shannon Valley – Legislative Affairs Specialist, GS-11 – 05/24/09
- Rashawn Mitchell – Legislative Affairs Specialist, GS-9 – 02/13/12
- Elise Nelson – Special Assistant, Office of the Administrator, GS-9 – 07/30/12

8.6 General Workforce Information

8.6.1 Staffing and Position Classification

Most NASA civil servants are career employees subject to competitive selection and advancement in accordance with merit system principles established in law.

The Agency developed the NASA Supplemental Classification System (NSCS) and a unique Aerospace Technology (AST) qualification standard in the early 1960's. The purpose was to recognize the distinctive aspects of NASA's work – particularly aerospace work – more accurately than the more broadly defined categories within the government-wide system.

NASA fills its positions through a variety of sources that include: selection of current and former federal employees, external hiring of applicants with no federal employment status, student hires, and recent university graduates.

Many college graduates enter into NASA employment through our student pipeline. The new NASA Pathways Intern Employment Program (which replaces our former Cooperative Education Program (Co-Op)), allows students to gain work experience while attending school. NASA currently has 520 such students, with 67.5 percent in Engineering and Science occupations, and 32.5 percent in business and clerical occupations. Some graduates that complete the student employment program are offered NASA employment, and converted to full time civil servant positions.

8.6.2 Compensation

- 90 percent of the civil servant workforce is paid under the government-wide pay scale (General Schedule (GS) grades 1-15), which ties pay to a position's level of duties and responsibilities.
    - This schedule is augmented by "locality pay," which varies by geographic area and is based on annual salary surveys of non-Federal jobs. Locality rates for NASA centers range from 14.16 to 35.15 percent, paid on top of base pay.
    - NASA's entry-level engineers (those at GS 5-12), Medical Officers, and certain Information Technology workers are covered by government-wide special rate schedules that authorize higher pay for shortage category positions.

- Less than one percent of NASA's civil servant workforce is in highly skilled blue-collar (wage system) positions paid on local wage schedules.

- The NASA Flexibility Act of 2004 gives the Agency the flexibility to set the pay of a GS employee at any step within the pay range for the grade of the position.
    - NASA utilizes the full range of benefits available for federal employees to include flexible work schedules and telecommuting utilizing the Work from Anywhere program. Since February of 2012, NASA has consistently had about 18 percent to 19 percent of its workforce teleworking.

8.6.3 Employee Relations/Labor Relations

Employee performance is evaluated by a five-level system focusing on strategic alignment, results, credible measures, and

distinctions in performance. The annual evaluation cycle ends September 30 for executives and April 30 for other employees, with a mid-year review.

Unions at eight NASA centers represent about 50 percent of the workforce.

UNIONS AT NASA CENTERS		
Center	**Local Chapter**	**National Union**
ARC	Ames Federal Employees Union (AFEU)	IFPTE
GRC	Lewis Engineers and Scientists Association (LESA)	IFPTE
GSFC	American Federation of Government Employees (AFGE)	AFGE
	Goddard Engineers, Scientists and Technicians Association (GESTA)	IFPTE
	Washington Area Metal Trades Council (WAMTC)	AFL-CIO
HQ	NASA Headquarters Professional Association (NHPA)	IFPTE
JSC	American Federation of Government Employees (AFGE)	AFGE
KSC	American Federation of Government Employees (AFGE)	AFGE
LaRC	American Federation of Government Employees (AFGE)	AFGE
MSFC	American Federation of Government Employees (AFGE)	AFGE
	Marshall Engineers and Scientists Association (MESA)	IFPTE

Table 8.6-1: Unions at NASA Centers

The Agency must inform certain unions, such as AFGE and IFPTE, of any proposed change to conditions of employment and provide 30 days (generally) for review and comment.

8.6.4 TRAINING AND LEADER DEVELOPMENT

- NASA has a robust technical training and leadership development program. Budget at every center is set aside to assure adequate training can take place each year.
- Leadership training programs:
  - NASA Foundations of Influence, Responsibility, Success and Teamwork (NASA FIRST) program is targeted to grades GS-11/12.
    - This one-year part time program includes on-going developmental assignments and 22 days of formal training that are divided between four modules at various locations throughout the Agency.
  - The Mid-Level Leader Program (MLLP) is targeted to grades GS-13/14.
    - This is a 16-month program composed of four week-long core learning sessions at various locations throughout the Agency, a rotation, and other individual development program activities.
  - The Agency's SES Candidate Development Program is lauded as one of the most successful in government.
    - The duration of the course is between 12-24

months and is generally offered every two years, as budget permits.

- Professional development opportunities include coaching and mentoring.
- Each NASA center supports local organizational development and change management.
    - Technical training (esp. engineering and project management) is developed, supported and provided by the Office of the Chief Engineer's Agency Program Project Engineering Leadership (APPEL) program.

9.0 NASA INTERACTION WITH EXECUTIVE OFFICE OF THE PRESIDENT

INTRODUCTION

NASA engages in a wide range of interagency cooperative and coordination activities, including:

- **Administrative, management, or policy coordination**, for example with the National Security Council, the Office of Science and Technology Policy, the Office of Management and Budget, and the Department of State;
- **Programmatic partnerships** with individual agencies; and
- **Multi-agency program or policy activities**, such as those under the aegis of the National Science and Technology Council.

NASA's Office of International and Interagency Relations (OIIR) is responsible for overall interagency coordination and for principal liaison with the Department of Defense and the intelligence community. Several NASA offices interact with the Office of Management and Budget depending on the subject matter, including: the Administrator's Office, the Office of the Chief Financial Officer, and the Office of Legislative and Intergovernmental Affairs.

This section discusses interaction between NASA and three White House offices – the Office of Management and Budget (OMB), the Office of Science and Technology Policy (OSTP), and the National Security Council (NSC).

9.1 OFFICE OF MANAGEMENT AND BUDGET

The President's Office of Management and Budget (OMB) is responsible for overseeing preparation and administration of the federal budget, and reviewing Agency reports, testimony, and proposed legislation to ensure consistency with the President's budget and Administration policies. OMB also oversees and coordinates federal procurement, financial management, information, and regulatory policies and activities. NASA's Office of the Chief Financial Officer is responsible for the Agency's interactions with OMB on appropriations actions, budget data, financial reporting, budget and performance planning, programming and justification of the data.

The precise nature of OMB's interaction with NASA depends on the operating mode of the President and the Director of the Office of Management and Budget.

9.2 OFFICE OF SCIENCE AND TECHNOLOGY POLICY

The Office of Science and Technology Policy (OSTP) is part of the Executive Office of the President. OSTP was established in 1976 to coordinate the nation's science and technology investment and provide policy advice to the President. The Director of OSTP also serves as the President's Science Advisor. OSTP provides a key mechanism for NASA to coordinate with the Executive Office of the President, primarily through the National Security Council and OMB. NASA and OSTP, with other EOP offices, regularly cooperate on matters of both policy and implementation.

OSTP also supports the National Science and Technology Council (NSTC), a Cabinet-level council established in 1993 as the President's principal means for coordinating science, space, and technology policy across federal agencies. The President chairs the council. NSTC membership is comprised of the Vice

President, Cabinet Secretaries and Agency Heads with significant science and technology responsibilities (including the NASA Administrator), and various White House officials.

A primary objective of the NSTC is the establishment of clear national goals for federal science and technology investments in a broad array of areas spanning virtually all of the mission areas of the Executive Branch. The Council prepares research and development strategies that are coordinated across federal agencies to form investment packages aimed at accomplishing multiple national goals. The work of the NSTC is organized under five primary committees:

- Environment, Natural Resources and Sustainability,
- Homeland and National Security ,
- Science,
- Science, Technology, Engineering, and Math Education, and
- Technology

Each of these committees oversees subcommittees and working groups focused on different aspects of science and technology, and works to coordinate across the federal government. NASA has participated in many of these committees and their various projects and reports. The Council also convenes ad hoc Interagency Working Groups to address specific policy issues.

Parallel and related to the NSTC, the Executive Office of the President has also created the Committee on Climate Change Science and Technology Integration whose Executive Director is the OSTP Director. This Committee oversees the Interagency Working Group on Climate Change Science and Technology (IWGCCST) comprising members at the Deputy Secretary or Under Secretary level, including NASA. Similarly, a Cabinet-level Committee on Oceans Policy exists to oversee the work of an Interagency Committee on Ocean Science and Resource Management Integration (ICOSRMI). The interagency programs under these committees are described in Section 12.6.

Along with the National Security Council (NSC), addressed below, OIIR has regular interactions with OSTP on space policy matters.

9.3 NATIONAL SECURITY COUNCIL

Established by the National Security Act of 1947, the National Security Council (NSC) is the President's principal forum for considering national security and foreign policy matters with his senior national security advisors and cabinet officials. Since its inception under President Truman, the function of the Council has been to advise and assist the President on national security and foreign policies. The NSC also serves as the President's principal arm for coordinating these policies among various government agencies, including NASA.

The NSC is chaired by the President. Its regular attendees are the Vice President, the Secretary of State, the Secretary of the Treasury, the Secretary of Defense, and the Assistant to the President for National Security Affairs. The Chairman of the Joint Chiefs of Staff is the statutory military advisor to the Council, and the Director of National Intelligence is the intelligence advisor. The Chief of Staff to the President, Counsel to the President, and the Assistant to the President for Economic Policy are invited to attend any NSC meeting. The Attorney General and the Director of the Office of Management and Budget are invited to attend meetings pertaining to their responsibilities. The heads

of other Executive Branch departments and agencies, as well as other senior officials, are invited to attend meetings of the NSC when appropriate.

The NSC staff leads regular interagency meetings to discuss international space cooperation and resolve issues in dispute. NASA international engagement is closely coordinated with the NSC and the interagency community. OIIR is the principal liaison with the NSC, and coordinates regularly on matters concerning space policy, significant space-related events such as spacecraft reentries, and other matters of national importance.

10.0 Congressional Committee Leadership as of October 10, 2012, and General Accountability Office Interaction

Introduction

NASA is subject to oversight by several Senate and House Committees. These Committees are supported by the Government Accountability Office (GAO). This section lists the Congressional Committees with primary responsibility for oversight of NASA. The list is followed by a description of the Committees, and their respective Subcommittees, with primary oversight responsibility for NASA.

10.1 NASA Congressional Oversight Committees

NASA Oversight Committees and Leadership

	House of Representatives	United States Senate
Authorization Committees	Committee on Science, Space and Technology U.S. House of Representatives	Committee on Commerce, Science, and Transportation United States Senate
	Chairman: Ralph Hall (R-TX) Ranking Member: Eddie Bernice Johnson (D-TX)	Chairman: John D. Rockefeller IV (D-WV) Ranking Member: Kay Bailey Hutchison (R-TX)*
	Subcommittee on Space and Aeronautics	Subcommittee on Science and Space
	Chairman: Steven Palazzo (R-MS) Ranking Member: Jerry Costello (D-IL)*	Chairman: Bill Nelson (D-FL) Ranking Member: John Boozman (R-AR)
Appropriations Committees	Committee on Appropriations U.S. House of Representatives	Committee on Appropriations United States Senate
	Chairman: Harold Rogers (R-KY) Ranking Member: Norm Dicks (D-WA)*	Chairman: Daniel K. Inouye (D-HI) Ranking Member: Thad Cochran (R-MS)
	Subcommittee on Commerce, Justice, Science and Related Agencies	Subcommittee on Commerce, Justice, Science and Related Agencies
	Chairman: Frank Wolf (R-VA) Ranking Member: Chaka Fattah (D-PA)	Chairwoman: Barbara A. Mikulski (D-MD) Ranking Member: Kay Bailey Hutchison (R-TX)*

**** Member retiring at end of 112th Congress***

Table 10.1-1: NASA Oversight Committees and Leadership

10.2 COMMITTEE DESCRIPTIONS

Below is a brief description of the Appropriations and Authorization Committees with primary oversight responsibility for NASA, and their respective Subcommittees,

10.2.1 APPROPRIATIONS COMMITTEES

The Appropriations Committees listed below perform a number of key functions while taking into account the following factors and guidelines:

- An Appropriations Committee provides budget authority to agencies (how much and for what).
- An Appropriations Committee allows an agency to incur obligations.
- An appropriation originates in the House of Representatives.
- A point of order can be raised on an appropriations bill containing funding for a program that is not authorized.
- Earmarks are usually not authorized.

