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Volume 2—Supplemental Material

NASA: BALANCING A MULTISECTOR WORKFORCE TO ACHIEVE A HEALTHY ORGANIZATION

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ACRONYMS

Academy	National Academy of Public Administration
ARC	Ames Research Center
ACCESS	Achieving Competency in Careers in Engineering and Space Science
BRAC	Base Realignment and Closure
CAIB	Columbia Accident Investigation Board
CalTech	California Institute of Technology
CaLV	Cargo Launch Vehicle
CCA	Clinger-Cohen Act
CEV	Crew Exploration Vehicle
CLV	Crew Launch Vehicle
CM & O	Center Management and Operations Account
CMS	Competency Management System
COTR	Contracting Officer Technical Representative
COTS	Commercial-off-the-Shelf
DAWIA	Defense Acquisition Workforce Improvement Act
DIME	Dropping in a Microgravity Environment
DFRC	Dryden Flight Research Center
EEO	Equal Employment Opportunity
EPA	Environmental Protection Agency
FAIR	Federal Activities Inventory Reform Act
FCA	Full Cost Accounting
FTE	Full Time Equivalent
FY	Fiscal Year
GAO	Government Accountability Office
GRC	Glenn Research Center
GS	General Schedule
GSFC	Goddard Space Flight Center
HC	Human Capital
HCIE	Human Capital Information Environment
HQ	Headquarters
HR	Human Resources
HRS	Heat Rejection System
HST	Hubble Space Telescope
IPA	Intergovernmental Personnel Act
IFPTE	International Federation of Professional and Technical Engineers
ISS	International Space Station
JPL	Jet Propulsion Laboratory
JSC	Johnson Space Center
KSC	Kennedy Space Center
LaRC	Langley Research Center
MAF	Michoud Assembly Facility
MD	Mission Directorate
MEO	Most Efficient Organization

MSFC	Marshall Space Flight Center
MSPB	Merit Systems Protection Board
NACA	National Advisory Committee for Aeronautics
NAPA	National Academy of Public Administration
NASA	National Aeronautics and Space Administration
NEX	NASA Excepted (Authority)
NSSC	NASA Shared Services Center
OCFO	Office of the Chief Financial Officer
OFPP	Office of Federal Procurement Policy
OHCM	Office of Human Capital Management
OMB	Office of Management and Budget
OPM	Office of Personnel Management
PA&E	Office of Program Analysis and Evaluation
PPBE	Planning, Programming, Budgeting, and Execution
PVR	Photovoltaic Radiator
R & D	Research and Development
RIF	Reduction-in-Force
S & E	Scientists and Engineers
SCEP	Student Career Experience Program
SLI	Space Launch Initiative
SSC	Stennis Space Center
SSMD	Space Sciences Mission Directorate
STEP	Student Temporary Employment Program
USPTO	United States Patent and Trademark Office
***Vision* or VSE**	Vision for Space Exploration
WFF	Wallops Flight Facility
WIG	Within-Grade
WSTS	White Sands Testing Facility

INTRODUCTION

NASA: Balancing a Multisector Workforce to Achieve a Healthy Organization is a February 2007 report by a Panel of the National Academy of Public Administration (the Academy). The report includes the Panel's formal conclusions and recommendations on three specific issues:

- What is a healthy center, and how should NASA measure it?
- How should NASA decide whether to obtain services from a contractor or a civil servant?
- If NASA decides to hire a civil servant, how should it decide what kind of appointment to use?

In addition, the Panel examined effective practices in other federal agencies and made recommendations on additional human capital management tools—some of which would require new statutory or regulatory authorizations—that NASA needs to safely achieve the Vision for Space Exploration (the *Vision*).

While conducting the research that led to these conclusions and recommendations, the Panel gathered a significant amount of background research and conducted additional supporting analyses not included in the report itself (hereafter referred to as "Volume 1"). *Volume 2: Supplemental Material* presents this additional material in three major appendices:

- **Appendix A: NASA Organizational and Programmatic Data.** This appendix presents background information on various organizations, planning processes, and programs throughout NASA. It also includes statistical data on such critical human capital areas as past hiring freezes, projected FTE trends, and employee age distribution.
- **Appendix B: Center Field Visit Summary.** Over the course of this study, the Panel and study team visited eight of NASA's ten field centers. This appendix presents a narrative description of key insights on each center, including its current situation and challenges at the time of the Academy's visit. It also includes a chart capturing key insights across six issues: (1) uncovered capacity; (2) Full Cost Accounting; (3) Competency Management System; (4) permanent-term issues; (5) contractor issues; (6) center health.
- **Appendix C: Contracting.** With approximately 18,000 civil servants and 40,000 contractors, NASA has a multisector workforce that relies heavily on contractors to meet its mission responsibilities. As the agency phases out the Shuttle and transitions to the programs supporting the *Vision*, its contractors will continue to play a critical role. This appendix presents information on the broader federal context for contracting, as well as statistical data related to NASA's procurement staff and key contractors.

Appendix D contains a Panel biography and staff list. Appendix E contains a list of center officials contacted in the field.

The fundamental theme of the Panel's Volume 1 report is that NASA needs to be a knowledge-based, data-driven organization with an objective approach to strategic planning, human capital, and acquisition. The Panel hopes to facilitate this goal by sharing its additional background research and supporting analyses in this separate volume.

NASA ORGANIZATIONAL AND PROGRAMMATIC DATA

Appendix A provides additional detail on NASA organization and programmatic information referenced in Volume 1. This section includes data regarding:

A-1. NASA's Mission Directorates
A-2. Functions of the NASA Shared Services Center
A-3. NASA Facilities by Type
A-4. NASA Shuttle Transition Process Flow
A-5. NASA's Education Programs
A-6. NASA Hiring Freezes
A-7. Projected Year-by-Year FTE Trend of NASA Workforce (2005-2011)
A-7. Employment by Age and Occupational Group: 40 to 49, 50 to 59, and 60 to 69
A-8. Term Hires by Occupation
A-9. NASA Human Capital and Complaint Data
A-10. Fall 2006 OHCM New Approach to Workforce Planning
A-11. NASA Workforce Planning Responsibilities Diagram

A-1. NASA'S MISSION DIRECTORATES

As discussed in Chapter I of Volume 1, NASA streamlined its organization in 2004 in order to more effectively align the agency with the *Vision*, as well as respond to the findings of the Columbia Accident Investigation Board, which had been established following the tragic 2003 accident of the Space Shuttle *Columbia*. Former Administrator O'Keefe said the reorganization was necessary to "align headquarters to eliminate the 'stove pipes,' promote synergy across the agency, and support the long-term exploration vision in a way that is sustainable and affordable." He emphasized that NASA needs to "take these critical steps to streamline the organization and create a structure that affixes clear authority and accountability."[1]

A fundamental change was to collapse NASA's seven Strategic Enterprises into four mission directorates, specifically aligned with goals of the *Vision*. The functions of the mission directorates are described below:

- **Aeronautics Research Mission Directorate** conducts research in aeronautical disciplines and develops capabilities, tools and technologies to enable safe, reliable, capable, and efficient flight vehicles and aviation systems. With a reduced budget for aeronautics research, NASA is working to restructure its aeronautics programs around long-term investment in cutting-edge fundamental research in traditional aeronautics disciplines. It has established four key objectives of reestablishing the agency's commitment to the science of subsonic (rotary and fixed wing), supersonic, and hypersonic flight; preserving the agency's research facilities, such as wind tunnels; focusing its research on areas appropriate to NASA's unique capabilities; and addressing

[1] "Administrator Unveils Next Steps Of NASA Transformation"
See http://www.nasa.gov/home/hqnews/2004/jun/HQ_04205_Transformation.html

the fundamental research needs of the Next Generation Air Transportation System in partnership with the other agency members of the Joint Planning and Development Office.

- **Science Mission Directorate** carries out the scientific exploration of the earth, sun, solar system and universe by engaging the national science community, sponsoring scientific research, and developing and deploying satellites and probes in collaboration with international partners. It seeks to understand the origins, evolution, and destiny of the universe, as well as the nature of the complex phenomena shaping it. The directorate also seeks to understand the nature of life in the universe, including the kinds of life that may exist beyond Earth; the solar system, both scientifically and in preparation for human exploration; and the changing relationship between the Sun and Earth. Some of its research is designed to assist NASA with its exploration activities, such as understanding Mars and the solar system as well as searching for planets similar to Earth around other stars.

- **Exploration Systems Mission Directorate** is working to develop the capabilities, along with the requisite research and technology, to enable sustained human and robotic exploration of the solar system. It is also working to ensure the health and performance of crews during long-duration space exploration. This directorate is responsible for developing the robotic precursor missions, human transportation elements, and life support systems for the initial goal of lunar exploration. By 2024, NASA plans to establish a permanent lunar outpost on the Moon's South Pole that will serve as a base for the next phase of its exploration endeavors.

- **Space Operations Mission Directorate** directs spaceflight operations, space launches, and space communications. It also manages the operation of integrated systems in Low Earth Orbit and beyond, including the International Space Station. This directorate is working to establish the foundation for human missions to Mars and a permanent human outpost on the Moon. NASA believes that the research and technologies developed through work on the International Space Station will lead to safer and more capable future exploration systems.

A-2. THE NASA SHARED SERVICES CENTER

As discussed in Chapter V of Volume 1, the new NASA Shared Services Center (NSSC), which officially opened in March 2006, will consolidate some human resources as well as procurement, financial, and information technology functions historically performed at the center level. This is relevant to the Panel's analysis of the Office of Human Capital Management because NSSC will change many of NASA's underlying operations and business processes in an attempt to increase efficiency, improve customer satisfaction, and allow centers to increasingly focus on work associated with their core competencies.

NSSC is a public-private partnership between NASA and Computer Sciences Corporation Service Providers. As an organization, it consists of a core group of contractors, with some civil

service staff overseeing the operation of the contract and performing other inherently governmental functions. Between 2006 and 2008, some operational human resource activities will be moving to NSSC:

- **Support to Personnel Programs**—drug testing, special HR studies, classification appeals, support to surveys, employee notices, information material development, general employment inquiries, award processing, agency honorary awards, and HR advisory services (between March 2006 and September 2007).

