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Volume VII

NASA Launch Systems, Space Transportation/ Human Spaceflight, and Space Science 1989–1998

Judy A. Rumerman

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PREFACE AND ACKNOWLEDGMENTS

This volume of the NASA Historical Data Book is the seventh in the series that describes NASA's programs and projects. Covering the years 1989 through 1998, it includes the areas of launch systems, human spaceflight, and space science, continuing the volumes that addressed these topics during NASA's previous decades. Each chapter presents information, much of it statistical, addressing funding, management, and details of programs and missions. This decade, which followed the Agency's return to flight after the *Challenger* accident, was especially productive. Upgraded expendable launch vehicles sent missions into Earth orbit and toward the outer reaches of space; 66 Space Shuttle missions were successfully launched; the Space Station received its first components; and 30 space science missions, most of which met their scientific goals, began returning scientific data to Earth. These events took place in an environment both of international cooperation and one in which NASA learned to make the best use possible of its resources.

A forthcoming companion volume will describe NASA's Earth science missions; aeronautics and space research activities; tracking and space operations; facilities; resources; and personnel areas.

A large group of people assisted in preparing this volume and should be recognized. Most valuable and essential was my research assistant, Tai Edwards, who gathered material, organized it superbly, entered data into tables, and proofed and edited draft chapters, all while attending graduate school and getting married. It would have been impossible to deal with the quantity of information I faced without her help. The NASA History Division archivists, Colin Fries, John Hargenrader, Liz Suckow, and chief archivist Jane Odom, helped gather information. Stephen Garber managed the project and dealt with contractual matters. Interns Matt Barrow and Clare Kim, also helped shepherd this project through the production cycle. Nadine Andreassen assisted in a myriad of ways.

On the production end, special thanks go to the NASA Headquarters Communications Support Services Center: Shelley Kilmer-Gaul carefully laid out this volume; Andrew Jarvis edited the layout; and Hanta Ralay oversaw the critical final step of printing. Many thanks are due to all these professionals.

Many people at NASA and in the NASA community gladly provided information and helped explain events and resolve discrepancies. Staff members at every NASA Center willingly offered their assistance and supplied material. Individuals in the program offices at Headquarters and in the various projects at Goddard Space Flight Center spent hours talking with me and finding documents. Graphics personnel both at Headquarters and at the Centers regularly filled my requests for "high resolution graphics."

A special thanks goes to the reviewers of the draft chapters. They took on the arduous job of reading drafts that often numbered in the hundreds of pages, finding errors, and making valuable suggestions.

Their work improved the quality of this document immensely.

I'd also like to thank my husband, Howard, who provided continual support, would listen to my concerns, and frequently resolved computer issues that could have proven disastrous.

ABOUT THE AUTHOR

Judith A. Rumerman is a professional technical writer who has written or contributed to numerous documents for the National Aeronautics and Space Administration. She has written documents describing various spaceflight programs, in-house procedures used at Goddard Space Flight Center, and various materials used for training. She was also the compiler of *U.S. Human Spaceflight: A Record of Achievement, 1961–1998*, a monograph for the NASA History Office detailing NASA's human spaceflight missions, and volumes five and six of the *NASA Historical Data Book, 1979–1988*. In the years preceding the 2003 Centennial of Flight, Ms. Rumerman served as technical lead and prime author of the series of essays written for the Centennial of Flight Commission describing all aspects of aviation and spaceflight aimed at young people of high-school age.

Ms. Rumerman has degrees from the University of Michigan and George Washington University. She grew up in Detroit and presently lives in Silver Spring, Maryland.

NOTES ON SOURCES

The bulk of sources used in preparing this volume are official NASA documents and references. Whenever possible, the author attempted to use primary sources prepared by the organizations or individuals most directly. involved in a program or mission. NASA Web sites were also used extensively. Secondary sources were most often used to provide perspective rather than data The following paragraphs describe major sources. Detailed footnotes are located in each chapter.