House Committee on Appropriations – Like its Senate counterpart, the House Appropriations Committee has broad responsibility for appropriating funds for government agencies. House Rule defines the Committee's jurisdiction as "appropriation of the revenue for the support of the Government" (and related powers to rescind and transfer funds). The Committee's 12 Subcommittees are aligned like the Senate's, with responsibility for specific agencies.

Subcommittee on Commerce, Justice, Science, and Related Agencies – The Subcommittee's jurisdiction covers NASA, Department of Commerce, Department of Justice, National Science Foundation, and several small related agencies. The Subcommittee reviews the President's budget request for each agency, hears agency officials' testimony, and drafts agency fiscal year spending plans. The Subcommittee also drafts supplemental bills for emergency expenses during a fiscal year.

Senate Committee on Appropriations – The Senate's largest Committee, Appropriations, is responsible for writing the annual bills that allocate Treasury funds for operations and activities of federal agencies. Within this enormous scope, responsibility for allocating funds to specific agencies is divided among the Committee's 12 Subcommittees.

Subcommittee on Commerce, Justice, Science, and Related Agencies – The Subcommittee's jurisdiction covers NASA, Department of Commerce (including NOAA), Department of Justice, National Science Foundation, and several small, related agencies, e.g. the Marine Mammal Commission, the Legal Services Corporation, and the International Trade Commission. The Subcommittee reviews the President's budget request for each agency, hears agency officials' testimony, and drafts agency fiscal year spending plans. The Subcommittee also drafts supplemental bills for emergency expenses during a fiscal year.

10.2.2 AUTHORIZATION COMMITTEES

The Authorization Committees listed below perform a number of key functions, taking into account the following:

- Authorization bills establish, continue or modify federal programs and are intended to precede the Appropriations process. However, Congress frequently enacts appropriations for a program/agency even though there is no specific authorization for it by waiving rules.
- Because the constitution provides that "No money shall be drawn from the treasury, but in **consequence of appropriations made by law,**" an appropriation is required to fund the agency notwithstanding the existence of authorizing legislation. Authorization Committees execute Congressional oversight of agency programs and plans.
- Bills often include limits on the amount that can be appropriated for the authorized program/agency as well as specific direction concerning program content that is binding on the agency.

Senate Committee on Commerce, Science, and Transportation – The Committee is composed of seven Subcommittees, which together oversee the large range of issues under its jurisdiction. These issues range from communications, highways, aviation, rail, shipping, transportation security, merchant marine, the Coast Guard, oceans, fisheries, climate change, disasters, science, space, interstate commerce, tourism, consumer issues, economic development, technology, competitiveness, product safety, and insurance. The Committee oversees NASA, NSF, NOAA, and NIST within the Department of Commerce, and the USCG. The Committee is the product of a 1977 merger of the Commerce Committee and the Committee on Aeronautical and Space Sciences which, like both its House counterpart (see below) and NASA itself, was established in 1958 in response to Sputnik.

Subcommittee on Science and Space – Under the leadership of Chairman Nelson, the Subcommittee has focused heavily on NASA-related issues including hearings on commercial space flight, the International Space Station, and Mars exploration in 2012. In addition, the Subcommittee held hearings on the implementation of the America COMPETES Act, marketplace fairness for small business, and the science standards of forensics. The Subcommittee holds a multi-agency hearing on federal research and development budgets each spring.

House Committee on Science, Space and Technology – The Committee has jurisdiction over most federal non-defense, scientific R&D, including programs at NASA, Department of Energy, Environmental Protection Agency, National Science Foundation, Federal Aviation Administration, National Oceanic and Atmospheric Administration including the National Weather Service, Federal Emergency Management Administration, U.S. Geological Survey, the National Space Council, and the White House Office of Science and Technology Policy. The Committee's strong interest in how Federal R&D sustains U.S. international competitiveness and economic health dates back to its creation in 1958 as a response to the 1957 Sputnik launch. Initially centered on space exploration, its jurisdiction now includes civil aviation, energy (including commercial applications), the environment, scientific research, science scholarships, marine research, and standardization of weights and measures through the National Institute of Standards and Technology.

The Committee has five Subcommittees, one of which is of primary relevance to NASA.

Subcommittee on Space and Aeronautics – The Subcommittee on Space and Aeronautics has legislative jurisdiction and general oversight and investigative authority on all matters relating to astronautical and aeronautical research and development, including: national space policy (which includes access to space); sub-orbital access and applications; NASA and its contractor and government-operated labs; space commercialization, including the commercial space activities relating to the Department of Transportation and the Department of Commerce; exploration and use of outer space; international space cooperation; the National Space Council; space applications, space communications and related matters; earth remote sensing policy; civil aviation research, development, and demonstration; research, development, and demonstration programs of the Federal Aviation Administration; and space law. In 2012, under Chairman Palazzo, the Subcommittee has held hearings on commercial suboribital reusable launch vehicles, NASA-derived technologies ("spinoffs"), launch indemnification, the Aeronautics Mission Directorate, Planetary Science, and the International Space Station.

11.0 NASA INTERACTION WITH FEDERAL DEPARTMENTS AND AGENCIES

INTRODUCTION

NASA routinely interacts with numerous federal departments and agencies. The NASA Office of International and Interagency Relations (OIIR) at NASA Headquarters coordinates Agency-level policy interactions with U.S. executive branch departments and agencies, and is the principal Agency liaison with the Department of State, the Department of Defense, and other federal agencies. However, it is important to note that interactions between NASA and other federal departments and agencies occur at multiple levels at the Agency, across all centers and Headquarters. In order to provide a strategic look at interagency partnerships across the Agency, OIIR leads two recurring forums: the Interagency Partnership Working Group; and the Interagency Partnership Liaison team. OIIR also reviews and provides regular reporting on all active and pending agreements between NASA and other U.S. departments and agencies. This section discusses NASA interaction with the Department of State, the Department of Defense, the Department of Commerce, regulatory efforts with other agencies, and provides examples of programmatic cooperation with individual federal agencies.

11.1 DEPARTMENT OF STATE

OIIR consults the State Department on issues with foreign policy ramifications. These include questions about countries of policy concern, export control and non-proliferation issues, and establishing cooperation with new international partners. In accordance with law and regulation, NASA obtains State Department concurrence before concluding significant international agreements. In addition to routine staff-level contacts, NASA and State Department officials interact at top levels on sensitive issues. The NASA Administrator has most often dealt with the Deputy Secretary of State and the Undersecretary for Political Affairs, but has also had periodic contacts with the Secretary of State and U.S. Ambassadors in countries in which NASA has activities.

Additionally, NASA provides support to the State Department on space matters addressed within the United Nations structure, particularly in the United Nations Committee on the Peaceful Uses of Outer Space (UNCOPUOS). NASA leads the U.S government delegation to the UNCOPUOS Scientific and Technical Subcommittee.

As the regulatory agency charged with administering the International Traffic in Arms Regulations (ITAR), the State Department receives all export license applications from NASA and Agency contractors for exports and services that are subject to the ITAR, including most space-related items and virtually all spacecraft. OIIR works with the State Department's Directorate for Defense Trade Controls (DDTC) on a daily basis to resolve ITAR-related issues impacting NASA programs. Efforts to obtain ITAR relief for NASA and its contractors have met with limited success; however, discussions on a potential ITAR exemption for the benefit of NASA and its contractors continue.

11.2 DEPARTMENT OF DEFENSE

In coordination with relevant NASA Mission Directorates and centers, OIIR consults with the Department of Defense on a wide variety of program and policy issues. OIIR provides staff support to senior NASA management for meetings with DOD officials. OIIR also manages the process by which military

officers, including astronauts, are assigned to NASA on a reimbursable basis. NASA/Department of Defense activities include jointly funded and jointly managed programs, reimbursable activities, and information exchanges. OIIR additionally provides NASA's primary policy point of contact with the Intelligence Community. Through its Liaison Officer stationed in Colorado Springs, OIIR also maintains close coordination with the Commander of the U.S. Air Force Space Command and the Commander, Northern Command.

As part of the NASA Export Control Program, NASA is among the agencies that reviews aerospace-related exports and the public release of technical documentation through the Defense Department's Office of Security Review. OIIR carries out this function for NASA, and also consults regularly with the Department's Defense Technology Security Administration (DTSA) on export license applications affecting NASA programs.

11.3 Department Of Commerce

The Commerce Department's Bureau of Industry and Security (BIS) administers the Export Administration Regulations (EAR), which control exports of all-dual use commodities and technology, including the International Space Station (ISS). Accordingly, OIIR regularly consults with BIS on dual-use export control matters and submits export license applications for transfers of items subject to the EAR.

OIIR also coordinates with the Commerce Department's National Oceanic and Atmospheric Administration (NOAA) on policy matters regarding remote sensing spacecraft and other matters. NASA additionally maintains extensive cooperation with NOAA for Earth science-related missions.

11.4 Regulatory Efforts with Other Agencies

In addition to the coordination in which OIIR engages with the Departments of Commerce, Defense, and State in the administration of the NASA Export Control Program, OIIR works closely with other U.S. government regulatory agencies in order to facilitate necessary licenses, permits, and approvals required to successfully implement NASA's missions. These include cooperation with the Department of Homeland Security (DHS) for customs clearance, NASA duty-free import certifications, consultations with the Department of Justice (DOJ) on export control enforcement matters, and obtaining necessary permits from the U.S. Department of Agriculture (USDA), the Food and Drug Administration (FDA), and others for imports of foreign-provided food for transport to International Partner astronauts aboard the International Space Station. OIIR also represents NASA at the Treasury Department's Committee on Foreign Investment in the United States (CFIUS), a regulatory body that implements the requirements of the Exon-Florio Act for U.S. government review of certain foreign acquisitions with national security implications. OIIR has additionally supported the President's Export Control Reform Initiative, and participated in interagency for a reviewing U.S. Munitions List items for possible transfer to the Commerce Control List.

11.5 Programmatic Cooperation with Individual Agencies

NASA cooperates extensively with other federal agencies on a wide range of joint program efforts. For example, NASA has a longstanding weather satellite partnership with NOAA, and works closely with the Department of the Interior's U.S. Geological

Survey (USGS) on land-remote sensing programs, such as Landsat. NASA meets regularly with the National Science Foundation (NSF) to coordinate cooperative space science research activities, and has several agreements with the National Institutes of Health (NIH) for joint projects to improve human health on Earth and in space.

NASA maintains a partnership with the Federal Aviation Administration (FAA) in both policy and program areas through participation on FAA advisory committees, executive committees, aviation rulemaking committees, and safety teams, and by working jointly with the FAA on Joint Planning and Development Office (JPDO) boards and Research Transition Teams (RTT). NASA focuses on new technology, while the FAA works to bring the technology into operational use and develop standards. Current partnership efforts include demonstrating new air traffic management technologies to enable and motivate faster technology insertion and equipage rates by airline operators; reducing technical barriers to allow routine access by unmanned aircraft systems to the airspace; and finding faster, less expensive verification and validation methods for highly complex systems to reduce cost, schedule and implementation risks of the next generation air traffic control system, including certification of new aircraft. NASA also works closely with the FAA to develop standards for an emerging commercial human spaceflight sector.