- **Human Resources Information System**—HR/training website development and maintenance, report preparation, HR/Training Information System, user support and expertise for center HR Data System. In addition, support to HR will be automated (between April 2007 and July 2008).

- **Employee Development and Training**—training service support, off-site training/data entry, and administration of online training and training data systems (between July 2006 and September 2007).

- **Employee Benefits**—health fairs, financial disclosure, leave donor and advanced sick leave, new hire processing, and benefits processing (between April 2006 and January 2008).

- **Senior Executive Service** appointments (April 2006).

- **Recruitment Logistics** (January 2007).

- **Other Services**—rank awards, relocation assistance and programs, performance record maintenance, and personnel action processing (between October 2006 and January 2008)

The operational support activities for three other functional areas will also be transferred:

- **Procurement:** transactional services for grants, cooperative agreements and Small Business Innovative Research/Small Business Technology Transfer processing; NSSC major contracting operations; workforce development and management operations; electronic business systems

- **Financial management:** accounts payable (payroll, travel, vendors); payment certification; accounts receivable (billing and collection); payroll, time, and attendance; labor processing and distribution; financial reporting (general ledger, Treasury 224, and NF-1018's); reimbursable accounting; and internal reviews for NSSC finance office

- **Information Technology:** competency center services; computing and communication services; and program management service

The team understands the agency has adjusted FTE levels for centers to reflect the 120 civil service FTE planned for NSSC for FY 2007. NASA is filling the civil service jobs at NSSC

through competitive announcements open to employees of all centers. As mentioned in Volume 1, the agency has not shared with the Academy Panel how it will redeploy any FTE regained through establishing NSSC, or to what extent it will refocus the remaining center human capital staff on strategic and consultative functions.

NASA has established a schedule by which activities will be transitioned to NSSC between FY 2006 and FY 2008. Figures 1 and 2 contain information on the transition schedule by type of service.

Figure 1
NSSC Transition Schedule for Procurement and Information Technology (IT)
(Green Bars=Procurement; Red Bars=IT)

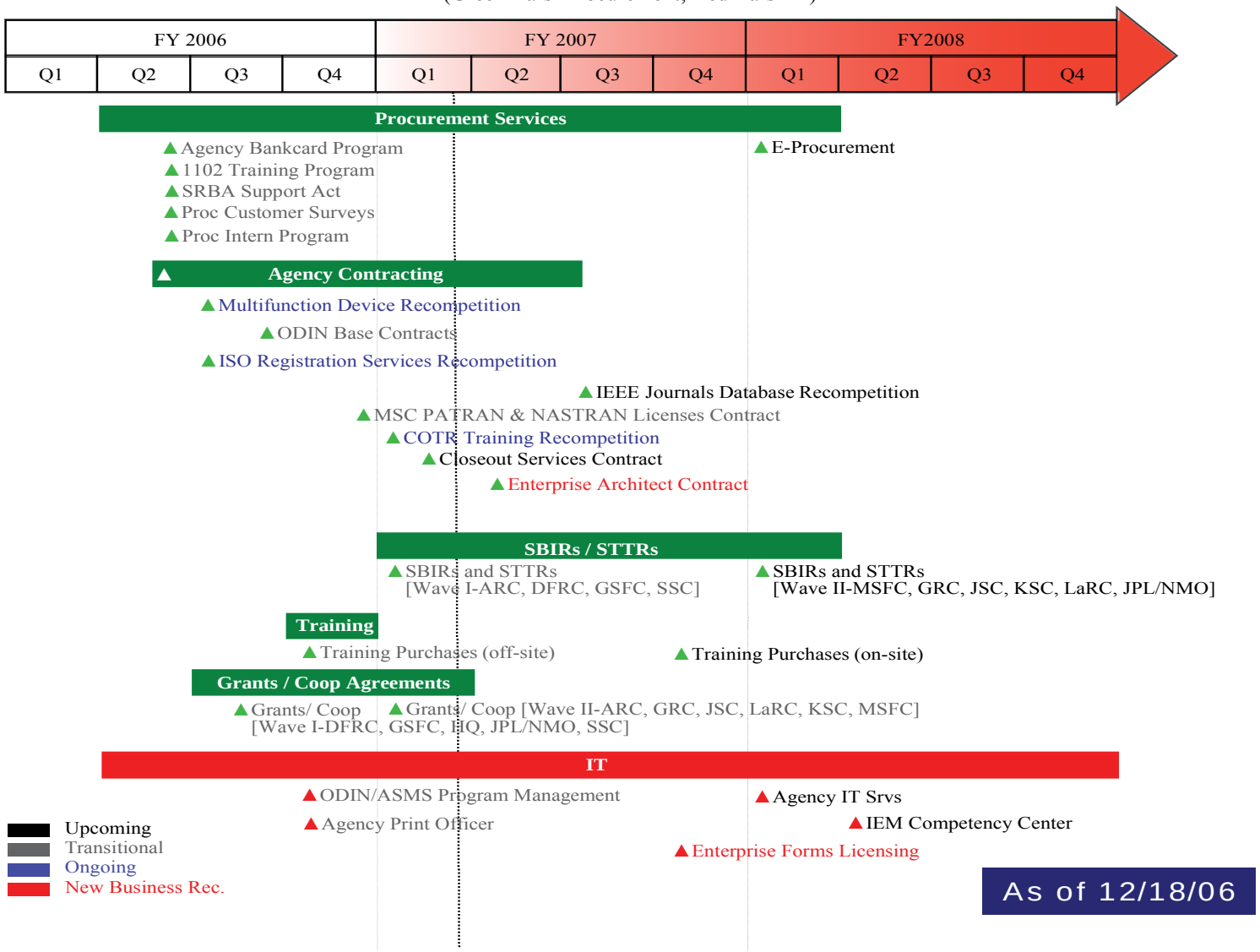
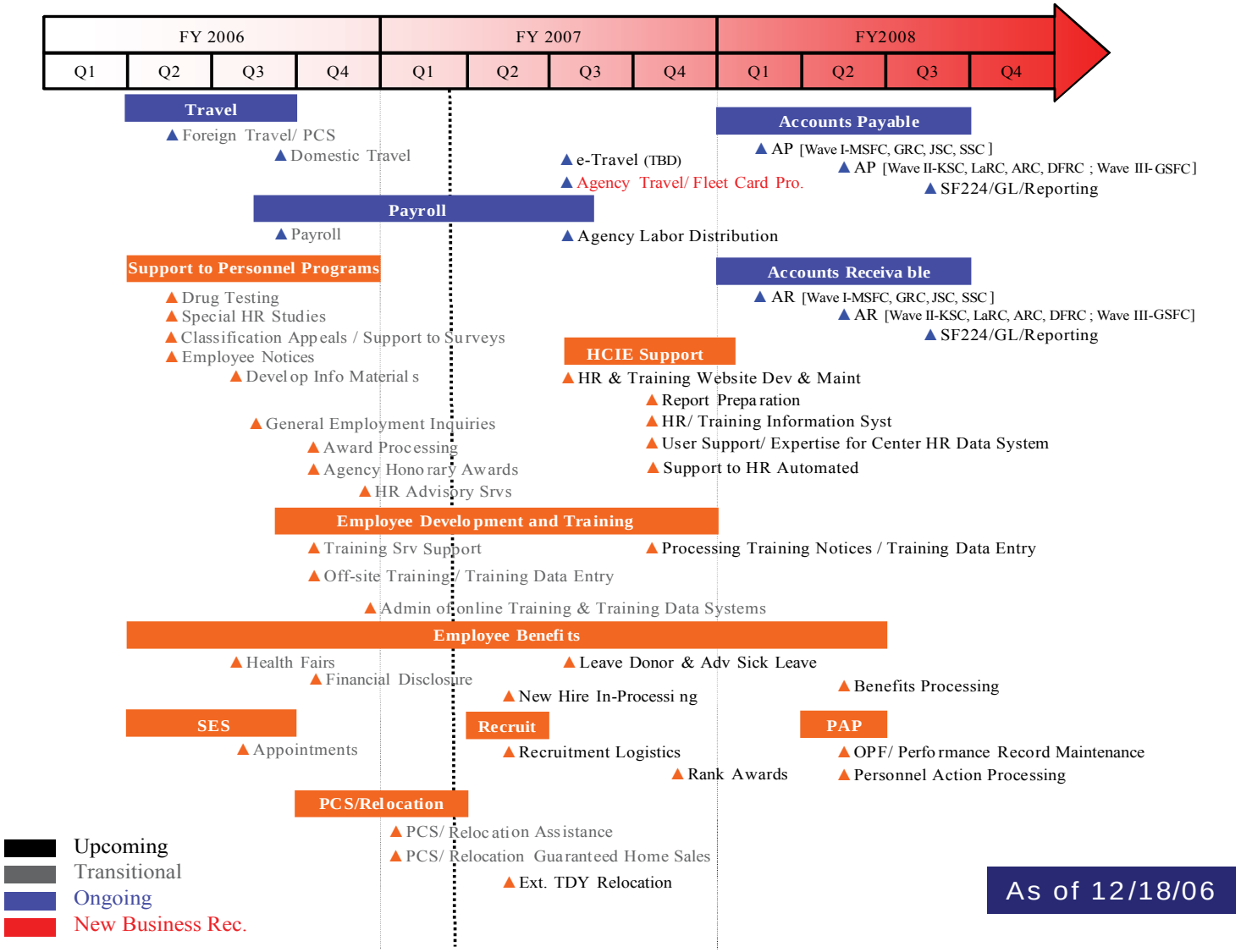


Figure 2
NSSC Transition Schedule for Finance and Human Resources
(Blue Bars=Finance;Orange Bars=Human Resources)



The Forest Service is implementing an even more aggressive consolidation of human resources services. In November 2006, it opened a central human capital management office in Albuquerque, New Mexico, with agency officials expecting the number of human resource employees in Albuquerque to jump from 109 to 360 by September 2007. This new human resources center will serve the vast majority of the Forest Service's employees (39,000). The consolidation means that many human resource employees scattered around the country will either lose their jobs or transfer to Albuquerque; the agency will not backfill all current positions, as it believes some are redundant. Forest Service budget documents estimate that this consolidation will save $22 million a year.[2]

A-3. NASA PHYSICAL INFRASTRUCTURE

NASA asked the Panel to identify the key components of a healthy center and propose requisite metrics. In response, the Panel developed a comprehensive Healthy Centers Framework—with twelve critical factors, key success elements, and metrics—which was presented in Chapter III of Volume 1. Infrastructure is one of the twelve critical factors; it covers underlying administrative support systems such as information management and finance, as well as the condition of a center's facilities. Table 1 presents data collected by NASA's Facilities Engineering and Real Property Division in 2006 on a variety of areas that are important indicators of the health of a center's physical infrastructure.