Annual Budget Estimates: These documents are issued each year by the NASA Office of the Chief Financial Officer when the annual budget request is presented to Congress. These lengthy documents, filling several loose-leaf binders each year, contain breakdowns of three fiscal years of budgets: the year just ending, the next fiscal year, and the fiscal year two years out. Budget figures are presented by appropriation, program office, installation, program, and in any other way that may be of interest to budget preparers. Toward the end of this decade, "full cost" accounting was adopted, and budget figures for major programs were presented in both the traditional way and in "full-cost" figures. The budget estimate documents also provided comprehensive narrative descriptions of programs and activities, describing both what had occurred during a prior fiscal year (and occasionally farther back) and what the Agency's plans were for the next two years. These descriptions provide a useful account of a program's evolution.

Press and Media Kits: NASA prepares press or media kits for every Space Shuttle mission and for a number of major robotic missions. They describe launch events, payloads, planned experiments, astronaut biographies, and other mission-unique information. Designed for non-technical audiences and the media, they provide a comprehensive description of NASA missions. All Shuttle press kits and most other press kits are available online.

Mission Operation Reports: Every NASA mission is required to prepare a pre-launch and post-launch mission operation report. These reports are designed for the use of senior management and, while they are part of the NASA Historical Reference Collection, they may not always be available to the public. They provide material similar to that found in the press kits but may also include more technical information, and the post-launch reports may include assessments of the success of various mission elements.

Aeronautics and Space Reports of the President: These annual reports describe the aeronautics and space activities of all government agencies that engage in these types of activities. They provide a good overview and an excellent starting point for research.

Press Releases: NASA Headquarters and each NASA Center regularly issue press releases describing newsworthy events.They provide the current status on various events including scientific missions, management and organizational

changes, contract awards, and changing Agency priorities. They are often the only source of current, detailed information about a mission. Headquarters press releases have been posted on the NASA Web site since the early 1990s. The Centers began posting their press releases in the mid-1990s.

Exploring the Unknown, Selected Documents in the History of the U.S. Civil Space Program, Volume V: Exploring the Cosmos and Volume VI: Space and Earth Science, edited by John Logsdon: Particularly in the space science area, the introductory essays preceding the documents in these two volumes, written by eminent individuals in their fields, provide outstanding descriptions of the major events in the history of the space program.

International Reference Guide to Space Launch Systems, Third Edition and Fourth Edition, by Steven J. Isakowitz, Joseph P. Hopkins, Jr., and Joshua B. Hopkins: Published by the AIAA, the two editions of this reference contain thorough descriptions of every launch vehicle used during this decade, as well as information related to performance, cost, flight history, vehicle design, payload accommodations, production and launch operations, and vehicle history.

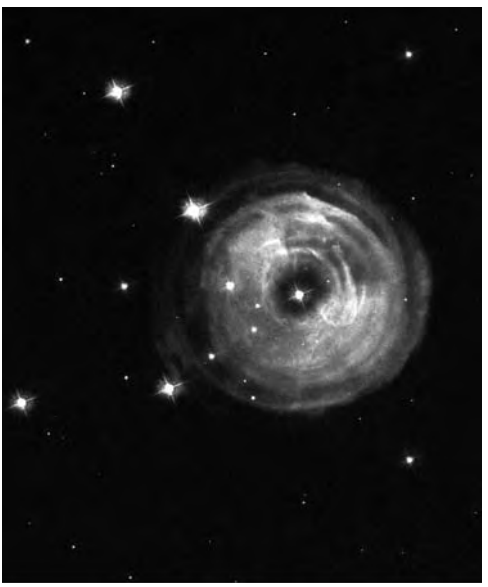
Faster, Better, Cheaper: Low-Cost Innovation in the U.S. Space Program, by Howard McCurdy: This book offers an excellent introduction to NASA's management approach, describing what very likely was the dominant philosophy at NASA during this decade.