NASA's interagency cooperative efforts occur at all levels within the Agency. NASA researchers collaborate directly with colleagues from other agencies in conferences, joint projects, and personnel exchanges. Program officials meet to coordinate complementary program efforts, and NASA belongs to numerous joint planning committees, ranging from working groups to senior-level management committees. Formal documentation for such interagency cooperation includes formal interagency Memoranda of Agreement, typically signed by the top management officials of each agency.

11.6 INTERAGENCY PROGRAMS

NASA is a key participant in major interagency programs on climate change and the environment. These include the U.S. Climate Change Science Program (CCSP), to which NASA is the largest contributor. CCSP and its companion Climate Change Technology Program are the implementing entities of the Interagency Working Group on Climate Change Science and Technology identified in Section 9.2. The National Science and Technology Council Joint Committee on Ocean Science and Technology coordinates interagency ocean research activities for the Interagency Committee on Ocean Science and Resource Management Integration identified in Section 9.2.

12.0 NASA INTERACTION WITH FOREIGN ENTITIES

INTRODUCTION

NASA has extensive dealings with foreign entities including activities with ministerial level officials, government space agencies, international organizations, foreign industry, and academia. NASA currently has over 500 active international agreements with over 120 countries. These agreements provide for significant international cooperation in each of NASA's Mission Directorates on a wide range of activities. This section presents an overview of NASA's interaction with foreign entities, and NASA's interaction with these entities according to the following geographic groupings: Canada, Europe, Japan, and Russia; Latin America; Africa and the Middle East; and Asia and the Pacific. The section also briefly describes NASA's interaction with the United Nations.

12.1 OVERVIEW

International cooperation is a significant component of the NASA mission. The National Aeronautics and Space Act of 1958 established international cooperation as one of the objectives of the civilian space program. In carrying out this mandate, NASA operates within broad U.S. government policies, such as economic, scientific, or foreign policy, and specific space policies, most importantly, the U.S. National Space Policy. The U.S. National Space Policy is the Administration's umbrella policy announced in June 2010, under which all U.S. space activities (national security, civil, commercial, and international) are governed. NASA has longstanding Agency-level policy guidelines on international space cooperation as well, including the fundamental principle that international partnerships must be of programmatic interest, and thus are a means to achieve the goals of NASA's Mission. The contributions of other nations and international organizations add unique capabilities or expertise, increase mission flight opportunities, and provide access to program critical locations outside the United States, or distribute the costs. In addition, international civil space cooperation helps to build or reinforce positive international relations between nations. Since its inception, NASA has concluded almost 4,000 agreements with more than 120 nations and international organizations. NASA's programs traditionally have had a strong international component, and international activities continue to grow.

NASA has well-established cooperative partnerships with other foreign government space agencies, and continues to seek new opportunities for mutually beneficial cooperation with current partners, with emerging space programs, and with appropriate government agencies in nations that do not have space agencies. In addition to cooperation with other nations, NASA cooperates with international organizations, such as the European Space Agency, the United Nations and its specialized agencies.

Within the past 10 years, NASA has concluded over 900 agreements with organizations in 90 countries. Of these, eight foreign partners account for 50 percent of these agreements: France, Germany, the European Space Agency, Japan, Italy, United Kingdom, Canada, and Russia. Additionally, in the last several years NASA has undertaken a more focused effort to engage non-traditional partners in support of NASA's mission objectives. This effort has built upon existing relationships and new

relationships with countries that have had no experience working with NASA.

The largest, most ambitious international cooperative program in the history of NASA is the International Space Station (ISS) program, a partnership among 15 nations implemented under the leadership of NASA, the European Space Agency (ESA), the Japan Ministry of Education, Culture, Sports, Science and Technology (MEXT)/Japan Aerospace Exploration Agency (JAXA), the Canadian Space Agency (CSA), and the Russian Federal Space Agency (ROSCOSMOS). Construction began in November 1998, and international crews have continuously inhabited the station since November 2000. Since May 2009, an international crew of six has been able to live and work onboard, supported by a cadre of international vehicles, control centers, ground support personnel and, very recently, U.S. commercial spacecraft. Astronauts from each of the ISS partners serve as ISS crew members.

In science research, over half of NASA's operational Earth and Space science missions involve significant international cooperation. Additionally, substantial international contributions are planned for many of NASA's future science missions currently in development, including the James Webb Space Telescope, the Global Participation Measurement Mission, Jason-3, and Gravity Recovery and Climate Experiment Follow-On mission. In Earth science, international cooperation is particularly important because a full understanding the Earth as a system requires data obtained from ground networks around the world, global airborne campaigns, and complementary orbiting spacecraft.

NASA's Office of International and Interagency Relations has led extensive discussions on behalf of the Human Exploration and Operations Mission Directorate with a broad range of potential international partners. As a result, a Global Exploration Strategy and the first Global Exploration Roadmap have been developed by civil space organizations from 14 countries in the International Space Exploration Coordination Group (ISECG), a non-binding international exploration coordination forum.

NASA's Aeronautics Research Mission Directorate (ARMD) employs international cooperation on a more limited basis in order to meet distinct programmatic needs, such as gaining access to unique foreign capabilities, resources or data; leveraging NASA's investments with those of international partners in like areas of research on non-competitive topics; or to inform international aviation standards and practices. ARMD participates in multilateral forums to share information and to identify potential areas for cooperation, and currently serves as the co-chair of the International Forum for Aviation Research (IFAR), a forum established in 2011 for exchange of views among senior leaders on national research agendas and priority topics of interest to the global aviation community. NASA aeronautics researchers engage with international partners at professional and academic conferences and symposia, as well as through other multilateral forums such as the International Civil Aviation Organization.

12.2 CANADA, EUROPE, JAPAN, AND RUSSIA

NASA has a long history of successful cooperation with Canada, Europe, Japan, and Russia, and we expect to build upon this history in our future cooperative endeavors. These partners have well-developed space capabilities and continue to make significant contributions to a variety of ongoing and planned NASA programs. Cooperation with these partners spans the breadth of NASA's Mission Directorates, as discussed below.

Canada: Canada and NASA have a long history of successful cooperation, particularly in science and human spaceflight cooperation. Building on their expertise in robotic space systems, Canada provided an essential element of the ISS: a robotic Mobile Servicing System which is used for a variety of ISS assembly and operations tasks. In addition, Canada is cooperating with NASA on the James Webb Space Telescope, along with the European Space Agency. Canada's specific contribution is the Fine Guidance Senor/Tunable Filter for the telescope. Other areas of current cooperation with NASA are in space science and Earth science.

Western Europe: The European Space Agency (ESA), headquartered in Paris, is an international organization with 20 member states. NASA has excellent, longstanding relations both with ESA and bilaterally with several of its Member States that have robust national space agencies and programs, most notably France, Germany, and Italy. NASA cooperates with ESA on the International Space Station, wherein the European primary contribution is the Columbus Research Laboratory, the Automated Transfer Vehicle, and the European Robotic Arm.

NASA also cooperates with ESA in a broad array of space science and Earth science projects, notably the James Webb Space Telescope, LISA Pathfinder, Rosetta, and a series of solar-terrestrial physics missions. NASA's cooperation with France, Germany, and Italy is very significant, spanning all NASA Mission Directorates and involving joint activities in space science and Earth science. NASA has cooperated with other European nations on small satellite missions, sounding rocket campaigns, and provision of European scientific instruments on NASA satellites.

NASA cooperates with Spain on the Madrid Deep Space Communications Complex (MDSCC). Since 1964, the MDSCC has been operated at Robledo (near Madrid), Spain, under an international agreement between the U.S. and Spain. The MDSCC is part of NASA's Deep Space Network (DSN) and provides mission-critical tracking and communications support for NASA's deep space missions.

Japan: NASA has strong cooperation with Japan in human spaceflight, space science, and Earth science. Japan cooperates with NASA on the International Space Station, wherein their primary contribution is the Japanese Experiment Module called Kibo ("hope") and the H-II Transfer Vehicle (HTV), an unmanned logistics resupply vehicle. Japan also cooperates with NASA on a broad array of Earth and space science missions.

Russia: NASA has an extensive history of cooperation with Russia and the former Soviet Union. High-visibility, large-scale U.S./ U.S.S.R. cooperation took place on the Apollo-Soyuz Test Project flown in 1975, followed by a period in the 1980s of bilateral cooperation limited to space science, Earth science, and space biology

and medicine due to foreign policy considerations. With the collapse of the Soviet Union, new opportunities emerged for U.S./Russia human spaceflight cooperation, and NASA successfully conducted a series of joint missions involving the U.S. space shuttle and the Russian Mir space station. Russia became a full partner in the International Space Station in the late 1990's. Its primary contributions to the program are the Soyuz crew vehicles, Progress cargo vehicles, the Zvezda Service Module, the Pirs airlock/docking compartment, and the upcoming Multipurpose Laboratory Module. Science collaboration with Russia has had successes and challenges. Russia provided instruments on NASA's Lunar Reconnaissance Orbiter, Mars Odyssey, and most recently the Mars Science Laboratory. NASA is the co-chair of the Space Cooperation Working Group and a member of the Science & Technology Working Group of the U.S.-Russia Bilateral Presidential Commission, created in July 2009.

12.3 LATIN AMERICA

NASA's cooperation with Latin America has historically been conducted primarily with Argentina and Brazil. However, several Earth science application initiatives have been conducted in Central America, most notably the SERVIR program. With Argentina, NASA has cooperated on a series of Argentine-built satellite missions and education activities. Currently, NASA is cooperating with Argentina through flight of a U.S. scientific instrument (Aquarius) on the Argentine SAC-D Earth science mission, which launched in 2011. With Brazil, NASA has had extensive cooperation in Earth science for several decades, including joint analysis of satellite data and NASA aircraft measurements taken in the Amazon region. Cooperation with other Latin American nations has been limited to modest projects to date, and include researcher collaboration, astrobiology analog studies, and education activities. With the recent establishment of a Mexican Space Agency and growing expressions of interest from Peru and Columbia, it is anticipated that cooperation in Latin America will continue to grow.

12.4 AFRICA AND THE MIDDLE EAST

Only a few countries in Africa and the Middle East possess space-related capabilities, while many have advanced scientific research programs in certain disciplines. Thus, the opportunities for NASA cooperation are limited.

Africa: NASA cooperates on ground-based instruments for aerosol, solar, and tectonic plate measurements with a small number of African nations. Additionally, NASA periodically conducts airborne science campaigns in Africa, though African nations themselves are not normally active participants in the science program.

Middle East: NASA has had past cooperation with Israel involving human spaceflight, with an Israeli astronaut on the Space Shuttle Columbia mission, lost in 2003. Exploratory dialogue is continuing with the Israel Space Agency in several areas of space and Earth science. NASA also cooperates on ground-based instruments, such as Aeronet and Space Geodesy, with a number of Arab countries in the region. NASA continues to look for prospective, mutually beneficial cooperation with Saudi Arabia, Kuwait, the United Arab Emirates, and Qatar.

12.5 ASIA AND THE PACIFIC

Australia: Australia is a longstanding cooperative partner to NASA, significant because of its highly qualified scientific talent and its geographic location for tracking support and science cooperation within the region. NASA's highest priority with Australia is to ensure the continued successful operation of its Deep Space Tracking Network set of antennas located at Tidbinbilla, Australian Capital Territory near Canberra, one of three complexes around the world essential for two-way communications links with planetary and Earth orbiting spacecraft.