Table 1
Physical Infrastructure Metrics for the Ten Field Centers

Center	Count Active	Book Value Active ($M)	2005 CRV Active ($M)	Book Value Inactive ($M)	2005 CRV In-Active ($M)	Count Inactive	Total Count Active and Inactive	Total Book Value ($M) Active and Inactive	Total CRV ($M) Active and Inactive
Ames	265	441	1,996	527	1,845	237	502	968	3,841
Dryden	203	164	283	0	0	5	208	164	283
Glenn	367	660	2,411	24	218	67	434	684	2,629
Goddard	773	636	1,671	9	34	102	875	645	1,705
JPL	448	577	1,200	28	44	27	475	605	1,243
Johnson	649	639	1,802	0	1	5	654	639	1,803
Kennedy	809	1,548	4,401	27	83	47	856	1,575	4,484
Langley	360	832	2,489	34	208	25	385	866	2,697
Marshall	563	664	2,445	63	255	39	602	727	2,700
Stennis	221	526	1,700	53	159	27	248	579	1,859
Total	**4658**	**6,688**	**20,398**	**765**	**2,847**	**581**	**5,239**	**7,453**	**23,245**

Note: The calculation of total current value for Johnson includes the White Sands Testing Facility; Marshall includes the Michoud Assembly Facility; and Goddard includes the Wallops Flight Facility.

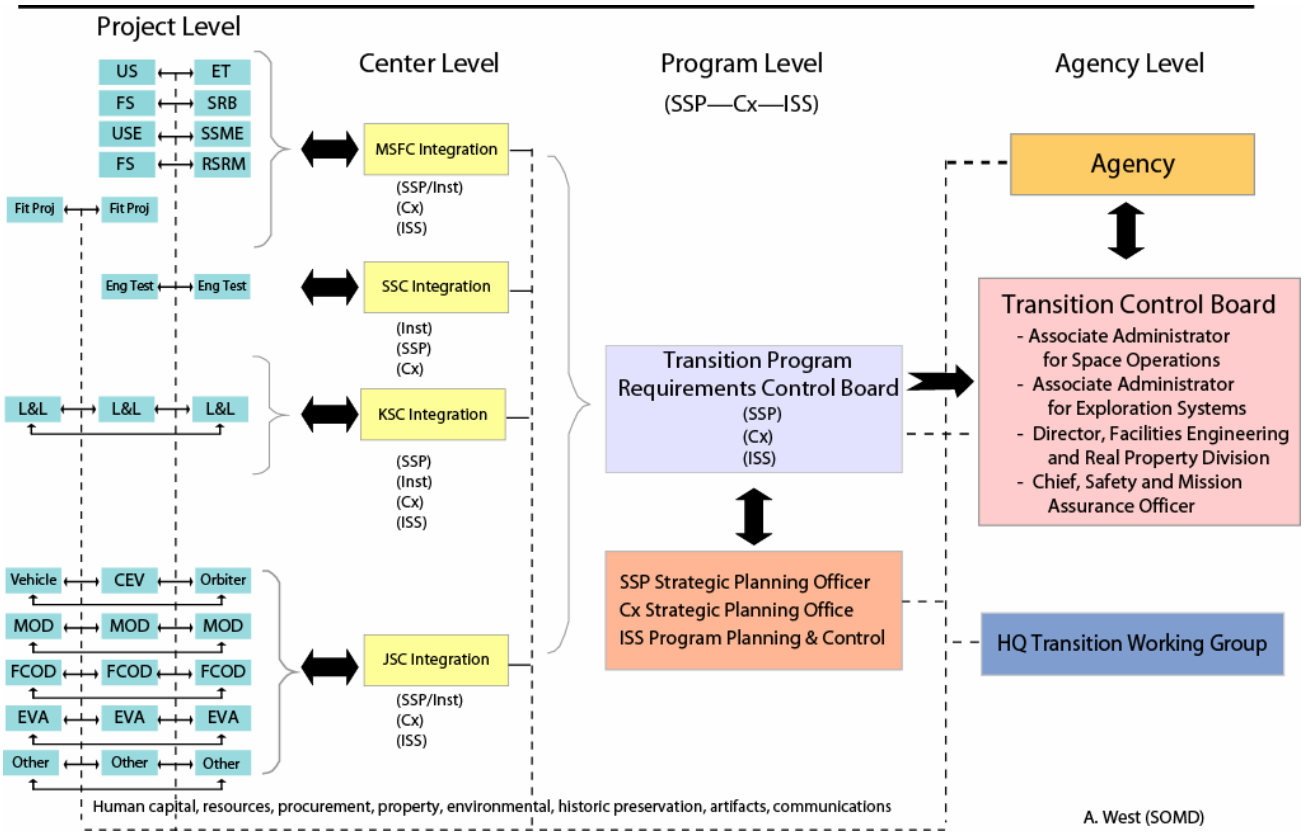
Source: NASA Facilities Engineering and Real Property Division

[2] "Forest Service Moves Hundreds of Human Resources Jobs to New Mexico," Government Executive (November 2, 2006). See http://www.govexec.com/dailyfed/1106/110206r1.htm

A-4. NASA SHUTTLE TRANSITION PROCESS FLOW

As discussed in Chapter II of Volume 1, NASA has established a process to facilitate the phase-out of the Shuttle Program and the transition of needed assets to Constellation. Figure 3 documents the process by which decisions are made about how Shuttle assets will be transferred to Constellation or phased-out altogether.

Figure 3
Shuttle Transition Process Flow and Participants



Source: NASA

A-5. NASA EDUCATION PROGRAMS

As discussed in Chapter VII of Volume 1, NASA's Office of Education manages a wide range of programs intended to contribute to national efforts to achieve excellence in science, technology, engineering, and mathematics education. This appendix presents a listing of these education programs, which are designed to:

- Build a diverse pipeline of science and engineering talent to serve in the coming decades and continue America's preeminence in space and aeronautics research and development

- Fill the agency's workforce needs by linking program participation to NASA workforce requirements

NASA's programs for elementary and secondary students include:

- **Dropping in a Microgravity Environment (DIME)** is a NASA competition that allows teams of students to design and build a science experience that will then be operated in a NASA microgravity drop tower facility.

- **International Space Station EarthKAM** is a NASA-sponsored education program enabling thousands of students to photographically examine Earth from the unique perspective of space.

- **MATHCOUNTS** is the national math coaching and competition program for 7th and 8th grade students.

- **Educational Flight Projects Office at Wallops Flight Facility** is a NASA program through which students fly their own experiments on NASA carriers for inspirational hands-on learning activities. Through this program, they become part of the NASA team. The Educational Office offers interface, integration, and verification support, with links to educational content that encourages students to pursue course work and careers in technical fields.

- **The Great Moonbuggy Race** is a national competition that allows high school students and undergraduates to apply engineering principles while expanding their awareness of space flight.

NASA's higher education programs include the Minority University Research and Education Program, which fosters the research and development capabilities of minority-serving universities.

NASA's Internships and Cooperative Education programs include:

- **Achieving Competency in Careers in Engineering and Space Science (ACCESS)** is an on-site summer work program for undergraduate and graduate students with disabilities majoring in engineering, science, mathematics, or computer science.

- **NASA Contracting Intern Program** is designed to prepare students for their careers in the federal government.

- **NASA Scholars** provides individualized needs-based scholars and fellowships at minority-serving institutions.

- **NASA Student Job Opportunities** is a program designed to combine academic studies with on-the-job training and experience, providing students an opportunity to work with the agency while completing their education.

- **New Opportunities Through Minority Initiatives in Space Science** is a program designed to encourage minority students, especially of Hawaiian ancestry, to engage in learning about culture and its relevance to the study of space science.

- **Program to Increase the Pursuit of Education and Learning in Engineering and Science** provides paid, on-site internships for ethnic minority students and faculty in engineering, science, mathematics, and computer science.

- **Society for Hispanic Professional Engineers' Opportunity to Enhance Outstanding Researchers in Engineering and Science** provides on-site, paid internships and scholarships for Hispanic students studying the fields of engineering, mathematics, and science at Hispanic serving institutions.

NASA's scholarship and fellowship programs include:

- **Harriett G. Jenkins Pre-Doctoral Fellowship Program** provides support for full-time graduate students belonging to groups that have been historically underrepresented in science, technology, and engineering.

- **NASA Earth System Science Graduate Student Fellowship Program** provides fellowships to students pursuing Masters of Science or Doctoral degrees in Earth System Science. The goal of the program is to ensure continued training of interdisciplinary science and to support the study of the Earth as a system.

- **National Consortium for Graduate Degrees for Minorities in Engineering and Science, Inc. Fellowship** is a program to assist underrepresented minority students in obtaining Masters of Science degrees in engineering and the natural and physical sciences.

- **National Space Grant College and Fellowship Program** funds research, education, and service projects through a national network of 52 university-based Space Grant consortia.

- **Space Science Engineering Scholars Program** is designed to build a pool of engineers to support the Space Flight strategic enterprise.