Web Sites: The past few years have seen an explosion of material posted on the Internet. Every NASA program has a Web site (too many to list here) and posts a wide variety of information about a project. This has had both positive and negative consequences. On the positive side, official documents such as legislation, policies, Agency reports, and directives are readily available. NASA programs post huge amounts of material describing all phases of missions including: mission parameters and specifications, instrument descriptions, scientific results, implications, etc. This information enables researchers to acquire a great deal of information without the need to cull through files or archives. However, it is also very easy for errors to be perpetuated, even when information is located on NASA Web sites. Information is easily copied from one Web site to the next, often without question, and errors are inadvertently introduced when material is not carefully edited. It is necessary for the researcher to verify information carefully before using it. Another issue is the removing of information from Web sites because of storage considerations without archiving the information. Information "disappears" or is moved to another location on the internet. This happens especially when information becomes "out-of-date" without concern for the historical value of the material. Broken links, due both to technical difficulties and the removal or moving of Web pages without revising the referring link, are also a problem. Web material has been used extensively in this volume, but care has been taken to ensure its reliability. An "access" date is always included, and a printed copy of all Web pages used has been provided to the NASA History Division.

Space Shuttle Mission Chronologies: These short mission descriptions provide launch and landing information, a crew list, and mission highlights. They originally existed as individual pages for each Space Shuttle mission available from the main Human Spaceflight Web page at Kennedy Space Center. Half way through preparing this volume, these disappeared from the site and were replaced by very brief mission descriptions with much less information. No link was provided to the new location of the original material. The original individual mission files were combined into two PDF files (up to 1999 and from 2000) and a link to a set of HTML files for each mission and placed at a different location *http://www-paokscnasagov/kscpao/nasafact/pdf/1981-99Volume1pdf; http://www-paokscnasagov/kscpao/nasafact/pdf/Volume2pdf;* and *http://sciencekscnasagov/shuttle/missions/missionshtml.* Most links within the HTML files do not work. This experience is indicative of the difficulties encountered when using the internet for research.

Space Science Project Web Sites: Each NASA project has a Web site of varying levels of detail and quality. Some provide extensive information about the mission and science results while others provide only basic information. Some missions have more than one Web site—one dealing with mission elements and a second dealing primarily with the science. The Web sites for the Hubble Space Telescope are particularly useful. The NASA Web site describes the mission, and the Web site sponsored by the Space Telescope Science Institute provides a great deal of detail concerning the science. Universities that co-sponsor or provide instruments to missions often have their own Web sites.

National Space Science Data Center: While not easy to navigate, the Master Catalog on the NSSDC database often provides the only available source of basic information for each mission. While not lengthy, the pages for each mission supply a basic mission description, orbital information, and a list and description of each instrument often with the names and affiliations of the Principal Investigators.



CHAPTER ONE

INTRODUCTION

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INTRODUCTION

NASA began operating as the nation's civilian space agency in 1958 after passage of the National Aeronautics and Space Act. It succeeded the National Advisory Committee for Aeronautics (NACA). The new organization was charged with preserving the role of the United States "as a leader in aeronautical and space science and technology," expanding our knowledge of Earth's atmosphere and space, and exploring flight both within and outside the atmosphere.

The decade from 1989 to 1998 was extremely productive, as NASA added to its already considerable list of achievements. The decade was marked by assembly of the first orbiting Space Station components, launch of the first two Great Observatories, and an outstanding record of safe and fruitful missions. This volume addresses NASA's activities during the decade in the areas of launch systems, human spaceflight, and space science.

A number of groups influenced NASA's direction. Congress influenced the Agency through authorization and appropriation bills. The Executive Branch articulated the President's views on space exploration and development through the annual budget submission, other legislation, and policy directives. During the administration of President George H. W. Bush, as in the administration of President Ronald Reagan before him, the National Space Council shaped and articulated "national" space policy (as defined by the administration). Chaired by the Vice President, the Council consisted of the heads of all departments or other offices with a programmatic role or concern in federal space activities. In November 1993, President William J. Clinton established the National Science and Technology Council, a cabinet-level council serving as the principal means for the President to coordinate science, space, and technology and coordinate the diverse parts of research and development at the federal level.