China: Over the last decade, NASA has had very limited bilateral cooperation with Chinese entities due to U.S. law and policy. In fact, NASA has only signed a single agreement with the Chinese Academy of Sciences for the exchange of data for geodynamics research. Although China has extensive space capabilities, including indigenous human spaceflight, launch vehicles and satellite development, recent U.S. legislation (Public Law 112-55) prohibits all bilateral cooperation between NASA and China.

India: India has extensive space capabilities, including launch vehicles and indigenous satellite development. In recent years, NASA has increased its level of dialogue and cooperation with Indian civil space organizations. The Chandrayaan-1 mission (2008-9), India's first lunar mission, carried two NASA instruments, the Moon Mineralogy Mapper and the Miniature Synthetic Aperture Radar (Mini-SAR). NASA recently signed two bilateral agreements with the Indian Space Research Organisation (ISRO) related to the Oceansat-2 and Global Precipitation Measurement/Megha-Tropiques missions. The principal forums for civil space cooperation are the semi-annual U.S.-India Civil Space Joint Working Group (CSJWG) and its subordinate Earth Science Working Group.

12.6 UNITED NATIONS

Working in close coordination with the U.S. Department of State, NASA cooperates with the United Nations and its specialized agencies. The United Nations has a standing committee on space dealing with scientific, technical, legal and policy issues, the Committee on Peaceful Uses of Outer Space (COPUOS). NASA actively participates in the U.S. delegations to meetings of COPUOS and its subcommittees. Key issues addressed include orbital debris, the use of nuclear power sources in space, and space law. In addition, NASA works with the executive secretariat for COPUOS, the United Nations Office for Outer Space Affairs, on United Nations-sponsored activities, such as workshops with developing countries. From a more programmatic standpoint, NASA cooperates with specialized agencies of the United Nations, such as the World Health Organization, the World Meteorological Organization and the Food and Agricultural Organization on satellite data analysis and other activities.

13.0 How NASA's Work is Done: In-House, Industry, Academia

Introduction

This section discusses how NASA's work is performed by drawing upon its own in-house workforce, as well as the resources of industry and academia. NASA performs its mission with a combination of civil servants, contractors, and academic researchers, in addition to international and other Agency partnerships. Civil servants are located at NASA Headquarters, centers, and component facilities across the United States, as indicated in Figure 13.1-1 below.

13.1 Overview

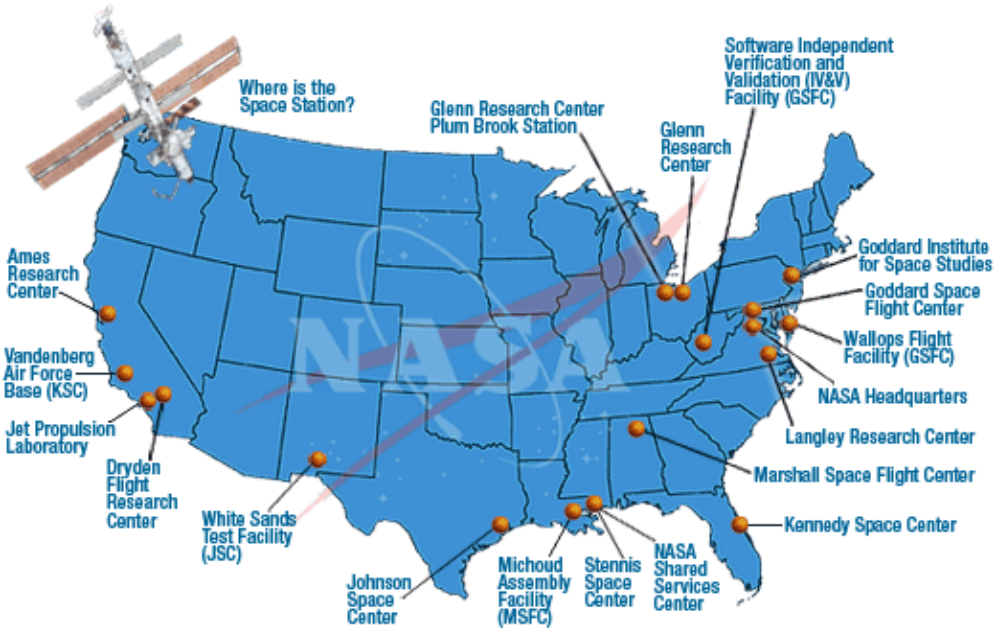


Figure 13.1-1: NASA Facilities in the U.S.

Contractors are located across the U.S., including on or near NASA centers. Recently, NASA characterized the actual number of on- or near-site contractors providing recurring work for FY11, excluding the NASA Shared Services Center (NSSC). The NSSC has been excluded from this count since it performs Agency-wide transactions and administrative activities in the areas of Human Resources, Information Technology, Procurement, and Financial Management for NASA. The civil service headcount and contractor work year equivalent (WYE) at the end of FY12 totaled 18,210 and contractor work year equivalent (WYE) at the end of FY11 totaled 44,111. ***Note:*** *FY12 WYE information was not available at the time of this submission.* The break-out of these totals by NASA center is shown in Table 13.1-1 below, NASA Headcount and Contractor Work Year Equivalent at the End of FY 2012. In addition, NASA provides funding to academic researchers across the U.S. ***Note:*** *JPL employees are Caltech employees, not civil servants. Thus, they are counted in the "Contractor WYE" column.*

Center	Civil Service Headcount	Contractor WYE
ARC	1,225	1,246
DFRC	553	653
GRC	1,659	1,478
GSFC	3,376	6,515
JSC	3,284	15,227
KSC	2,102	6,612
LaRC	1,907	1,756
MSFC	2,481	4,320
SSC	298	904
HQ	1,182	631
NSSC	143	
JPL	N/A	4,769
Total	**18,210**	**44,111**

Table 13.1-1: NASA Headcount and Contractor Work Year Equivalent at the End of FY12

13.2 NASA's In-House Workforce

13.2.1 Roles of NASA Workforce

NASA employs civil servants to manage the Agency, manage NASA programs and projects, and manage the Agency's institutions. NASA carries out its mission by using the governance structure and strategic management systems defined in NASA Policy Directive (NPD) 1000.0 NASA Governance and Strategic Management. The civil servant workforce that carries out the NASA mission is organized as described in NPD 1000.3 The NASA Organization. **Overviews of NASA's governance structure and its workforce are also provided in other sections of the *NASA Presidential Transition Binder*.**

In general, the Headquarters workforce is responsible for Agency-level management of all aspects of the Agency's business, including managing Mission Directorate portfolios, and maintaining the institutional capabilities necessary for implementing NASA's mission. In addition, it is responsible for maintaining external relationships with and meeting external requirements from entities such as the Congress and the Office of Management and Budget, and heads of other federal agencies.

Center workforce is responsible for executing programs and projects under direction from Mission Directorate management, and for developing and managing the institutional capabilities required to execute the assigned programs and projects. The Jet Propulsion Laboratory (JPL) is a Federally Funded Research and Development Center (FFDRC) that functions much like a NASA center with additional workforce flexibilities. The NSSC provides Agency-wide centralized business and technical services in highly transactional areas, e.g., finance accounts receivable, for increased operational efficiency and improved customer service.

13.2.2 NASA's Approach to Performing Its Work

To accomplish NASA's mission, NASA divides its work into programs and projects. NASA procedural requirements for the formulation, approval, implementation, and evaluation of NASA programs and projects are provided in the NASA Procedural Requirements (NPR) 7120 series of documents. NPR 7120.5 describes the procedural requirements for spaceflight programs and projects, NPR 7120.8 describes the procedural requirements for research and technology programs and projects, and NPR 7120.7 describes the procedural requirements for information technology and institutional infrastructure programs and projects.

Although the specifics vary depending on the type of project, in general, program and project management is based on life cycles, key decision point milestones, and evolving products during each life-cycle phase. These are embedded in NASA's four-part process

for managing programs and projects consisting of the following steps:

1. **Formulation** – the identification of how the program or project supports the Agency's strategic needs, goals, and objectives; the assessment of feasibility, technology and concepts; risk assessment, team building, development of operations concepts and acquisition strategies; establishment of high-level requirements and success criteria; the preparation of plans, budgets, and schedules essential to the success of a program or project; and the establishment of control systems to ensure performance to those plans and alignment with current Agency strategies and schedules essential to the success of a program or project.

2. **Approval (for Implementation)** – the acknowledgment by the Decision Authority that the program/project has met stakeholder expectations and formulation requirements and is ready to proceed to implementation. By approving a program/project, the Decision Authority commits the budget resources necessary to continue into implementation.

3. **Implementation** – the execution of approved plans for the development and operation of the program/project, and the use of control systems to ensure performance to approved plans and continued alignment with the Agency's strategic needs, goals, and objectives.

4. **Evaluation** – the continual, independent (i.e., unbiased and outside the advocacy chain of the program/project) evaluation of the performance of a program or project and incorporation of the evaluation findings to ensure adequacy of planning and execution according to approved plans.

This four-part process involves people from all levels of the NASA organization with all competencies, and may include participation by industry and academia, depending on the project or program. The process ensures that NASA's work is performed in an effective, efficient, reliable manner to maximize mission success.

13.3 INDUSTRY'S INVOLVEMENT IN NASA'S WORK

NASA accomplishes its programs using extensive support from the private sector. Contractors, when properly used, perform an important role in helping NASA accomplish its mission. Contracts are used to procure major end items, support services, and small purchases. During FY11, private sector organizations in all 50 states and the District of Columbia participated in NASA procurements.

In addition, NASA has leveraged the Space Act to form agreements with industry for the development of our Commercial Space Transportation Program. Through this innovative approach to working with industry, NASA is able to judiciously bring to bear the right combination of skills and capabilities from private industry, and in precisely the amount needed in order to further NASA space operations.

13.3.1 AWARDS BY TYPE OF CONTRACTOR

More than 85 percent of NASA funding is obligated through procurements. The remainder includes salaries, benefits, and travel for NASA civil service employees. Table 13.3-1 below shows the distribution of NASA procurements by type of organization, both in actual dollars and by percent. In FY08, most of the contracts (73 percent) were awarded to business firms, followed by awards to JPL (10 percent) and educational institutions (6 percent), with the remaining 8 percent of the contracts awarded to other government agencies (4 percent), nonprofit organizations (3 percent), and awards outside the U.S. (1 percent).

TRENDS IN AWARDS BY TYPE OF CONTRACTOR
FISCAL YEARS 2008 - 2011

	PROCUREMENT DOLLARS (IN MILLIONS)			
	FY 2008	FY 2009	FY 2010	FY 2011
BUSINESS FIRMS	$12,372	$12,305	$13,186	$12,530
EDUCATIONAL	1,085	1,124	1,035	941
NONPROFIT	587	620	660	602
JPL	1,768	1,708	1,619	1,605
GOV'T AGENCIES	665	504	490	526
OUTSIDE U.S.	308	466	427	496
TOTAL	$16,785	$16,727	$17,417	$16,699

	PERCENT OF TOTAL DOLLARS			
BUSINESS FIRMS	73.7%	73.6%	75.7%	75.0%
EDUCATIONAL	6.5%	6.7%	5.9%	5.6%
NONPROFIT	3.5%	3.7%	3.8%	3.6%
JPL	10.5%	10.2%	9.3%	9.6%
GOV'T AGENCIES	4.0%	3.0%	2.8%	3.1%
OUTSIDE U.S.	1.8%	2.8%	2.5%	3.0%
TOTAL	100.0%	100.0%	100.0%	100.0%

Table 13.3-1: Trends in Awards by Type of Contractor

13.3.2 AWARDS BY CONTRACT TYPE

Different types of contracts are used to perform different types of work. Firm fixed price contracts are low risk, and are used for services and small purchases. When the work is less well defined, cost plus award fee contracts are used. Table 13.3-2 below depicts the trends in awards to business firms by contract type in actual dollars and by percentage. Although very few award fee contracts are used throughout the Agency, a large percentage (65 percent) of procurement obligations were awarded under cost plus award fee contracts in FY2011. Firm Fixed Price contracts represented 21 percent of the contracts awarded. Only a few Cost Plus Fixed Fee (6 percent), Incentive Fee Contracts (5 percent), and other award structures (3 percent) were used.