NASA's research programs include:

- **The Graduate Student Researchers Program** offers competitive fellowships to American citizens pursuing graduate degrees at U.S. accredited universities in areas of science and engineering that support the NASA research and development mission.

- **The National Space Grant College and Fellowship Program** contributes to the nation's science enterprise by funding research, education, and service projects through a national network of 52 university-based Space Grant consortia.

- **The Resident Research Associateship Program** is a national competition for doctoral and post-doctoral level scientists and engineers to become guest investigators at NASA field centers.

- **Students Training for Achievement in Research Based on Analytical Space-Science Experience** is a program to involve motivated high school and college students and direct and indirect participants in the research of space scientists and space-based astrophysical research.

- **The Undergraduate Student Award for Research** is a program to enhance enrollment and retention in disciplines relevant to NASA's mission by providing financial aid and support services at designated minority institutions.

- **The Undergraduate Student Researchers Program** is an on-site mentored research experience open to full-time rising undergraduates and high school seniors.

- **Women in Science and Engineering Research** is a program for women in their first year of undergraduate studies designed to help retain them in the traditionally male-dominated fields of science and engineering.

To recruit fresh-out technical and professional talent into the agency as employees, NASA has made extensive use of the **Student Employment Program (Student Career Experience Program or Co-op)**, which provides paid work experiences for undergraduate and graduate students at cooperating colleges and universities. Students may work part-time while attending school part-time or attend school full time, alternating with periods of full-time work. The SCEP also provides non-competitive conversion to a term or permanent position. NASA uses its Cooperative Education Program more extensively than many other federal agencies, and it is the agency's primary feeder mechanism for hiring fresh-outs. Like other federal agencies, NASA can also use the **Student Temporary Employment Program** to hire high school or college students for temporary one-year appointments that are renewable based on their academic achievement and the agency's requirements. While the Student Career Experience Program is an ongoing cooperative educational program that may lead to permanent NASA employment, the STEP program is solely a temporary employment program. NASA also participates in the **Presidential Management Fellows Program** and the **Federal Career Intern Program**.

A-6. NASA HIRING FREEZES

As discussed in Chapter I of Volume 1, NASA has used freezes, with varying parameters and geographic boundaries, to adapt its workforce to changing budget and mission circumstances. This appendix presents background information on the use of NASA freezes since the early 1990s.

From 1993 through 2006, NASA hired a total of 4,685 new employees and converted an additional 2,659 individuals, mostly from cooperative education and other types of non-permanent appointments. Hiring rates, however, have varied dramatically from year to year. NASA only hired 41 new employees in 1996, for example, whereas it hired over eighteen times as many new employees (a total of 754) just four years later. Examples of NASA freezes and those more broadly imposed over the course of the last several years include:

- **A July 2006 hiring limitation** was imposed as part of budget instructions on Glenn, Langley, Goddard, and Ames; the restriction, still in force, allows these centers to hire to replace only one new employee for every three that depart, with quarterly reviews by headquarters of progress in reaching FY 2009 funding levels.[3]

- **A total hiring freeze, imposed by the Associate Administrator on October 19, 2005, for three months following the Headquarters Institutional Requirements Review**.[4] The primary purpose of this freeze was to help NASA address uncovered capacity and better plan for the *Vision.* The agency granted exceptions for critical hires. The freeze ended in January 2006, when the agency gave out new FTE ceilings to the centers, thus allowing them to manage their own hiring. Centers with excess capacity therefore had to continue to limit their hiring. The FTE ceilings remain in place until work assignments for the *Vision* are complete and the agency addresses all skill gaps and other human capital issues.

- **A Jet Propulsion Lab outside hiring freeze in 2005**[5]

- **A government-wide freeze, initiated in January 2001** at the beginning of the Bush Administration, included NASA. OMB imposed an immediate freeze on all agencies. Agencies were required to report existing hiring commitments, which they were allowed to honor. NASA had 297 commitments at that time. Exceptions in other circumstances were also permitted. By mid-February 2001, NASA requested and OMB approved 344 hires in three exception categories. Because of additional bureaucratic layers for approval, many of these hires were somewhat delayed.

- **From 1993 to 2000**, all ten centers had hiring limitations and used a combination of restricted hiring and provided incentives for attrition to meet downsizing targets without resorting to a RIF.

Quarterly hiring data over the last 14 years reflects the fact that some centers have felt the impact of hiring restrictions more severely than others, with several centers going for multiple consecutive quarters without an outside hire. For example:

- Langley Research Center (LaRC) had no outside hires for two successive quarters during 1993, 1998, 2005, and most recently in 2006.

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[3] See June 13, 2006 testimony of IFPTE official Gregory Juneman, as delivered by Lee Stone, before the House Subcommittee on Space and Aeronautics. On page 5, IFPTE officials note that of the 403 new full-time permanent employees hired since the start of FY 2005, only 22 percent or 90 were scientists or engineers, while 74 percent or 299 were non-clerical administrative. This official equates recent agency hiring limitations, and particularly those at the centers with uncovered capacity, to the equivalent of a hiring freeze for most technical and scientific positions.

[4] Internal NASA memorandum from Associate Administrator Rex Geveden to NASA Center Directors, "Freeze on Center Hiring," October 19, 2005, available at http://www.spaceref.com/news/viewsr.html?pid=18442 Critical hiring exceptions required approval of Associate Administrator.

[5] On September 7, 2005, JPL leaders also announced that, due to NASA's need to rebalance the mix of space science missions, JPL would reduce its FFRDC workforce by 5 percent, in addition to the previously imposed and continuing freeze. See http://www.spaceref.com/news/viewsr.html?pid=18289

- Glenn Research Center (GRC) had four successive quarters from 1995-1996 when it brought in no outside hires.

- Marshall Space Flight Center (MSFC) experienced lulls during 1993, when it hired no one from the outside for three consecutive quarters, and again for two consecutive quarters in 1996 and in 1997. In 2005 and 2006, MSFC hired no one from the outside for four consecutive quarters.

- Kennedy Space Center (KSC) ceased outside hires for five consecutive quarters during 1995-1996 and again for two consecutive quarters in 1997 and most recently in 2006.

A-7. PROJECTED YEAR-BY-YEAR FTE TREND OF NASA WORKFORCE (2005-2011)

As discussed throughout Volume 1, especially in Chapter VII, NASA faces a significant challenge in restructuring its civil service workforce due to the restrictions of Title 5. Unlike private organizations, federal organizations governed by Title 5 are limited in their ability to influence turnover and manage attrition. NASA will have difficulty bringing in significant numbers of civil servants with new competencies if existing employees with unneeded competencies do not leave voluntarily. What makes this an even more difficult problem is the expectation that NASA's overall civil service FTE allocation between FY 2006 and 2011 will decline by over 9 percent, as shown in Table 2.

Table 2
NASA's Projected FTE Levels

	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
Ames	1380	1284	1193	1070	1070	1070	1070
Dryden	524	488	488	488	488	488	488
Glenn	1821	1700	1562	1428	1428	1428	1428
Goddard	3303	3332	3223	3223	3223	3223	3223
Johnson	3126	3237	3262	3262	3262	3172	2905
Kennedy	1981	2082	2107	2107	2107	2107	1902
Langley	2130	1963	1839	1749	1749	1749	1749
Marshall	2668	2600	2600	2600	2600	2500	2400
Stennis	294	284	284	284	284	284	284
HQ	1397	1390	1300	1300	1300	1300	1300
NSSC		50	121	146	157	159	159
Total	**18624**	**18410**	**17979**	**17657**	**17668**	**17480**	**16908**

(Note: In this table, "HQ" is the acronym for NASA Headquarters, while "NSSC" is the acronym for the NASA Shared Services Center.)

Source: *NASA Workforce Strategy* (February 2006)

A-8. EMPLOYMENT BY AGE AND OCCUPATIONAL GROUP: 40 TO 49, 50 TO 59, AND 60 TO 69

As discussed in Chapter I of Volume 1, the NASA civil service workforce has a skewed age distribution, with the mean age continuing to rise over time. Between 1994 and 2007, for example, NASA's total number of civil servants between the ages of 20 and 29 declined by 8.9 percent, with those between 30 and 39 declining by 14.2 percent. Over this same period, the total number of civil servants between the ages of 40 and 69 grew, as shown in Table 3 below.

Table 3
Comparison of NASA Occupational Age Distribution for Three Decades
FY 1994 vs. FY 2007[6]

Age Group 40-49

Occupational Category	FY 1994			FY 2007			Percentage Point Change from 1994 to 2007
	Total Occupational Population	Employees	%*	Total Occupational Population	Employees	%	
Science and Engineering	13,317	2,498	18.8%	10,007	4,688	46.8%	+28
Professional and Administrative	4,712	1,649	35%	4,677	1,672	35.7%	+.7
Clerical	2,597	749	28.8%	835	251	30.1.%	+1.3
GS Technical	2,420	770	31.8%	1,154	429	37.2%	+5.4
Wage Grade	649	214	33%	31	7	22.6	-10.4
All Employees	**23,695**	**5,880**	**24.8%**	**16,704**	**7,047**	**42.2%**	**+17.4**

** Percent of Occupational Category*

Age Group 50-59

Occupational Category	FY 1994			FY 2007			Percentage Point Change from 1994 to 2007
	Total Occupational Population	Employees	%*	Total Occupational Population	Employees	%	
Science and Engineering	13,317	3,755	28.2%	10,007	2,467	24.7%	-3.5
Professional and Administrative	4,712	1,188	25.3%	4,677	1,732	37%	+11.7
Clerical	2,597	578	22.3%	835	293	35.1%	+12.8
GS Technical	2,420	677	28%	1,154	528	45.8%	+17.8
Wage Grade	649	127	19.6%	31	20	64.5%	+44.9
All Employees	**23,695**	**6,325**	**26.7%**	**16,704**	**5,040**	**30.2%**	**+3.5**

** Percent of Occupational Category*

[6] Figures reflect data from the start of FY 1994 and, for FY 2007, for data collected on September 16, 2006.