In addition, a series of advisory committees, task groups, and commissions, often formed by the NASA Administrator to address specific Agency concerns, advised the Agency on the direction it deemed most advantageous and worthwhile to take and how it could solve identified problems and improve the way "it did business." These advisory committees and commissions typically consisted of individuals, both experts and non-experts in fields related to space, from diverse backgrounds such as industry, academia, the military, Congress, NASA, and other government agencies. Proceedings of these groups, as well as national policy directives, are cited in the following chapters where relevant.

Overview of the Agency

NASA is an independent federal government agency consisting of a headquarters in Washington, DC, nine Centers or installations located around the United States, and the Jet Propulsion Laboratory, a government-owned, contractor-occupied facility in Pasadena, California, operated under contract to NASA and staffed by the California Institute of Technology. NASA Headquarters consists of program and staff offices providing overall program management and administrative functions for the Agency. During the 1990s, the Agency adopted a thematic strategic enterprise approach to supplement its traditional program office structure. These strategic enterprises, led by Associate Administrators, developed strategy and policy, formulated programs, and assigned lead Centers for specific projects and activities. Although the focus and content of the enterprises changed at times, as did their names, they generally fell into the areas of aeronautics, human spaceflight, Earth science, and space science. To provide continuity when dealing with Congress, NASA retained its program office designations for its annual budget submissions to Congress. Table 1–1 shows NASA's program offices and their major functional areas as stated in the annual budget submissions broken down by appropriation.

NASA Centers operated fairly autonomously to implement Agency plans, programs, and activities as part of a program office or strategic enterprise. Each Center focused on particular types of projects, technology, and discipline areas, indicated by its designation as a Center of Excellence (see table 1–2). Installations were assigned the role of Lead Center for programs based on the Center's mission and Center of Excellence capabilities. Each Center was responsible for day-to-day program management and execution, hiring its own personnel, and awarding its own procurements.

Program and Project Development

NASA called most of its activities "programs" or "projects." The Agency defined programs as "major activities within an enterprise that have defined goals, objectives, requirements, and funding levels, and consist of one or more projects." Projects were "significant activities designated by a program and characterized as having defined goals, objectives, requirements, life-cycle costs, a beginning, and an end."[1]

NASA's programs and projects followed a sequence of events, called a life cycle, consisting of program formulation, program implementation, and several approval milestones needing to be passed. For most of the decade, the life cycle consisted of six phases (with corresponding letter designations). Formulation included Advanced Studies (Pre-Phase A), Preliminary Analysis (Phase A), and Definition (Phase B). Program implementation included Design (Phase C), Development (Phase D), and Operations (Phase E).[2]

In 1998, NASA replaced this structure with one consisting of the same two major stages—program formulation and program implementation—neither of these divided into formal phases. Program formulation included program planning, systems analysis, and technology requirements synthesis. Program implementation included program control, technical requirements management, and the design and development of technology and systems. Several reviews and evaluations took place at specific points within each stage.

Typically, funding for project formulation activities came out of research and technology funding held at the Headquarters level. Congressional funding for a specific program was received after a major review was conducted at the end of program implementation. At all stages, a prescribed set of documents, performance metrics, and evaluations were a large part of the process to ensure that requirements were achieved.[3]

NASA's Budget

NASA depends on a reasonable level of funding from Congress each year to finance its programs.[4] The federal budget process is complex and requires foresight and planning by everyone involved with the allocation of resources. This section provides an overview of the budget process. More detailed information can be found in chapter 7 of Volume VIII of the *NASA Historical Data Book, 1989–1998*.

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[1] NASA Procedures and Guidelines (NPG) 7120.5A, "NASA Program and Project Management Processes and Requirements," Effective April 3, 1998 (canceled).