TRENDS IN AWARDS TO BUSINESS FIRMS BY CONTRACT TYPE*
FISCAL YEARS 2008 - 2011

	PROCUREMENT DOLLARS (IN MILLIONS)			
	FY 2008	FY 2009	FY 2010	FY 2011
Firm Fixed Price	$2,414	$2,443	$2,676	$3,074
Incentive Fee	925	1,092	806	710
Award Fee	8,131	9,834	8,985	9,552
Cost Plus Fixed Fee	370	527	713	915
Other	838	581	428	374
TOTAL BUSINESS	$12,678	$14,477	$13,608	$14,625

	PERCENT OF TOTAL DOLLARS			
Firm Fixed Price	20%	23%	20%	21%
Incentive Fee	13%	6%	6%	5%
Award Fee	60%	62%	66%	65%
Cost Plus Fixed Fee	3%	4%	5%	6%
Other	4%	5%	3%	3%
TOTAL BUSINESS	100%	100%	100%	100%

*Includes contract awards with place of performance outside the US

Table 13.3-2: Trends in Awards to Business Firms by Contract Type

13.3.3 ROLE OF COMPETITION

The Competition in Contracting Act (P.L. 98-369), with limited exceptions, requires full and open competition within the federal government. Full and open competition means that all responsible sources are permitted to submit sealed bids or competitive proposals on a given procurement. Contracting without providing for full and open competition is allowable under certain circumstances. Written justifications are required to award procurements on other than a full and open competition basis. Federal agencies are required to submit uniform competition statistics to Congress in an annual report that summarizes past year accomplishments of the agency's competition advocacy program and describes proposed current year actions to increase competition and reduce noncompetitive contract awards. As shown in Table 13.3-3, 57.4 percent of contracts were competed, and 42.6 percent were not competed. Beginning in FY 2011, Follow-On Actions were included in Not Competed.

Shown below in Table 13.3-3 are the trends by extent of competition for Fiscal Years 2008-2011.

TRENDS IN AWARDS BY EXTENT OF COMPETITION
FISCAL YEARS 2008 - 2011

TYPE OF ACTION	FY 2008	FY 2009	FY 2010	FY 2011
Total	$14,967.0	$15,150.2	$16,016.5	$15,355.8
Competed	$ 7,645.7	$ 8,121.4	$ 8,865.3	$ 8,806.9
Not Competed*	$ 5,537.4	$ 5,487.1	$ 5,343.3	$ 6,548.9
Follow-On	$ 1,783.9	$ 1,541.7	$ 1,807.9	**
		Percent of Total		
Total	100.0	100.0	100.0	100.0
Competed	51.1	53.6	55.4	57.4
Not Competed	37.0	36.2	33.4	42.6
Follow-On	11.9	10.2	11.3	**

* Beginning in FY 2008, Not Competed includes figures for awards that are not available for competition.

** Beginning in FY 2011, Follow-On actions are included in Not Competed.

Table 13.3-3: Trends in Awards by Extent of Competition - Fiscal years –2008-2011

13.3.4 Contract Selection Process from Acquisition Strategy Planning to Award

NASA contracting is accomplished through 10 locations outside of Washington, D.C. At NASA, procurement authority flows from the President of the United States to the NASA Administrator, the Assistant Administrator for Procurement, Center Directors, and Center Procurement Officers. The Center Procurement Officers have authority to award procurements subject to review of major actions by Headquarters. The contract and acquisition planning process operates under policy and oversight by the Headquarters Office of Procurement.

The Federal Acquisition Regulations (FAR) and the NASA FAR Supplement (NFS) are the regulations governing NASA's acquisition planning process through award. The NASA acquisition planning process is separated into three discrete events, leading to a

procurement: Strategy Implementation Planning (SIP), the Acquisition Strategy Meeting (ASM), and the Procurement Strategy Meeting (PSM) (see NFS 1807.170). The procurement strategy planning process through award is depicted in the flowchart below. The NASA Acquisition Forecast is published to alert industry of an upcoming procurement. An acquisition plan and statement of work (SOW) is developed, and an industry day may be held to provide additional information and answer questions about the procurement. A synopsis of the procurement is published, typically followed by a draft request for proposal (RFP). After responding to questions, the final RFP is released. Proposals are received, evaluated, a selection is made, and the contract is awarded. The Source Selection Guide provides the process in detail at the following web site:http://prod.nais.nasa.gov/portals/pl/documents/Source_Selection_Guide_March_2012.pdf. Figure 13.3-1 below illustrates the NASA acquisition process.

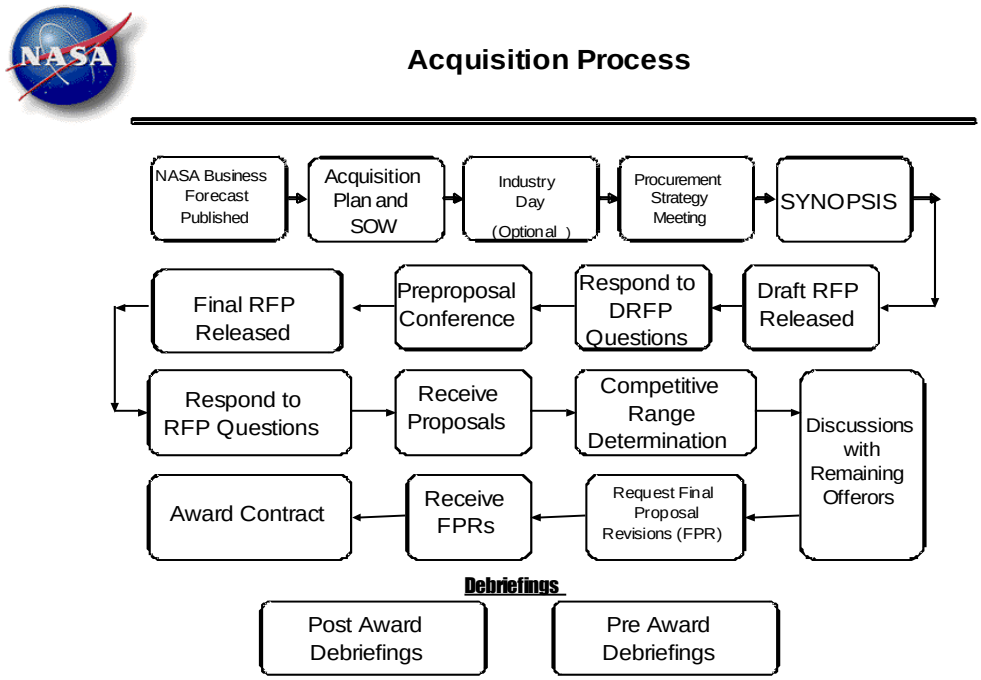


Figure 13.3-1: The NASA Acquisition Process

13.3.5 CHARACTERIZATION OF OUR CURRENT PRINCIPAL CONTRACTORS (BUSINESS FIRMS)

The 34 contractors that received the largest dollar value of NASA direct awards to business firms during FY 2011 are shown below in Table 13.3-4: NASA Direct Awards to Business Firms during FY 2011. The awards to these contractors accounted for 77.12 percent of the direct awards to business firms during the year. The smallest aggregate award to any contractor was in excess of $12 million. Of the top 100 contractors, 35 were small business firms (S) and of these 8 were disadvantaged (D) firms at the time of award.

	TOTAL AWARDS TO BUSINESS FIRMS			$13,021,919,066	77.12
1.	LOCKHEED MARTIN CORP.			1,759,039,165	13.51
2.	UNITED SPACE ALLIANCE LLC			1,139,946,671	8.75
3.	BOEING COMPANY			1,132,695,443	8.70
4.	JACOBS TECHNOLOGY INC.			662,003,379	5.08
5.	ATK LAUNCH SYSTEMS INC.			454,979,843	3.49
6.	RUSSIAN SPACE AGENCY			414,009,394	3.18
7.	PRATT & WHITNEY ROCKETDYNE INC.			398,779,707	3.06
8.	ORBITAL SCIENCES CORP.			350,564,312	2.69
9.	UNITED LAUNCH SERVICES LLC			345,210,983	2.65
10.	SCIENCE APPLICATIONS INTL CORP.			278,204,055	2.14
11.	NORTHROP GRUMMAN SPACE & MISSION SYS			265,358,246	2.04
12.	S G T INC.			259,344,435	1.99
13.	RAYTHEON COMPANY			233,289,461	1.79
14.	URS FEDERAL TECHNICAL SERVICES INC.			201,115,775	1.54
15.	SPACE EXPLORATION TECHNOLOGIES CORP.			195,440,755	1.50
16.	WYLE LABORATORIES			156,206,125	1.20
17.	QINETIQ NORTH AMERICA INC.			155,367,505	1.19
18.	BALL AEROSPACE & TECH. CORP.			141,427,186	1.09
19.	I T T SPACE SYSTEMS LLC			135,951,146	1.04
20.	HONEYWELL TECHNOLOGY SOLUTIONS INC.			132,541,347	1.02
21.	I T T CORPORATION			130,784,835	1.00
22.	GENERAL DYNAMICS C4 SYSTEMS INC.			124,011,069	0.95
23.	COMPUTER SCIENCES CORP.			106,863,148	0.82
24.	C S C APPLIED TECHNOLOGIES LLC			102,861,222	0.79
25.	ABACUS TECHNOLOGY CORP.	(S)		92,726,273	0.71
26.	HAMILTON SUNDSTRAND CORP.			90,324,204	0.69
27.	M E I TECHNOLOGIES INC.			90,246,180	0.69
28.	A S R C RESEARCH & TECHNOLOGY SOLUTIONS	(S)	(D)	87,821,207	0.67
29.	ANALEX CORP.			83,202,605	0.64
30.	MCDONNELL DOUGLAS CORP.			72,836,163	0.56
31.	TELEDYNE BROWN ENGINEERING INC.			67,140,163	0.52
32.	SCIENCE SYSTEMS & APPLICATIONS INC.	(S)		64,971,992	0.50
33.	A S R C AEROSPACE CORP.	(S)		59,832,047	0.46
34.	D B CONSULTING GROUP INC.	(S)	(D)	56,871,585	0.44

Table 13.3-4: NASA Direct Awards to Business Firms during FY2011

13.4 ACADEMIA'S INVOLVEMENT IN NASA'S WORK

This section discusses how NASA leverages academia's capabilities to achieve the NASA mission.

13.4.1 ROLE OF ACADEMIA

Scientific and technological research, from basic to applied, is a small component of the exploration systems portfolio, and a large component of the science and aeronautics portfolios. While scientific and technological research is supported by in-house staff as described earlier, a majority of this work is performed by academia. Outside investigators participate in the following:

- National Research Council (NRC) study committees: performing strategic goal setting and science and independent program assessments;
- Advisory committees: serving on the NASA Advisory Council, its five science subcommittees, and numerous subordinate analysis groups;
- Science and Technology Definition Teams: establishing science and technology requirements for missions in formulation;
- Management Operations Working Groups: assessing science program management;
- Flight project definition: assembling teams and developing competitive proposals for flight investigations;
- Supporting research: analyzing flight data and conducting the underlying basic ground research funded by NASA;
- Technology development: developing critical NASA technology via grant or contract funding;
- Mission operations: supporting science operations on flight mission teams;
- Peer review panels: critically evaluating research proposals to support the Headquarters selection process; and
- Senior review panels: periodically appraising operating missions for continuing science potential.