Age Group 60-69

Occupational Category	FY 1994			FY 2007			Percentage Point Change from 1994 to 2007
	Total Occupational Population	Employees	%*	Total Occupational Population	Employees	%	
Science and Engineering	13,317	956	7.2%	10,007	917	9.2%	+2
Professional and Administrative	4,712	332	7%	4,677	362	7.8%	+.8
Clerical	2,597	145	5.6%	835	114	13.7%	+8.1
GS Technical	2,420	189	7.8%	1,154	90	7.8%	0
Wage Grade	649	27	4.2%	31	3	9.7%	+5.5
All Employees	**23,695**	**1,649**	**7%**	**16,704**	**1,486**	**8.9%**	**+1.9**

** Percent of Occupational Category*

A-9. NASA TERM HIRES STATISTICAL INFORMATION

As discussed at various points in Volume 1, especially in Chapters V and VI, the NASA Flexibilities Act of 2004 provided the agency with expanded authority to hire and convert term employees. Specifically, NASA can hire term employees for up to six years and convert them to permanent positions without a second round of competition as long as they were competitively selected for the initial term appointment. Table 4 presents data compiled by NASA on term hires, by occupation, between FY 1993 and FY 2006.

Table 4
Term Hires by Occupation, FY 1993 - 2006

Fiscal Year	Scientists & Engineers	Professional Administrative	Clerical	GS Technician	Wage Grade	TOTAL
FY 1993	3	0	18	0	0	21
FY 1994	4	6	9	0	0	19
FY 1995	2	1	10	1	0	14
FY 1996	12	11	25	0	1	49
FY 1997	129	30	50	4	2	215
FY 1998	76	51	59	4	0	190
FY 1999	31	15	30	6	0	82
FY 2000	40	14	27	1	0	82
FY 2001	41	18	19	0	0	78
FY 2002	14	25	9	0	0	48
FY 2003	27	91	28	6	0	152
FY 2004	212	79	21	8	0	320
FY 2005	174	77	0	15	3	269
FY 2006	92	44	0	5	0	141

Source: NASA Office of Human Capital Management

A-10. NASA COMPLAINT AND PERFORMANCE DATA

As part of the Panel's development of its Healthy Centers Framework, the study team gathered basic human capital and complaint data from each center and headquarters. The Healthy Centers Framework can be found in Chapter III of Volume 1.

Equal Employment Opportunity (EEO) and Other Complaints

Under the critical factor of "civil service workforce," the Healthy Centers Framework includes such metrics as the number of EEO complaints, grievances, and unfair labor practices filed at a center. Such data can provide significant insight into employee morale as well as point to potential impacts on productivity and organizational climate. The Department of Veterans Affairs, for example, estimates that it saves at least $50,000 for each complaint or grievance

preempted because doing so avoids the costs of counseling, investigation, reporting, and mediation, as well as the total time taken away from directly supporting the mission. The Equal Employment Opportunity Commission estimates the total cost of processing an EEO complaint from pre-complaint counseling to litigation at between $162,390 and $310,390.[7] As is typically the case, organizations under the threat of potential RIF or budget cuts tend to experience higher rates of complaints than those in stable budgetary situations.

For these reasons, data on complaint levels can be an important indicator to consider in evaluating center health. As part of its annual evaluation of center health, the agency may wish to determine the underlying causes of cross-center variances in complaint levels and determine the appropriate level of investment to reduce the complaint volume. Table 5 provides information on EEO and complaint data over a six-year period, from FY 2001 – FY 2006, for headquarters and each center.

Table 5
Summary of NASA Component EEO/Complaint Activity
(FY 2001- FY 2006)

Organization	EEO Discrimination Complaints[8]	Employee Grievances[9]	Unfair Labor Practice Charges[10]	Total Activity
Ames	22	124	9	155
Dryden	14	10	2	26
Glenn	26	84	17	127
Goddard	55	35	1	91
Johnson/	18	19	0	37
Kennedy	28	14	0	42
Langley	25	5	2	32
Marshall	57	6	2	65
Stennis	4	1	NA[11]	5
Headquarters	51	7	0	58
TOTAL	300	305	33	638

Under provision of the No Fear Act of 2002, federal agencies must post detailed information on the number of complaints received annually. When evaluating center health, NASA may wish to compare its performance to other federal agencies of similar size. From 2001 to 2006, NASA had 160 fewer EEO/Discrimination complaints than the Environmental Protection Agency and 54 fewer complaints than the National Institutes of Health.

[7] National Academy of Public Administration, *Action Plan to Achieve a Diverse Workforce*, December 2005, pp. 32-33.
[8] Source: NASA No Fear Act web site.
[9] Employee grievances include both individual and union grievances. Grievance numbers are based on calendar year.
[10] Unfair Labor Practices include both those filed by labor organizations against NASA and those filed by NASA against labor organizations.
[11] Stennis does not have any organized labor unions.

Performance Management/ Disciplinary Actions

Under the critical factor of "civil service workforce," the Healthy Centers Framework includes such metrics as the distribution of performance ratings, the distribution of monetary awards, and the distribution of honorary awards. Over the course of this study, NASA headquarters and center officials said the agency is paying increasing attention to performance management, with a particular focus on documenting poor work performance and developing strategies to help individuals improve. Given this increased emphasis, the study team gathered information from the operating human resource offices on four key indicators for each year during the period from FY 2001- FY 2006. Table 6 summarizes this data for the nine civil service-based centers and headquarters:

Table 6
Performance Management/Disciplinary Actions:
Summary of NASA Component Actions
(FY 2001- FY 2006)

Organization (total actions)	Probationary Discharge	Denial of Within Grade Increase	Removal	Resignation or Retirement in Lieu of Adverse Action
Ames (47)	3	2	4	38
Dryden (9)	1	5	3	0
Glenn (4)	1	1	0	2
Goddard (36)	2	6	11	17
Johnson (51)	6	1	10	34
Kennedy (7)	0	0	3	4
Langley (17)	1	0	6	10
Marshall (21)	0	15	2	4
Stennis (21)	0	1	0	20
Headquarters (27)	6	0	5	16
TOTAL (240)	**20**	**31**	**44**	**145**

As NASA evaluates center health, it may wish to explore the nature of center variances and determine their relationship to such possible factors as recruitment practices; increased management attention at certain centers to performance and conduct issues; strength of the local employee relations and/or legal staff; local emphasis on coaching, performance improvement, and/ or career counseling; or possible deficiencies in employee supervision or training. It may also wish to compare these statistics to those of other federal agencies, especially with regard to probationary discharges and removals:

- **Probationary discharges**, when appropriately utilized, can be an effective and lower cost means of removing poor performers. Managers have more flexibility in removing probationary employees, as they do not—prior to one full year of service—have the procedural protections granted to permanent employees. In FY 2001 and 2002, OPM found that just over three percent (under 5,000) of the federal government's 145,000 new

hires were terminated during their probationary period. The U.S. Patent and Trademark Office—which has highly quantifiable work and a strong work measurement system—has one of the highest probationary discharge rates in the federal government, terminating 5.7 percent during their probationary period[12]. NASA had 20 probationary discharges from FY 2001–FY 2006, during which it hired some 3,646 permanent full-time employees. While some of the reported discharges may have been for term hires with appointments in excess of one year, and that level of detail was not available to the study team, at most the probationary discharge rate for NASA was .55 percent of hires.

- **Removal of permanent employees** is the most procedurally demanding process. From FY 2001 to FY 2006, NASA removed 44 employees, or an average of 7.3 per year. At an average employee population of 17,000, this would equate to an average annual removal rate of .043 percent. During this same six-year period, the agency had 145 employees either retire or resign in lieu of adverse action; agency statistics do not capture these in lieu of actions as removals. As a point of comparison, the Centers for Disease Control had a removal rate for FY 2002 of .09 percent.

Table 7 shows activity by fiscal year in these various areas.

Table 7
NASA Performance Management and Employee Relations Activity
(FY 2001-2006)

Fiscal Year (total actions)	Probationary Discharge	Denial WIG	Removal	Resignation/Retirement in Lieu of Adverse Action
FY 2001 (20)	1	2	4	13
FY 2002 (51)	6	3	10	32
FY 2003 (34)	5	5	10	14
FY 2004 (47)	3	9	5	30
FY 2005 (46)	3	3	10	30
FY 2006 (40)	2	9	5	26
TOTAL (240)	**20**	**31**	**44**	**145**

A-11. FALL 2006 OHCM NEW APPROACH TO WORKFORCE PLANNING

As discussed in Chapter II of Volume 1, the NASA Office of Human Capital Management is revising its workforce planning process to formally establish the following key components:

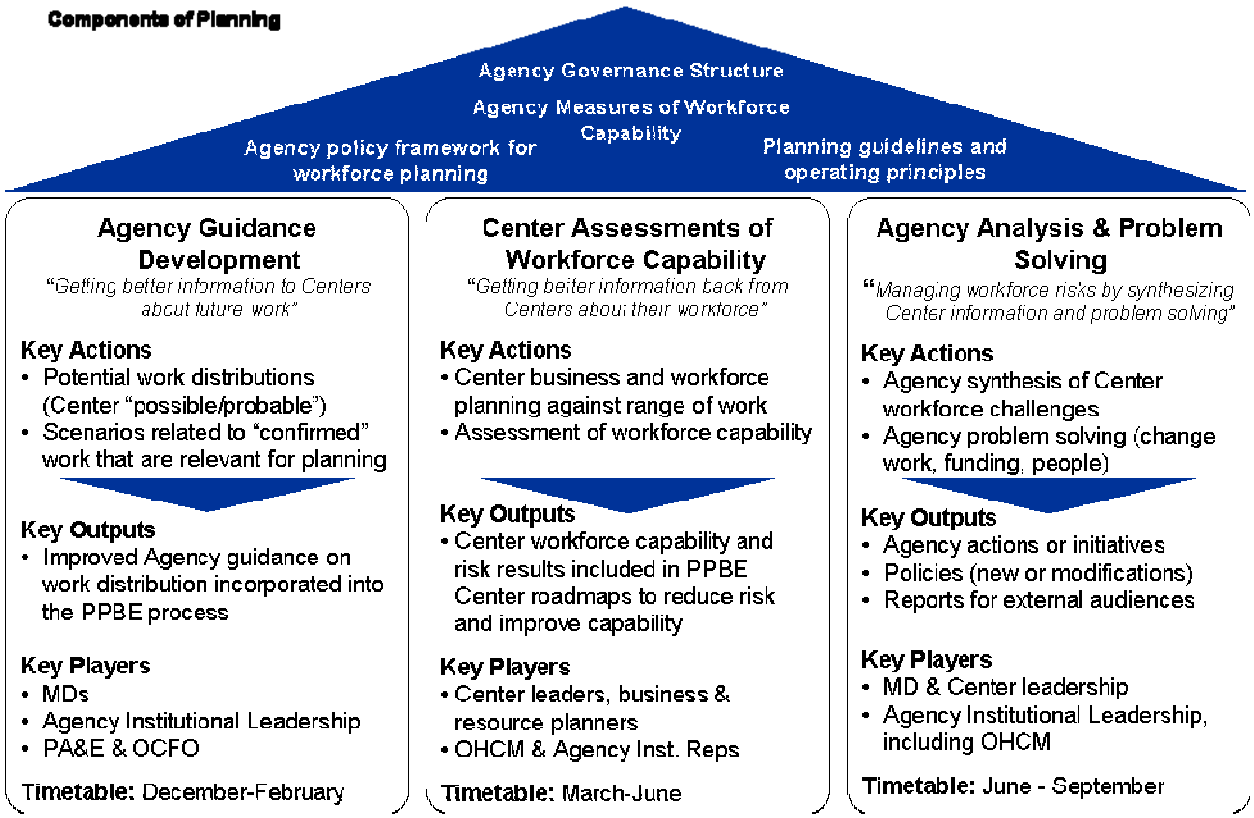
- Agency Guidance Development
- Center Assessments of Workforce Capability

[12] National Academy of Public Administration, *U.S. Patent and Trademark Office: Transforming to Meet the Challenges of the 21st Century,* August 2005, p. 110.

- Agency Analysis and Problem Solving

Figure 4 depicts this new process.

Figure 4
New NASA Workforce Planning Process

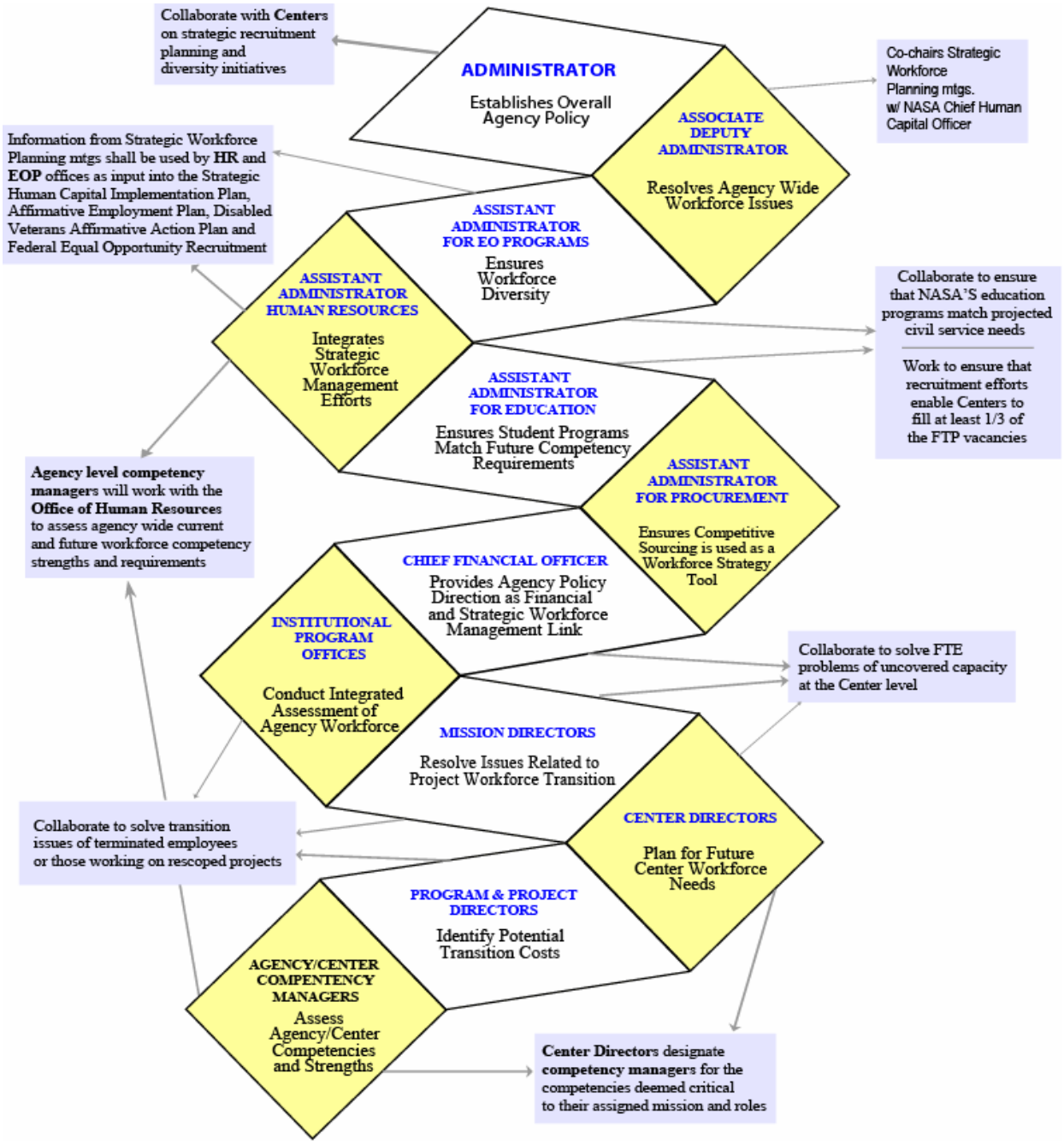


Source: NASA Office of Human Management

A-12. NASA STRATEGIC WORKFORCE MANAGEMENT PROCESS

As discussed in Chapter V of Volume 1, NASA Procedural Requirement 3010 establishes the agency's strategic workforce management process. Figure 5 is a visual depiction of the agency's process, as developed by the Panel and study team.

Figure 5
NASA Strategic Workforce Processes



APPENDIX B

CENTER FIELD VISIT SUMMARY

B-1: LESSONS LEARNED DISCUSSION

Between June and November 2006, representatives of the Panel and study team visited eight of NASA's ten field centers, in the following order:

- Goddard Space Flight Center
- Ames Research Center
- Johnson Space Center
- Glenn Research Center
- Marshall Space Flight Center
- Langley Research Center
- Kennedy Space Center
- Jet Propulsion Laboratory

NASA and the Academy and the agency jointly agreed that it would be unrealistic to visit every center and that the Academy would not visit Dryden or Stennis, but would conduct background research on all ten centers relevant to the Ten Healthy Centers task. This research was incorporated into Volume 1, Chapter III.

The team has compiled key insights from each of the field visits that provide a snapshot of the center's existing and projected situation *at the time of the field visit*. Because NASA's programmatic and budgetary plans continued to evolve significantly over 2006, the concerns of each center and some of their challenges varied throughout the year. In particular, as the implications of the Constellation work packages became clearer, some initial concerns about uncovered capacity began to dissipate.

Goddard Space Flight Center

The team visited Goddard Space Flight Center in June 2006. Established in May 1959 as the first NASA Space Flight Center, Goddard is a major national laboratory for unmanned scientific spacecraft and manages several of NASA's missions in the areas of earth observation, astronomy and space physics. Its mission is to "expand knowledge of the Earth and its environment, the Solar System, and the universe through observations in space" through such major programs as the Hubble Space Telescope, the Explorer Program, the Discovery Program, and the Earth

Observing System.[13] Goddard manages unmanned earth observation missions and observatories in Earth orbit, while the Jet Propulsion Laboratory manages unmanned planetary missions.

Goddard officials identified their main mission and core competencies as executing complex space-based scientific missions from end-to-end. Center officials believe that these core competencies serve as the foundation for their role in the preservation of U.S. leadership in science, engineering, and technology. They expressed concerns that they are not going to be allocated a major program for the Vision for Space Exploration. Although the agency-wide hiring freeze in early 2006 had been lifted by June, centers were able to maintain their own controls, with the Goddard Associate Director evaluating every hiring action at the center. Even with such close monitoring, center officials said that their uncovered capacity would not be completely resolved by attrition and hiring restrictions.

Goddard has historically relied on contractors to augment civil service skills across a wide range of disciplines in response to changing mission demands. The center structures contracts to allow for variability in usage. In some cases, center officials have found that ceiling constraints had eroded civil service competencies, so continued reliance on existing contractors has been essential for mission success. They have also determined that it is either undesirable or difficult to shift large blocks of commercially available work back to civil servants (for example, engineering technicians).

Goddard told the team that it was planning to manage its uncovered capacity as follows:

- Determine the feasibility and appropriateness of shifting individual work assignments from contractors to civil servants. In FY 2006, Goddard's work shifts impacted about 200 contractor positions. The center was examining the possibility of additional shifts in FY 2007. Most work assignment shifts are initiated by the branch manager, who is the manager closest to the work and most knowledgeable about civil servant and on-site contractor capabilities.

- Check with each directorate to assess vacancies that may be appropriately filled with the skills of uncovered employees.

- Although Goddard officials reported that only a small portion of uncovered employees had skills that would simply not be needed in the future, they acknowledged the need for managers to identify these and take appropriate actions, such as aggressive retraining or, if appropriate, performance counseling.

- Aggressively pursue new exploration work opportunities, along with seeking work from sources outside NASA.