[2] NASA Handbook (NHB) 7120.5, "Management of Major System Programs and Projects Handbook," November 8, 1993 (canceled).

[3] NPG 7120.5A.

[4] The government operates on a "fiscal year" basis that runs from October 1 through September 30 of the following year. The fiscal year is called by the year in which it ends, e.g., FY 1993 runs from October 1, 1992, through September 30, 1993.

Congress funded NASA's activities each year by means of large appropriations categories. Through fiscal year (FY) 1994, four major appropriations funded the Agency. The Research and Development (R&D) appropriation funded most of NASA's programs and projects. Spaceflight, Control, and Data Communications (SFC&DC) funded operation of the Space Shuttle, some Space Station activities, and tracking and data acquisition activities. The Research and Program Management (R&PM) appropriation funded civil service salaries, regardless of the project or office in which an individual worked, as well as related expenses such as benefits, training, and travel. Construction of Facilities (C of F) funded design and construction of facilities, purchase of land, and similar activities. The Office of Inspector General appropriation funded this independent office.

In FY 1995, the appropriations categories changed to a three-appropriation structure. The new categories were Human Space Flight (HSF), Science, Aeronautics, and Technology (SAT), and Mission Support (MS). HSF funded most Space Station and Space Shuttle activities. The SAT appropriation funded most research and development programs with the exception of the Space Station and Space Shuttle. MS funded the civil service workforce, space communication services, safety and quality assurance activities, maintenance, and most activities formerly funded by the C of F appropriation. The Office of Inspector General retained its appropriation arrangement, as it had before.

NASA was required to spend its funds according to the way Congress allocated funds among the appropriation categories. Although a program office could administer activities from more than one appropriation category, the Agency could not transfer funds from one appropriation category to another without congressional notification. Table 1–3 shows the major programs within each appropriation category.

NASA's budget planning cycle lasted two years. Two years before the beginning of a fiscal year, NASA Headquarters sent programmatic and budget guidelines to each Center based on the Agency's long-range plans and budget forecasts from the Office of Management and Budget (OMB). Each Center then prepared a detailed budget, or Program Operating Plan, for the fiscal year beginning two years in the future. The Center also refined the budget for the remainder of the current fiscal year and revised the budget request for the next fiscal year that it had submitted the year before. Additionally, it provided budget figures for future years. Upon approval from each Center's comptroller and Director, this budget was forwarded to the appropriate Headquarters program or enterprise office, the NASA comptroller, and the NASA Administrator. The comptroller and Administrator finalized the budget request and submitted it to the OMB. After OMB review and further discussion with NASA, the OMB formally submitted the NASA budget request to Congress as part of the President's budget request in February of each year.

NASA prepared and submitted a draft authorization bill that went to NASA's House and Senate science committees that authorized NASA's budget. Ideally, each committee held hearings and discussed the bill with the NASA Administrator and heads of specific programs. These program heads often testified before Congress in preparation for a vote on the bill. The final bill was sent to the full House and Senate and, if necessary, a conference committee reconciled any differences between the House and Senate versions. When both houses of Congress passed the same bill, it went to the President for signature. The authorization bill limited how much could be appropriated and could set conditions on how funds were to be spent.

In some years, however, Congress did not pass an authorization bill. In those years, although Congress held authorization hearings and discussions, only an appropriations bill was passed.[5] The appropriations bill was required for NASA to actually spend funds. Without an appropriations bill at the start of a fiscal year, Congress must pass a continuing resolution allowing agencies to continue operating at a particular level of funding.

The appropriation process was similar to the authorization process, with the bills going to the proper appropriations committees for discussion, revision, and approval. However, in practice, appropriations committees usually did not review the proposed budget in as great detail as the authorization committees unless its members were especially interested in a particular program. Upon committee approval, the appropriations bills went to the full House and Senate, back to a conference committee if necessary, and finally to the President. After approval by the President, the OMB established controls on the release of the funds to the Agency.