Outside scientists also play supporting roles in science management under contract at various institutes. Examples are the Space Telescope Science Institute and the National Space Biomedical Research Institute, bricks-and-mortar organizations, and the NASA Astrobiology Institute, a "virtual" institute of dispersed investigator teams organized around scientific competencies and objectives.

Academia has a role in supporting NASA's education goals as well. NASA's Higher Education projects attract and prepare students for NASA-related careers through scholarships, internships and fellowships at NASA centers and through the National Space Grant College and Fellowship Program, Minority University Research and Education Project (MUREP), and other NASA activities. Student projects serve as a major link in the pipeline for addressing NASA's Human Capital Strategies and the President's Management Agenda, and in FY 2011, 34,032 undergraduate and graduate students participated in NASA education opportunities. Through MUREP, NASA invested nearly $30M in support to Minority Serving Institutions including Historically Black Colleges and Universities (HBCUs), Hispanic Serving Institutions (HSIs), and Tribal Colleges and Universities (TCUs),

and to organizations with a history of supporting underrepresented and underserved students. The program also strengthens the research capabilities of institutions. In FY11, the Experimental Program to Stimulate Competitive Research (EPSCoR) provided approximately $23.8M to universities and consortia that advance the research capacity and infrastructure at targeted states in NASA-related areas.

13.4.2 Science and Aeronautics Program Acquisition Processes

The actual procurement of science to support SMD, HEO, ARMD, STMD, and the Office of Education goals use a variety of mechanisms. SMD generally uses the Announcement of Opportunity (AO) for NASA flight mission opportunities, and some programs make multiple awards to a single solicitation. In addition, an innovative AO, the Stand-Alone Mission of Opportunity Notice (SALMON), is used for participation on foreign missions and comparable opportunities. SMD, STMD, ESMD, and ARMD use NASA Research Announcements (NRA) to solicit research supporting their programs. Nearly all SMD grant opportunities for supporting ground-based research, approximately 55 annually, are issued as program elements of the omnibus NRA "Research Opportunities in Space and Earth Science" (ROSES). Similarly, many ARMD cooperative agreements, contracts and grants are issued as elements of the omnibus NRA "Research Opportunities in Aeronautics" (ROA). ARMD competitions are open to both academia and industry. Proposals are submitted, peer reviewed, and then selected. NASA's Higher Education proposals are selected based upon a proposer's ability to foster and expand new concepts in NASA-related science and technology development; and develop mechanisms for increased participation by faculty and students in the research programs of NASA's Mission Directorates. Once proposals are selected, the funding package is then transmitted to the NASA Shared Services Center (NSSC) for execution of grants to successful proposers.

13.4.3 Characterization of Our Current Grants

The number and dollar amount of all grants awarded by NASA over the past four years are shown in Table 13.4-1 below.

Fiscal Year	Total # of Awards	$ Amount Awarded
08	2457	$358,704,999
09	2002	$321,405,613
10	1904	$342,202,297
11	1625	$204,725,585

Table 13.4-1: NASA Grants from 2008-2011

14.0 NASA FEDERAL ADVISORY COMMITTEES AND THE NATIONAL ACADEMIES

INTRODUCTION

NASA and its predecessor, the National Advisory Committee for Aeronautics (NACA), have traditionally sought independent judgment and guidance from scientific and technical experts in academia, industry, and other government agencies. This section discusses the five federal advisory committees that NASA currently sponsors under the Federal Advisory Committee Act (FACA):

- Aerospace Safety Advisory Panel *(Congressionally mandated)*
- NASA Advisory Council
- National Space-Based Positioning, Navigation and Timing Advisory Board
- International Space Station Advisory Committee
- International Space Station National Laboratory Advisory Committee *(Congressionally mandated)*

A sixth federal advisory committee is in the process of being chartered at this time:

- Applied Sciences Advisory Committee *(Congressionally mandated)*

In addition, Public Law 107-368, the National Science Foundation Authorization Act of 2002, mandated the establishment of the following multi-agency federal advisory committee:

- Astronomy and Astrophysics Advisory Committee

It is co-sponsored by the National Science Foundation, NASA, and the Department of Energy. It produces an annual report of findings and recommendations for the federal agencies and the Congress. The Astronomy and Astrophysics Advisory Committee is managed by the National Science Foundation.

NASA also seeks independent external scientific and technical expertise and advice from the National Academies (i.e., National Academy of Science, National Academy of Engineering, and Institute of Medicine) through its operating arm, the National Research Council (NRC). NRC boards with which NASA currently has contracts are:

- Space Studies Board
- Aeronautics and Space Engineering Board

These Boards coordinate the participation of other NRC boards and committees as needed in studies, assessments, and surveys performed for NASA. In recent years, Congress has mandated that several studies be conducted by the NRC on NASA-related topics via its authorization and appropriations bills.

14.1 NASA FEDERAL ADVISORY COMMITTEES

14.1.1 HISTORICAL BACKGROUND

NACA was established in 1915 and became the United States' premier aeronautical research organization. An advisory committee governed it, and its members were appointed by the President. The "main committee" of the advisory panel served as a board of directors, and a group of research

advisory committees guided its research in specific areas. With the creation of NASA is 1958, NACA was abolished, and its three aeronautical research centers (Langley Aeronautical Laboratory, Lewis Research Center, Ames Research Center) were incorporated into NASA, along with some elements of the U.S. Army and U.S. Navy-sponsored rocket research.

Since 1958, NASA's tradition of seeking independent judgment and guidance from scientific and technical experts in academia, industry and other government agencies started by NACA has continued up to the present day. For the past 54 years, NASA has turned to highly accomplished citizens and world-class experts to develop observations, findings and recommendations on major programmatic and policy issues related to the U.S. civil space program. NASA has sponsored numerous advisory committees covering the breadth and depth of Agency programs and activities, including aeronautics, commercial space, space science, Earth science, human spaceflight, and exploration.

NASA's Federal advisory committees are formally chartered under FACA, have specific goals, objectives, charters, appointed members, and specified durations for their work.

NASA's current five federal advisory committees are described in greater detail below.

14.2 AEROSPACE SAFETY ADVISORY PANEL

In 1967, the U.S. Congress directed NASA to form the Aerospace Safety Advisory Panel (ASAP) after the Apollo-1 fire on the launch pad that resulted in the death of three astronauts. The *NASA Authorization Act of 1968* set forth the statutory duties for the Panel. The purpose of ASAP is to advise the Congress and the NASA Administrator on safety issues in NASA's aerospace programs. The Congress envisioned a continuity of membership and a degree of professional technical expertise for the Panel that makes it unique in NASA's advisory committee structure up to this day. More recently, the *NASA Authorization Act of 2005* reauthorized the ASAP's original duties, and included a requirement that ASAP evaluate "NASA's compliance with the return-to-flight and continue-to-fly recommendations of the Columbia Accident Investigation Board (CAIB)," as well as a requirement to submit an annual report to the NASA Administrator and to Congress. The annual report was also to include "an evaluation of NASA's management culture related to safety." The current ASAP members are as follows:

- VADM Joseph Dyer *(USN, Ret.), ASAP Chair, iRobot Corporation*
- Dr. James Bagian, *University of Michigan, former NASA Astronaut*
- The Honorable Claude Bolton, *Defense Acquisition University*
- Capt. Robert Conway, *USN (Ret.)*
- Mr. John Frost, *Safety Engineering Services*
- Dr. Donald McErlean, *L-3 Communications*
- Dr. George Nield, *Federal Aviation Administration*
- Mr. Bryan O'Connor *(NASA, Ret.), former NASA Astronaut*
- Dr. Patricia Sanders, *Independent Aerospace Consultant*

The most recent annual report of the ASAP was published in January 2012 (*ASAP Annual Report for 2011).* It is posted on the NASA website and contains the panel's findings and recommendations covering calendar year 2011. The current charter of ASAP was signed by the NASA Administrator on October 13, 2011, and has a duration of two years. All ASAP formal recommendations to NASA are carefully considered and receive an Agency formal response.

14.3 NASA ADVISORY COUNCIL

While versions of senior-level advisory groups have existed since NASA was formed in 1958, the NASA Advisory Council (NAC) was formally created in 1977 by combining two pre-existing Agency-level advisory committees into a larger, more comprehensive body of experts. These were the Space Program Advisory Council and the Research and Technology Advisory Council. The NASA Advisory Council held its first meeting in 1978. It reports directly to the NASA Administrator and is the most senior body charged with developing findings and recommendations across the breadth and depth of NASA's programs, policies and plans for consideration by the NASA Administrator and Agency senior leadership.

The NASA Advisory Council is comprised of the Council, eight standing committees, and six subcommittees. The current Council members are as follows:

- Dr. Steven Squyres, *Council Chair, Cornell University*
- The Honorable Marion Blakey, *Aerospace Industries Association*
- Mr. Robert Hanisee, *Trust Company of the West*
- Ms. Patti Grace Smith, *Consultant*
- Mr. Lars Perkins, *Entrepreneur*
- Mr. Richard Kohrs, *NASA (Ret.)*
- Dr. Larry Smarr, *University of California, San Diego*
- Dr. Wesley Huntress, *Geophysical Laboratory, Carnegie Institute of Washington (Ret.)*
- Dr. William Ballhaus, *The Aerospace Corporation (Ret.)*
- Dr. Charles Kennel, *Ex-Officio, Chair, Space Studies Board, National Academies*
- Gen. Lester Lyles, *USAF (Ret.), Chair, Aeronautics and Space Engineering Board, National Academies*

The current NAC standing committees and subcommittees are:

- Aeronautics Committee
    - Unmanned Aircraft Systems Subcommittee
- Audit, Finance and Analysis Committee
- Commercial Space Committee
- Education and Public Outreach Committee
- Human Exploration and Operations Committee
- IT Infrastructure Committee
- Science Committee
    - Astrophysics Subcommittee
    - Earth Science Subcommittee
    - Heliophysics Subcommittee
    - Planetary Protection Subcommittee
    - Planetary Science Subcommittee

- Technology and Innovation Committee

The current charter of the NASA Advisory Council was signed by the NASA Administrator on October 25, 2011, and has a duration of two years. All NAC formal recommendations to NASA are carefully considered and receive an Agency formal response.

14.4 NATIONAL SPACE-BASED POSITIONING, NAVIGATION AND TIMING ADVISORY BOARD

The National Space-Based Positioning Navigation and Timing (PNT) Advisory Board was established in 2006 by the NASA Administrator to implement national space policy related to the U.S. Global Positioning System (GPS), specifically, the U.S. Space-Based PNT Policy announced by the White House on December 8, 2004. This Presidential policy created a permanent National Space-Based PNT Executive Committee comprised of the following seven federal agencies: Department of Defense, Department of Transportation, Department of State, Department of Commerce, Department of Homeland Security, the Joint Chiefs of Staff, and NASA. In 2007, the PNT Executive Committee was expanded to include two additional federal agencies: the Department of Agriculture and the Department of the Interior.

The PNT Executive Committee is co-chaired by the Deputy Secretaries of Defense and Transportation, and the PNT Advisory Board's role is to provide expert advice to the PNT Executive Committee on U.S. space-based PNT policy, planning, program management, and funding profiles in relation to the current state of national and international reports space-based PNT services. The PNT Advisory Board's findings and recommendations have been considered by the PNT Executive Committee in recommending a national PNT strategy and in developing annual updates to the Five-Year Space-Based PNT Plan.