- Participate in all buyout opportunities for non-critical skills

- Maintain hiring controls to ensure backfills are for critical skills only

[13] This is the central component of the agency's Earth Science Enterprise.

Goddard's FTE ceiling through FY 2012 will decline slightly from 3,373 FTE in FY 2006 to 3,321 FTE in FY 2007. Center management strongly supports the use of term appointments. Goddard's Applied Engineering and Technology Directorate, for example, was only hiring term appointees for all fresh-out and student positions, and increasingly for other employees. Across the center, terms are now approximately 10 percent of the civil service workforce. They have been used in a variety of ways: as a short-term backfill for vacancies resulting from the NASA Shared Services Center to feeders for permanent hiring in science and engineering.

Center officials identified two needed workforce planning improvements. First, the center needs tools to do more real-time workforce management. The annual planning process is not linked to personnel systems, and the data gets out-of-date quickly. Second, the center needs more stability in the research and development budgets in order to improve long-term skills management. It is difficult to adjust the civil service workforce in very short-term timeframes.

During the field visit, Goddard officials expressed significant concerns about their center's long-term health. They said that the center has historically had a steady flow of missions—having always had at least two in-house missions—because the science budget was strong and growing. When evaluating themselves based on the criteria listed in NASA's *Workforce Strategy*, they have serious concerns about the current and future health of Goddard and expect to have workforce difficulties (exemplified by uncovered capacity) as early as FY 2007. Contributing to future work picture uncertainty are the following:

- Lack of sustained level of in-house work
- The "Beyond Einstein" program is undefined
- Research and Analysis reduction poses a threat to retaining the scientific workforce
- Lack of a clear role in the Exploration program after the Lunar Reconnaissance Orbiter

Ames Research Center

The team visited Ames Research Center on July 2006. Located in Moffett Federal Airfield, California, Ames was founded in 1939 as the second laboratory of the National Advisory Committee for Aeronautics (NACA), and moved to NASA in 1958. Ames is NASA's lead center for astrobiology and houses the world's largest wind tunnel (decommissioned in 2003). Ames has evolved from an almost total aeronautics center to a more balanced center with competencies the areas of (1) astrobiology, (2) integrated next generation computing systems, (3) intelligent/adaptive systems, (4) entry, descent and landing systems (with the Jet Propulsion Lab and Langley Research Center), and (5) air traffic management systems. As part of its research and technology development role, Ames is the lead center for astrobiology. The center is also active in nanotechnology, aeronautics research, life sciences, space science, fundamental space biology, biotechnology, aerospace and thermal protection systems, and human factors research. In addition, Ames works collaboratively with the Federal Aviation Administration, conducting

research in air traffic management. It engages in information and education outreach, forms collaborative partnerships, and fosters commercial application of NASA technologies.

Ames officials believe their center is one of the nation's premiere research labs for supporting NASA missions. They have created partnerships with leading universities and high-tech industry leaders in Silicon Valley, bringing the science and corporate communities together in efforts to advance human knowledge and explore the unknown. Senior officials emphasized the importance of Ames as a portal for outside organizations to access the agency. Ames has established a NASA Research Park to promote collaborative research, development, and education.

During the field visit, Ames officials told the team that the center had a significant amount of uncovered capacity and expected that to continue for the foreseeable future. Over the past few years, the center has also lost a great deal of contractor capabilities, which has disrupted the productive civil service-contractor partnership historically present at the center. Because the space flight centers make the large program management decisions, Ames officials believe their small center is analogous to a "subcontractor" to the "prime contractors" at Johnson, Kennedy, and Marshall. Given the space operations centers' control of the budgets for their large programs, they are able to determine how many people at Ames work on a given project and when products must be delivered. The team was told that space operations centers often later reduce the total funding for current or expected projects at Ames because the priorities and needs of their center, mission directorate, or Congress have changed. In such cases, Ames no longer has the resources needed to sustain its workforce.

Ames has taken innovative steps to manage its uncovered capacity by establishing a Transitional Workforce. Because the center must pay all of its civil servants, the center's philosophy has been to assign uncovered employees meaningful tasks within an unclassified set of duties. The center has intended for these tasks to be short-term, as well as grade and occupationally appropriate.[14] Ames assigns these individuals to one of four types of tasks: (1) strategic issues, focused on a core investment area for the center; (2) business development; (3) center tasks submitted by the directorates; or (4) short-term tasks. As funded work in their core competencies becomes available, employees are supposed to move off the Transitional Workforce rolls. Human capital officials maintain an updated spreadsheet of all employees uncovered for a portion of their time.

Although the center emphasized that programmatic funding cutbacks in certain areas were the cause of the uncovered workforce, some employees indicated they felt stigmatized by inclusion in the Transitional Workforce.[15] In addition, the team found the center's approach to its uncovered workforce more focused on individual placement within NASA, rather than on

[14] Center officials indicated that some uncovered employees had, nevertheless, filed complaints alleging that assigned transitional work was grade or occupationally inappropriate.

[15] The agency's scientists are expected to bring in enough funds from intramural competitions to cover their salary. In addition, project managers across the center have some discretion in choosing which scientists and engineers go into the Transitional Workforce: because funding is often sufficient to cover some FTE in a given labor category, but not all, managers choose which personnel will be partially or wholly "offloaded" to the Transitional Workforce rolls. Similarly, when new project funding arrives at Ames, managers choose which personnel will be partially or wholly removed from the Transitional Workforce rolls in order to work on the new tasks.

placing individuals outside of NASA or in moving significant blocks to other agencies, such as the U.S. Patent and Trademark Office (USPTO).[16] For example, the agency's "job fair" for the uncovered workforce focused on tasks available within NASA and did not include private industries or other government agencies. Ames is focused on maintaining the current workforce (minus retirements) in case programs/funding are returned, while also working to convince headquarters to establish new programs or reinstate old ones.

Ames identified a number of significant challenges:

- **Stabilizing the workforce in alignment with the *Vision*.** The Constellation program has designated Ames as the lead for development of thermal protection systems and information technology for NASA's exploration effort. It is also leading the development of the Lunar Crater Observation and Sensing Satellite, which will launch with the Lunar Reconnaissance Orbiter in 2008 and crash into the lunar South Pole to search for water ice. Ames officials said they need to know more about their role in the *Vision* to evaluate their center's capabilities and workforce size. Officials also expressed concern about their aging workforce (the average age of 49 is the highest of any NASA center), which is a result of significantly limited hiring in recent years.

- **Receiving program management responsibility.** Officials recognize that the center needs to expand its program and project management skills to meet short-term deliverables. Unfortunately, this creates somewhat of a Catch-22: the center needs seasoned managers to attract projects to Ames, but such managers are difficult to attract or develop without significant projects.

- **Renovating aging facilities.** The average age of facilities at Ames is 42 years, which is the second-oldest agency-wide (only Glenn is higher). Ames essentially "inherited" Air Force base facilities requiring maintenance and attention, even though they add little value to the center's mission. At Ames, the total current replacement value of active and inactive facilities is $3.8 billion. At the same time, the center's Facilities Condition Index[17] is under 4 (approximately 3.7, or fair-to-good), which is the agency-wide average.[18] Ames's deferred maintenance costs are approximately $125 million; four centers (Dryden, Goddard, JPL, and Johnson) are lower.

Prior to the *Vision*, Ames officials said headquarters provided some significant lumps of information technology, science, and aeronautics work. Ames believes, however, that they need an "anchor tenant" (management responsibility for a major NASA program) and have been working with headquarters to be the agency-wide lead for small satellites and spacecrafts. In addition to helping to stabilize the center's workforce, Ames officials believe that the center's unique capabilities in this area would advance the agency's exploration work.

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[16] In April 2006, the Academy study team offered to broker a meeting between senior NASA officials and officials of USPTO to facilitate the discussion of USPTO accepting detailees and transfers from NASA.
[17] The Facilities Condition Index is analyzed on a five point scale, with 1 being "Poor" and 5 being "Very Good."
[18] Only the Jet Propulsion Laboratory, Dryden, and Goddard are higher; the other six centers have worse facilities conditions than Ames.

Johnson Space Center

The team visited Johnson Space Center (JSC) in August 2006. Located in southeast Houston, Texas, and opened in September 1963 as the Manned Space Center, JSC is NASA's lead center for human spaceflight/exploration. It comprises more than 142 buildings on a 1,600-acre site. JSC is one of five NASA centers focusing primarily on space engineering (development) as opposed to aeronautical and scientific research. JSC is the lead center in the design and implementation of the International Space Station (ISS), coordinating the efforts of 16 space-faring nations.[19] The center has also been the home of NASA's Space Shuttle Program for more than 20 years, coordinating and monitoring every crewed NASA mission since Gemini 4 in 1965. The shuttle astronauts train, work, and plan their mission at JSC. Most recently, NASA gave JSC lead management responsibility for the Constellation program to develop the next generation launch vehicles (including Orion, the exploration vehicle).[20]

JSC has a major role in three NASA programs: (1) Shuttle; (2) International Space Station; (3) Constellation. In addition, COTS and the human research program are competing for resources within the center's portfolio. Given the center's FTE allocation cap of 3,236 for FY 2006 and 3,262 in FY 2007, the total mission directorate and program work requests would require approximately 400 additional civil service FTE at Johnson. Accordingly, senior center officials have emphasized the need to be realistic in their commitments. The center is reexamining all work not supporting the programs and is likely to cut research and technical work not supporting Constellation, such as astro-materials research (curation of the moon rocks, objects in space).. Moreover, the center is currently performing a gap analysis in which managers are identifying work they will be unable to do. Officials noted that this is contrary to the center's "can-do" culture. Thus far, they have not identified any skill gaps. Directorates within the center are working to solve short term, tactical issues and to look long-term at strategic issues.