Once NASA received control over its appropriated funds, it designated the funds for its various programs, projects, and facilities. An "account" for each item was set up allowing the Agency to commit, obligate, cost, and disburse the funds and track them as they were spent.[6] NASA scrupulously monitored all of its financial activities, first at the project and Center level and then at the Headquarters level. Its financial transactions were eventually reviewed by the congressional General Accounting Office to ensure that they were legal and followed appropriate procedures.

In FY 1995, NASA began a "full cost" accounting initiative. This initiative included all costs (both direct and indirect) associated with an activity, not just funds spent during a limited part of a program's life cycle (usually the prelaunch development phase). Before full cost was implemented, expenses associated with launch and mission operations and the cost of civil service salaries were not counted toward project costs but were instead put into a separate "launch support," or "mission operations" category. Full cost included all of these costs such as civil service salaries, the use of facilities,

[5] An authorization bill is not required for appropriations to be passed.

[6] "To cost" funds refers to the process of recording the total value of resources used in producing goods or rendering services.

and support services associated with the benefiting activities as part of a project's expenses, thus providing a more accurate picture of the actual cost of a project. Formulating a full cost budget allowed for full disclosure of NASA's activities and established a more defined link between funds received and funds spent. Full cost also provided the Agency with greater accountability regarding the use of its resources. For FY 1997 and FY 1998, NASA prepared dual budgets: one using full cost and one using traditional budget methods. In the next decade, NASA went completely to using full cost.

The budget tables in the following chapters show the initial amounts requested by NASA each fiscal year (two years before the start of the fiscal year for which the funds were requested) and the revised amounts (one year before the start of the fiscal year for which the funds were requested). The tables also show the programmed amount, or what the program actually had available to spend. If full cost figures are available for an activity, they are shown.

This volume addresses NASA's launch systems, human spaceflight, and space science activities. Each chapter provides a review of activities of the previous decade, an overview of the topic, budget and funding data, management structure and personnel, and a description of the systems and missions of the decade.

Table 1–1. Programs Within the R&D Appropriation

1989	1990	1991	1992	1993
Office of Space Flight • Space Transportation Capability Development				
Office of Space Station • Space Station	Office of Space Flight • Space Station			
Office of Space Science and Applications • Physics and Astronomy • Planetary Exploration • Life Sciences • Solid Earth Observations • Environmental Observations • Materials Processing in Space • Communications • Information Systems	Office of Space Science and Applications • Physics and Astronomy • Planetary Exploration • Life Sciences • Earth Sciences • Materials Processing in Space • Communications • Information Systems			
Office of Commercial Programs • Technology Utilization • Commercial Use of Space				

Table 1–1. Programs Within the R&D Appropriation (Continued)

1989	1990	1991	1992	1993
Office of Aeronautics and Space Technology • Aeronautical Research and Technology • Transatmospheric Research and Technology • Space Research and Technology		Office of Aeronautics and Space Technology • Aeronautical Research and Technology • Transatmospheric Research and Technology • Space Research and Technology • Exploration Mission Studies	Office of Aeronautics and Space Technology • Aeronautical Research and Technology • Transatmospheric Research and Technology • Space Research and Technology	
				Office of Space Exploration
Office of Safety, Reliability, Maintainability, and Quality Assurance • Safety, Reliability, and Quality Assurance				
Office of Space Tracking and Data Systems • Advanced Systems				
	University Space Science and Technology Academic Programs	Academic Programs		
	Technology Academic Programs			

Table 1–2. Centers of Excellence

Center	Designated Center of Excellence	Mission Area
Ames Research Center	Information technology	Aviation operations systems and astrobiology
Dryden Flight Research Center	Atmospheric flight operations	Flight research
Goddard Space Flight Center	Scientific research	Earth science and physics and astronomy
Jet Propulsion Laboratory	Deep space systems	Planetary science and exploration
Johnson Space Center	Human operations in space	Human exploration and astro materials
Kennedy Space Center	Launch and cargo processing systems	Space launch
Langley Research Center	Structure and materials	Airframe systems and atmospheric science
Lewis Research Center	Turbomachinery	Aeropropulsion
Marshall Space Flight Center	Space propulsion	Transportation systems development and microgravity
Stennis Space Center	Propulsion testing systems	Propulsion test