The PNT Advisory Board meets up to two times per year. The Board currently consists of 24 members who represent a broad spectrum of GPS expertise across critical industry sectors, academia, and users. There are four foreign members of the Board, representing GPS interests of a national or international nature. The current members are as follows:

- Dr. James R. Schlesinger, *Chair, MITRE*
- Dr. Bradford Parkinson, *Vice Chair, Stanford University*
- Dr. Gerhard Beutler, *International Association of Geodesy (Switzerland)*
- Mr. Dean Brenner, *Qualcomm*
- Capt. Joseph D. Burns, *United Airlines*
- Ms. Ann Ciganer, *U.S. GPS Industry Council*
- Mr. Richard Dalbello, *Intelsat*
- Mr. Arve Dimmen, *Norwegian Coastal Administration (Norway)*
- Dr. Per K. Enge, *Stanford University*
- Mr. Martin C. Faga, *MITRE (Ret.)*
- Mr. James Geringer, *Environmental Systems Research Institute*
- Mr. Keith R. Hall, *Booz-Allen Hamilton*
- Mr. Ronald Hatch, *NavCom Technology*

- Dr. Robert J. Hermann, *Global Technology Partners, LLC*
- Dr. Rajiv Khosla, *Colorado State University*
- Gen. Lance Lord, *USAF (Ret.), Former Commander, Air Force Space Command*
- Mr. Peter Marquez, *Orbital Sciences Corporation*
- Gen. James P. McCarthy, *USAF (Ret.) Air Force Academy*
- Mr. Terence J. McGurn, *Private Consultant*
- Mr. Timothy A. Murphy, *The Boeing Company*
- Ms. Ruth Neilan, *Jet Propulsion Laboratory*
- Mr. Hiroshi Nishiguchi, *Japan GPS Council (Japan)*
- Dr. Refaat Rashad, *Arab Institute of Navigation (Egypt)*
- Mr. Charles R. Trimble, *U.S. GPS Industry Council*

The current charter for the PNT Advisory Board was signed by the NASA Administrator on May 17, 2011, and has a duration of two years.

14.5 INTERNATIONAL SPACE STATION ADVISORY COMMITTEE

On May 2, 1994, NASA established the NASA Advisory Council Task Force on the Shuttle-Mir Rendezvous and Docking Missions, with Lieutenant General Thomas P. Stafford, USAF (Ret.) as its chair. The purpose of the Task Force (known informally as the "Stafford Task Force"), was to review the planning, training, rendezvous/docking, operations, and management of the Shuttle-Mir Program. The Shuttle-Mir program was a series of joint U.S./Russian missions in which the U.S. space shuttle docked with the Russian Mir space station during the mid to late 1990s and crews were exchanged.

On December 15, 1994, the U.S./Russian Joint Commission on Economic and Technological Cooperation directed NASA and the Russian Space Agency to establish a process to review the Shuttle-Mir Program. NASA and the Russian Space Agency agreed that General Stafford and Academician Vladimir F. Utkin would lead this joint review committee. NASA and the Russian Space Agency further agreed that the joint review committee would focus its reviews on issues of safety and reliability. The NASA Shuttle-Mir Task Force and the Russian Space Agency's Advisory Expert Council (AEC) under Academician Utkin produced its first joint report on June 7, 1995.

The Stafford-Utkin Joint Commission began to focus its attention on the safety and operational readiness of the International Space Station (ISS) in 1998. In 1999, NASA changed the name of the Task Force to the NASA Advisory Council Task Force on ISS Operational Readiness. In January 2006, NASA Administrator Michael Griffin formally chartered the committee as a federal advisory committee and changed its name to the ISS Advisory Committee and directed that it report to the NASA Associate Administrator for the Human Exploration and Operations.

The ISS Advisory Committee and its predecessors have been a valuable source of expert opinion to the ISS program, and an alternative path of open communications with the Russian Federal Space Agency. It

was instrumental in assessing the cause and corrective action associated with past Russian human spaceflight-related issues, such as the Progress-Mir collision, the fire onboard Mir, the Proton failures just prior to Service Module launch; visiting ISS crewmember certification requirements; and the cause of the off-nominal Soyuz landing in 2003. The Joint Commission assessed impacts of the Columbia accident to ISS operations, and provided advice on ISS assembly missions before the ISS was permanently inhabited. On a regular basis, the Joint Commission assesses ISS software, visiting vehicle guidance and crew interface requirements and procedures, and overall readiness for ISS expeditions. The Joint Commission reviewed and assessed the readiness of the ISS for a six-person crew. The Joint Commission included a new task, to assess the possibilities for using the ISS for future space exploration.

Equally important, ISS Advisory Committee members and their Russian counterparts have developed trust and mutual respect in working together over the past 18 years. This trust has provided both NASA and the Russian Federal Space Agency with valuable insight into each others' space programs and has facilitated open and candid communications at the Center Director/Program Manager/Chief Engineer level.

The current members of the ISS Advisory Committee are as follows:

- Lt. Gen. Thomas P. Stafford, *USAF (Ret.), Chairman, President, Stafford, Burke & Hecker Inc., technical consulting*
- Col. James C. Adamson, *U.S. Army (Ret.), CEO, Monarch Precision, LLC, Consulting firm*
- Mr. Percy Baynes, *Director, Technology Applications Group, Anteon Corporation (Ret.)*
- Mr. Joseph W. Cuzzupoli, *Consultant to Kistler Aerospace Corporation/ Rocketplane*
- Dr. Charles C. Daniel, *Engineering Consultant, Valador, Inc.*
- Dr. Daniel W. Heimerdinger, *Executive Vice President, Exostrategies*
- Maj. Gen. Ralph H. Jacobson, *USAF (Ret.), President Emeritus, Charles Stark Draper Laboratory*
- Dr. Ronald C. Merrell, *FACS, Professor of Surgery, Medical College of Virginia, Virginia Commonwealth University*
- Dr. Josef F. Schmid, MD, MPH, *Flight Surgeon, Medical Operations, NASA Johnson Space Center*
- Mr. Thomas Whitmeyer, *Deputy Chief, Office of Safety and Mission Assurance, NASA Headquarters*
- Col. Jeffrey N. Williams, *U.S. Army (Ret.), NASA Astronaut*

The current ISS Advisory Committee charter was signed on September 7, 2012, and has a duration of one year.

14.6 International Space Station National Laboratory Advisory Committee

The establishment of the International Space Station (ISS) National Laboratory Advisory Committee was mandated by Congressional direction in the NASA Authorization Act of 2008. The purpose of this federal advisory committee is to monitor, assess and make recommendations regarding effective utilization of the ISS as a national laboratory

and platform for research. The committee was formally established by NASA in 2009 and its most recent charter was signed by the NASA Administrator on October 6, 2011. Due to an ongoing restructuring of the management for U.S.-sponsored ISS utilization activities, the committee is currently dormant; no members have been appointed and it has not met.

14.7 NATIONAL ACADEMIES

In addition to its own federal advisory committees, NASA has a longstanding tradition of seeking external independent technical assessments, studies and expert advice from the National Academies: the National Academy of Science, the National Academy of Engineering, and the Institute of Medicine. This takes place both at NASA's initiative and when directed by NASA's Congressional oversight committees. The assessments, studies and expert advice are provided by distinguished members of the U.S. scientific and engineering community and are obtained via NASA contracts with the operating arm of the National Academies, the National Research Council (NRC). The NRC manages two key independent advisory bodies for NASA:

- Space Studies Board
- Aeronautics and Space Engineering Board

The NRC also manages the Aeronautics Research and Technology Roundtable (ARTR) established in 2011, at NASA's request, to provide stakeholder views on aeronautics research and development topics.

15.0 Timeline of Major Milestones and Events in the Budget Process

Introduction

This section describes the timeline of events in a "normal" NASA budget process. The section begins by addressing budget milestones and the status of budget documents. It also presents other key milestones over a six-month period.

15.1 Budget Milestones and Status of Budget Documents

The annual Planning, Programming, Budgeting and Execution (PPBE) Steps are highlighted in Table 15.1-1. Major budget milestones are presented in Table 15.1-2, Table 15.1-3, and Table 15.1-4, which list the major steps in the federal budget formulation process, the major steps in Congressional action, and the NASA steps involved in budget formulation, respectively.

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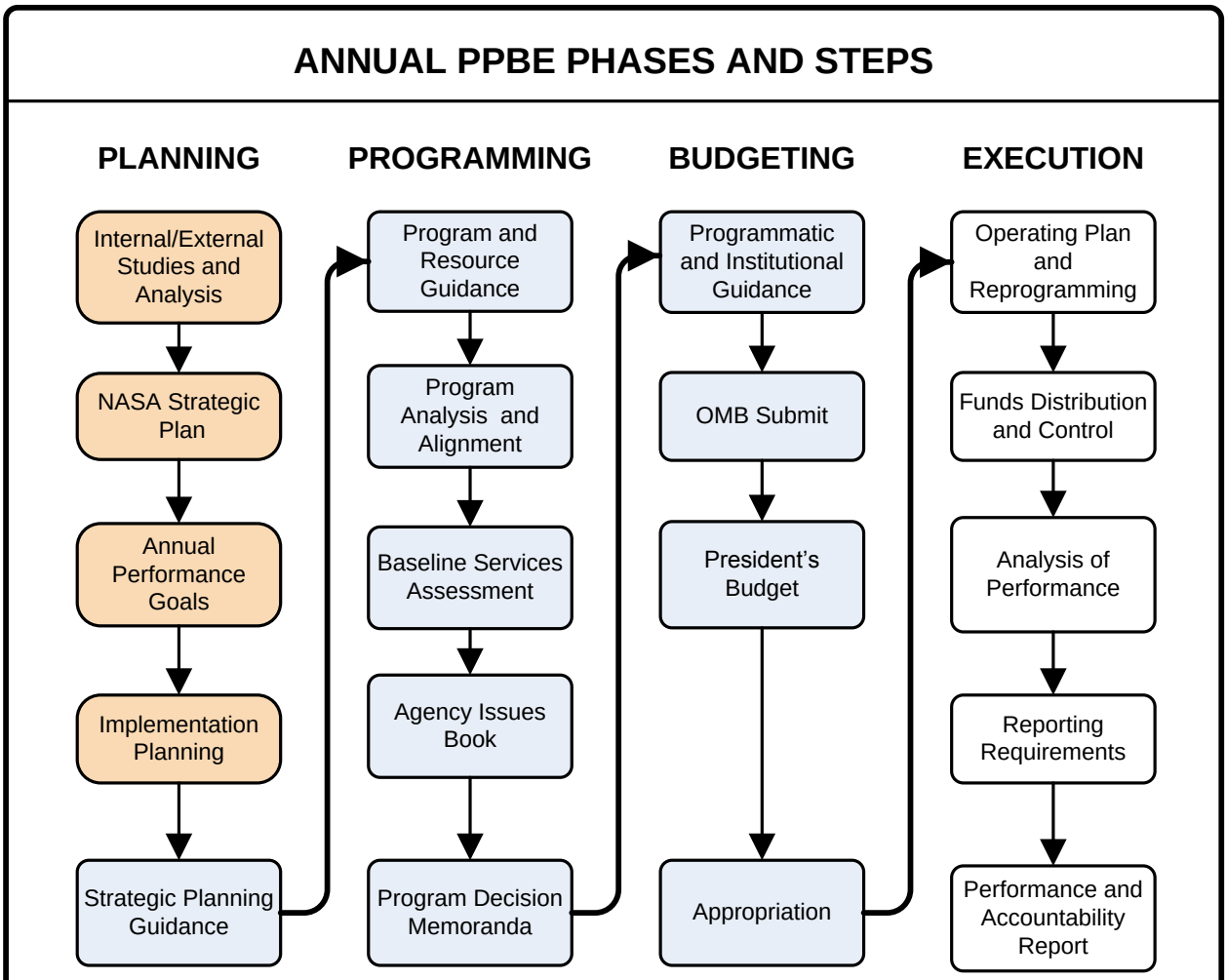

Table 15.1-1: Overview of NASA's Planning, Programming, Budgeting and Execution

What Happens?	When?
NASA reviews open issues that need to be addressed that were either not submitted with the OMB budget Submit or were disapproved by OMB during the Fall Budget process.	Fall
OCFO develops the Strategic Planning Guidance (SPG) to set the budget and plans for the B+ 4 year Formulation period. It is released officially in NASA's Budget Formulation OMB MAX folder when the B+1 year President's Budget Request is submitted to Congress.	Dec - Feb
The Control Account Managers (CAMs) issue lower-level Programmatic Resources Guidance (PRGs) for the programs and mission support functions to develop their budget requirements; program budget reviews are held with the CAMs.	Jan - Mar
The CAMs respond with their proposed budget and issues in a report called the Programmatic Analysis and Alignment (PAA) Report. Centers also have an opportunity to submit their budget requirements and issues to the CAMs.	April - May
CAMs deliver their Budget and Issues to the Administrator and senior management.	June
OCFO evaluates the issues, coordinates responses and brings forward options and recommendations to the Senior Management Councils. Issue papers are consolidated into an Issue Book and released in the Budget Formulation OMB MAX folder.	June - July
OCFO develops Program Decision Memorandum to document the outcome of the issues and consolidates all PDMs into a PDM Book and released in the Budget Formulation OMB MAX folder.	August
OCFO locks the budget data for the CAMs to make adjustments to their budget based on the PDMs. A budget trace is developed to identify the changes across the Agency, thereby establishing the Program and Institutional Guidance (PaIG) budget controls.	August
OCFO submits the Proposed Budget to OMB.	~1st Monday in Sept (date published in OMB Circular A-11)
OCFO develop the Agency Budget Justification briefings and discuss with OMB. Followed with detailed presentations from the various CAMs.	Sept - Oct
Passback and Appeal cycle is usually after Thanksgiving and ends with the Final Settlement sometime in December.	Nov - Dec
OCFO completes development and production of the Congressional Budget Justification and Performance Data a.k.a the Integrated Budget and Performance Document (IBPD). Copies are provided to NASA offices, OMB and OLIA for distribution to Congressional Staff on the first Monday in February.	Jan - Feb
OCFO prepares Budget rollout materials (Agency Overview, detail Briefings, Fact Sheets). OLIA prepares Testimony. PAO sets up Conferences.	Jan - Feb
Briefings are provided to Congressional Staff and Testimony is provided for Budget Hearings.	Within 6 weeks of budget transmittal

Table 15.1-2: NASA Steps in Budget Formulation (B + 4 Years)

What Happens?	When?
OMB issues Spring planning guidance to Executive Branch agencies for the upcoming budget. The OMB Director issues a letter to the head of each agency, providing policy guidance for the agency's budget request. Absent more specific guidance, the out year estimates included in the previous budget serve as a starting point for the next budget. This begins the process of formulating the budget the President will submit the following February.	Spring
OMB and the Executive Branch agencies discuss budget issues and options. OMB works with the agencies to: Identify major issues for the upcoming budget; Develop and analyze options for the upcoming Fall review; and Plan for the analysis of issues that will need decisions in the future.	Spring and Summer
OMB issues Circular No. A–11 to all federal agencies. This Circular provides detailed instructions for submitting budget data and materials.	July
Executive Branch agencies (except those not subject to Executive Branch review) make budget submissions. See Section 25.	Early September
Fiscal year begins.	October 1
OMB conducts its Fall review. OMB staff analyzes agency budget proposals in light of presidential priorities, program performance, and budget constraints. They raise issues and present options to the Director and other OMB policy officials for their decisions.	October to November
OMB briefs the President and senior advisors on proposed budget policies. After OMB has reviewed all agency requests and considered overall budget policies, the OMB Director recommends a complete set of budget proposals to the President.	Late November
Passback. OMB usually informs all Executive Branch agencies at the same time about the decisions on their budget requests.	Late November
All agencies, including those in the Legislative and Judicial Branches, enter MAX computer data and submit print materials and additional data. This process begins immediately after passback and continues until OMB locks agencies out of the database in order to meet the printing deadline. Executive Branch agencies may appeal passback decisions to OMB and the President. An agency head may ask OMB to reverse or modify certain decisions. In most cases, OMB and the agency head resolve such issues and, if not, work together to present them to the President for a decision.	Late November to early January
Agencies prepare and OMB reviews congressional budget justification materials. Agencies prepare the budget justification materials they need to explain their budget requests to the responsible congressional subcommittees.	January
CBO reports to Budget Committees on the economic and budget outlook.	January

Table 15.1-3: NASA/OMB Steps in Federal Budget Formulation

What Happens?	When?
President submits the budget to Congress.	First Monday in February
CBO re-estimates the President's Budget based on their economic and technical assumptions.	March
Other committees submit "views and estimates" to House and Senate Budget Committees. Committees indicate their preferences regarding budgetary matters for which they are responsible.	Within 6 weeks of budget transmittal
The Congress completes action on the concurrent resolution on the budget. The Congress commits itself to broad spending and revenue levels by passing a budget resolution.	April 15
The Congress enacts regular appropriations bills or provides continuing resolutions for the upcoming fiscal year.	September 30

Table 15.1-4: Major Steps in Congressional Action

15.2 DRAFT DETAIL BUDGET ROLLOUT PLAN

Normal Year Date	Transition Year	Who	Task
2nd week Jan		OCFO	Draft Messages
		OCFO	Submit CBJ to OMB for Concurrence
		OCFO/OLIA	Administrator review of Current FY initial operating plan
3rd week Jan		OCFO	Finalize Agency Budget Briefing
		OCFO	Complete 1 page budget request
		OCFO	Complete Supporting data
		OCFO	Complete Supplemental data
		OCFO	Draft Detail Budget Briefing
		OLIA	Draft list of Internal Questions to MD/MSOs for responses
		PAO	Draft PAO questions provided to OLIA
		OCFO	CBJ submitted for Print
4th week Jan		OCFO	Finalize Detail Budget briefing
		Strat Comm	Draft oral testimony for posture hearing
		OLIA	Provide latest versions of budget prep package to Deputy admin for review
		PAO	Final PAO questions provide to OLIA
		OCFO	Draft MD Fact/Talking Point sheets
5th week Jan		OCFO	Provide and review Mission Directorate Budget Justification to DA
		OLIA/OCFO	Draft responses to Rollout Q&A due to OCFO and OLIA from RMOs
		OCFO	Finalize MD and Center Fact/Talking Point sheets
Day 1		CFO/OLIA	Prep session for Administrator & DA on budget rollout, review products (overview briefing, first draft of oral and written, testimony)
		OCFO	Prep session for MD AA's on budget rollout briefings
		PAO	Issue media advisory regarding budget rollout news conf
Day 2		OCFO	Prep Session for RMOs on detailed budget brief
		OLIA	Go-No-Go decision regarding inclusion of proposed auth provisions in rollout
		President	State of the Union Speech

Normal Year Date	Transition Year	Who	Task
Day 4		VITS - Morning	Internal Budget brief - DA, AA, CFO, MD AA's, CD's, Center CFOs, PAO, OLIA
		VITS - Afternoon	Internal Budget Brief - Center PAOs & Gas, HQ PAOs, OLIA, OCFO
		OCFO	PM email to CD - Agency summary, summary briefing, internal Q&A
Day 5		OLIA	A & DA phone calls to leadership MOCs
		OCFO	Delivery of CBJ (IBPD) to OLIA, NASA Offices, and OMB
		OLIA	Administrator Tag up on Budget Rollout
		OLIA/PAO	A & DA prep session for Q&A
		OLIA	Morning Highlights briefing to Select Committee staff by OCFO
		PAO	Embargoed media roundtable w/ DA, OCFO
		OLIA/PAO	Conference Call with select influential's (A & DA brief, OCFO brief)
		OLIA	Detailed budget briefing for Approps subcommittee staff by OCFO
1st week Feb	3rd week April	OLIA	Sunday evening: Email materials to select committee staff
Day 1		OLIA	Deliver CBJ (IBPD) to Congressional offices
		OLIA	Email materials to NAC. Administrator call NAC
		PAO	OSTP press conference
		VITS	NASA Leadership VITS on final budget
		OLIA	Email materials to Congressional staff
		OLIA	Final Budget prep to A & DA, AA as required, OCFO, PAO
		PAO	Budget info posted to NASA websites
		PAO	Budget Rollout Briefing at NASA Pres Conf, A & DA, MD AA, and OCFO
		PAO	MD host post briefings telecons
		PAO	Press Avail/Stakeholders briefings BY CDs at NASA Centers following Administrator's event
Day 2 - 5		OLIA	Administrator calls/meetings w/ key members of staff
		OLIA	Detailed Budget briefing for Congressional staff OCFO

Normal Year Date	Transition Year	Who	Task
		OLIA	NAC Budget briefing OCFO
		OLIA	Stakeholders briefing DA, OCFO
2nd week Feb		OLIA	Administrator hearing preps
			Administrator meet with Congressional members
			Administrator House Hearing
			MD Brief Committees and Subcommittees
3rd week Feb		OLIA	Administrator Senate Hearing

Table 15.2-1: Draft Detail Budget Rollout Plan

15.3 OTHER MILESTONES (11/2012- 4/2013)

This section contains a six-month period's timeline (November 2012 to April 2013) of other major NASA milestones and events, such as shuttle launches, expendable launch vehicle launches, major procurements, and other miscellaneous milestones.

(**Note:** This list is not all-inclusive, since it only contains information maintained by SID/OCFO. Other offices may have additional key milestones not tracked by SID/OCFO.)

Date	Event	Description
11/2/2012	Space Shuttle Atlantis	Space Shuttle Atlantis Roll-Out to KSC Visitor Complex.
11/20/2012	SOFIA Cycle 1 Science Flights	SOFIA begins Cycle 1 Science Flights with the GREAT instrument. Over 200 hours of competitively-selected science observations will take place over the course of Cycle 1 as additional instruments are commissioned.
11/27/2012	Ground Systems Development and Operations (GSDO)	Scheduled date to enter Key Decision Point (KDP)-B.
12/4/2012	Space Network Ground Systems Sustainment (SGSS)	Scheduled date to enter KDP-C.
12/8/2012	Launch of TDRS-K	The next Tracking and Data Relay Satellite in NASA's space communications network that provides communications services to NASA's missions.
12/2012	JWST Contract Definitization	Definitization of the new JWST contract with NGAS, the primary contractor, which reflects the new cost, schedule, and scope of work following the 2011 replan.
12/2012	PhoneSat Launch	Demonstration of small satellite technology.
2/22/2013	Launch of IRIS mission	The Interface Region Imaging Spectrograph (IRIS) – a Heliophysics Explorer mission to study the crucial interface region of the sun between the photosphere and the corona.
1/2013	Orion Multi-Purpose Crew Vehicle	Scheduled date to enter KDP-B.
2/2013	JWST Instrument Delivery	Delivery of the NIRCam instrument to GSFC, the third of four science instrument deliveries for JWST.
2/2013	Parabolic Flight Week	Zero gravity aircraft support of microgravity science and research.
4/2013	Space Launch System	PDR Readiness Assessment.
2/11/13	Launch of Landsat Data Continuity Mission (LDCM)	Earth science mission in the Landsat series – the oldest continuous series of Earth science measurements, extending back to 1972. Landsat data (and LDCM data) provide high resolution images in visible, near infrared, and short wave infrared wavelengths, providing crucial data for agriculture, etc. on land usage and changes.
2/2013	Suborbital Flights	Multiple experiments for microgravity science and research.
4/2013	Suborbital Flights	Multiple experiments for microgravity science and research.

Table 15.3-1: Other Milestones (11/2012 – 04/2013)