Table 1–3. Program Office Functional Areas

Programs Within the R&D/Science, Aeronautics and Technology Appropriation				
1994	**1995**	**1996**	**1997**	**1998**
Office of Space Flight • Space Transportation Capability Development	Moved to Human Space Flight appropriation			
Office of Space Systems Development • Space Station	Moved to Human Space Flight appropriation			
Office of Space Science • Physics and Astronomy • Planetary Exploration			Office of Space Science (separate mission divisions were dropped)	
Office of Life & Microgravity Sciences & Applications • Life Sciences • Microgravity Science Research • Shuttle/Spacelab Payload, Mission Management and Integration	Office of Life & Microgravity Sciences & Applications • Life Sciences • Microgravity Science Research • Space Shuttle/ Spacelab Payload, Mission Management and Integration • Space Station Payload Facilities	Office of Life & Microgravity Sciences & Applications • Life Sciences • Microgravity Science Research • Space Shuttle/Spacelab Payload, Mission Management and Integration • Space Station Payload Facilities • Aerospace Medicine/ Occupational Health		Office of Life & Microgravity Sciences & Applications • Life Sciences • Microgravity Science Research • Space Shuttle/ Spacelab Payload, Mission Management and Integration • Aerospace Medicine/ Occupational Health • Space Product Development

Table 1–3. Program Office Functional Areas (Continued)

Programs Within the R&D/Science, Aeronautics and Technology Appropriation (Continued)				
1994	**1995**	**1996**	**1997**	**1998**
Office of Mission to Planet Earth				
Office of Advanced Concepts & Technology • Space Research and Technology • Commercial Programs • Technology Transfer • Commercial Use of Space	Office of Advanced Concepts & Technology • Advanced Concepts and Technology (combined functional areas)	Reallocated to Space Access and Technology and other programs		
		Office of Space Access and Technology • Space Access and Technology		Program office dissolved; activities moved to Aeronautics and Space Transportation Technology
	Launch Services	Included with Space Access and Technology		Moved to Human Space Flight appropriation

Table 1–3. Program Office Functional Areas (Continued)

Programs Within the R&D/Science, Aeronautics and Technology Appropriation (Continued)				
1994	**1995**	**1996**	**1997**	**1998**
Office of Aeronautics • Aeronautical Research & Technology • Transatmospheric Research & Technology	Office of Aeronautics • Aeronautical Research & Technology		Office of Aeronautical Research and Technology • Research and Technology Base • Focused Programs	Office of Aeronautics and Space Transportation Technology • Aeronautical Research and Technology • Commercial Technology/SBIR • Advanced Space Transportation Technology
Safety, Reliability, and Quality Assurance • Safety, Reliability, and Quality Assurance	Moved to Mission Support appropriation			
Space Communications • Advanced Systems	Mission Communication Services • Ground Network • Mission Control & Data Systems • Space Network Customer Service			
Academic Programs	Academic Programs • Education • Minority University Research and Education			

Table 1–3. Program Office Functional Areas (Continued)

Programs Within the Spaceflight, Control, and Data Communications Appropriation					
1989	**1990**	**1991**	**1992**	**1993**	**1994**
Office of Space Flight • Shuttle Production and Operational Capability • Space Transportation Operations					Space Flight • Shuttle Production and Operational Capability • Space Transportation Operations • Launch Services
Office of Space Tracking and Data Systems • Space and Ground Network, Communications and Data Systems					
Space Station					
U.S.-Russian Cooperative Program					
Space Shuttle					
Payload & Utilization Operations					