Although JSC is considered one of the healthiest centers, JSC officials believe they face some challenges due to their restrictive civil service FTE limitation. Center officials repeatedly emphasized that the next phase of the ISS will require the most difficult missions to date. Regardless, senior center officials are supportive of the Ten Healthy Centers concept, maintaining that it is appropriate for the mission directorates to identify work that can be shared across other centers. In fact, other centers have significant exploration work: human research programs at other centers comprise 34 percent of the portfolio; CEV work, 46 percent; Constellation work, 78 percent; and Exploration Technology Development work, 82 percent. JSC will work to maintain capabilities to successfully perform shuttle and station programs and will continue to seek efficiencies and improvements. Recognizing that some work otherwise done in Houston will be performed at other centers, JSC is building new processes, including a virtual engineering model, to facilitate the use of services from distant centers.

Despite the commitment of senior leaders, some technical personnel expressed concerns about how Ten Healthy Centers would work in practice. Technical directorates said it would be a

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[19] The International Space Station is a microgravity research platform where astronauts and cosmonauts live and work for months at a time.

[20] "New Crew Exploration Vehicle Named Orion"
See http://www.nasa.gov/mission_pages/exploration/spacecraft/.

major challenge to successfully transfer work to other centers without a negative impact on technical performance, cost, and schedule. They expressed concerns that skills may not be readily available at the other centers and that training of other center personnel will be required. Even if skills are available at the other centers, they said that certifying flight readiness and maintaining the schedule would be major program risks, with cost and technical quality also potential risks. Technical personnel contended that space flight operations are geographically constrained because planning, training, and operations are physically located in Houston. They also expressed some concerns that the transfer of work to other centers could result in skill mismatches within the center's own workforce.

The Center Director has established the "Johnson 2025" initiative, managed by the Office of Advanced Planning. The center recently held a senior staff retreat to help management focus and develop follow-on actions related to 2025 strategic planning. The center is working to determine what core competencies it should sustain, how the center should plan for skill transition, and how it should manage the process. . It is also looking at such broader questions as:

- What long-term changes to the center's organizational structure and governance structure will be needed?
- How should these be transitioned through 2025?
- Who will the center's partners be in the future?
- Does the center have the necessary skills to deal with its international partners, both now and in the future?

Glenn Research Center

The team visited Glenn Research Center in August 2006. Glenn was established in 1942 as part of the National Advisory Committee for Aeronautics (NACA) and was later incorporated into the National Aeronautics and Space Administration (NASA or the "agency") as a laboratory for aircraft engine and propeller research.[21] It is the third oldest NASA center. Glenn is in the process of a major transition from a heavily aeronautics research center to one with a much stronger focus on exploration systems, space flight development, and space operations. It has established a new Space Flight Systems Directorate in response to the PA&E Organizational Readiness Assessment.

During the visit, the center was restructuring its organization to accommodate its changing mission—evolving from a heavily aeronautics research center to one with a much stronger focus on exploration systems, space flight development, and space operations. For example, it had established a new Space Flight Systems Directorate in response to an Organizational Readiness Assessment by the Office of Program Analysis and Evaluation.

[21] It was initially named the Aircraft Engine Research Laboratory and later renamed as the Flight Propulsion Research Laboratory in 1947, the Lewis Flight Propulsion Laboratory in 1948, the NASA Lewis Research Center in 1958, and the NASA John H. Glenn Research Center at Lewis Field in 1999.

Glenn has been undergoing a transformation since 2004. Over the past three years, center officials said they had faced:

- Termination of the Space Launch Initiative (SLI)
- Termination and transformation of many of the mission and science measurement programs
- Refocusing of the biological and physical research work
- Changing scope and schedule of Prometheus
- Transitional agency funding to accommodate FY 2006 workforce impacts due to the SLI termination
- Transformation of the Aeronautics Vehicle Systems Program
- Cessation of direct headquarters funding of core competencies

Despite these obstacles, center officials believed that Glenn's future was looking brighter because the agency had given it significant responsibilities through June 2006 announcements of work to support Constellation, the CEV (service module and spacecraft adapter), and the CLV. Glenn will manage the work on the CEV's service module, which will provide maneuvering with its propulsion system, generate power using solar arrays, and keep the vehicle cool with heat rejection radiators. It will also be the lead for the upper stage of the Crew Launch Vehicle. In areas outside Constellation, Glenn has additional assignments on the International Space Station, the Shuttle, and science. Finally, it was undertaking an aeronautics re-planning exercise expected to yield more in-house aeronautics research.

In other ways, however, Glenn's future remains uncertain and challenging. Before the Constellation work announcement,[22] the center had projected an uncovered capacity of up to 700 FTE. Given the skill demands of the new work, Glenn has a need for significantly fewer FTE in such areas as aeronautics research and space-related research. Glenn identified the successful matching of skills required for future development projects to the relatively static civil servant engineering population as a major challenge. Like the other research centers, it has a high average age because of limited ability to hire: Glenn has more civil servants over the age of 60 than under the age of 30.

To deal with skill mismatches, Glenn has been working to re-deploy and retrain some personnel. It has established the Space Mission Excellence Program to do retraining. The center hopes to train approximately 50 engineers in systems engineering—a skill in short supply across NASA and the aerospace industry as a whole. Other strategies for dealing with the workforce include

[22] Headquarters officials (both HC and PA&E) have now told the study team that there is minimal uncovered capacity at Glenn of approximately 20 – 30 FTE.

attempting to expand reimbursable work and providing additional discipline training for program and project managers, especially in the space flight area.

Given the uncertainties of the past few years, Glenn expressed some wariness about the future and whether NASA's mission could evolve yet again. The center acknowledged that there was little political support for increasing the agency's involvement in aeronautics and seemed pleased that the science budget would likely increase in four years, which would lead to critical partnership opportunities.

Marshall Space Flight Center

The team visited Marshall Space Flight Center in September 2006. Established in July 1960 and formally dedicated as Marshall by President Eisenhower on September 8th of that year, Marshall was the civilian base for Dr. Wernher von Braun, a renowned German rocket developer and scientist, who assisted the U.S. Army in the development of ballistic missiles at the Redstone Arsenal,[23] and became the center's first director. Von Braun was the chief architect of the Saturn V launch vehicle, the superbooster that propelled Americans to the Moon. Administrator Griffin has said he "can't imagine returning to the moon or going to Mars … without the capabilities that Marshall Space Center brings to bear. Marshall is our launch vehicle center."

Like other centers, Marshall must balance the effective continuation of existing programs while transitioning to new ones. This requires transitioning the workforce, knowledge, facilities, capabilities, tools, and equipment needed to support the next generation exploration programs at the same time it safely flies the shuttle through 2010, completes the space station, and contributes to science. Marshall officials said their activities were intended to ensure that they were an outstanding systems developer and integrator for space operations, exploration, and scientific missions. They believed that these activities would help ensure the center's health over the years.

Marshall has had 25 years of experience managing the external tank, main engines, reusable solid rocket boosters, and reusable solid rocket motors for the Shuttle Program. In addition, it has significant responsibilities for the International Space Station in such areas as payload operations, multi-purpose logistical modules, environmental control and life support systems, and microgravity science. For the Constellation program, Marshall has responsibilities in the following areas:

- **Ares I crew launch and Ares V cargo launch vehicles projects.** For Ares V, Marshall is developing new heavy lift capability, which will help establish a long-term human presence on the Moon. Ares I and V will be the "successor[s] to shuttle as America's workhouse system for routine space access."

- **Lunar Precursor Robotic Program.** Through this program, Marshall will evaluate landing zones, demonstrate precision landing, determine lunar resources, and provide an evolvable platform.

[23] Von Braun is believed to have been the leader of what has been called the "rocket team" that developed the V–2 ballistic missile for the Nazis during World War II

- **Lunar Lander Project (including the Lunar Surface Access Module).** Through Marshall's Lunar Lander Project Office, it is conducting preliminary engineering studies, developing requirements for the descent stage, and reporting to the Constellation program. Marshall will ultimately build the rocket for the lunar lander.

Around the time the President announced the *Vision,* NASA decided to cancel work at Marshall in exploration systems research and technology and human systems research and technology. In addition, it cancelled ISS payload work and terminated other programs. As a result, Marshall had approximately 650 uncovered FTE (agency-wide, NASA had approximately 2,000 uncovered FTE). Consequently, Marshall began a significant re-planning of its work, resulting in substantial changes over the course of three fiscal years (FY 04, 05, and 06).

In response, Marshall was very proactive in making significant changes to its organizational structure and fundamentally realigning its workforce:

- The center streamlined and integrated the organization to focus on customers and initiated a workforce reshaping effort. Specifically, it focused on relevant competencies and strengthened its engineering, safety, and mission assurance disciplines.

- Within 18 months, it completed two reorganizations—realigning 2,000 FTE and 1,000 FTE respectively (some people were realigned twice).

- The center benchmarked, prioritized, and consolidated critical mission support functions.

- The center enhanced its governance system to improve strategic decision-making.

For FY 2007 and beyond, Marshall's 2,600 FTE are fully funded, which is a major turnaround. The process was challenging. As the support for the space labs, the center had a significant number of physical scientists whose skill set was displaced. Marshall conducted a comprehensive assessment of their skills and began moving them to other work. While most skills were readily transferable, the center still encountered some initial resistance from affected personnel. For example, with propulsion research no longer a Marshall focus, the center had to move these researchers to new work. In general, the center found scientists had a more difficult time transitioning than engineers. Marshall strategically coalesced previously uncovered personnel in a new directorate (Science and Mission Systems) headed by an NEX employee. Senior center officials took a firm stand that the workforce had to be realigned to new initiatives. At the time of the Academy's visit, officials acknowledged that a small number of employees were unsatisfied because they are no longer doing the work they want to do.

Langley Research Center

The team visited Langley Research Center in September 2006. Located in Hampton, Virginia, Langley is the oldest of NASA's field centers and directly borders the Langley Air Force Base. Historically, the center has conducted aviation and space research for aerospace, atmospheric sciences, and technology commercialization and has been dedicated to improving civilian and

military aircrafts. Established in 1917 by the National Advisory Committee for Aeronautics as the nation's first civilian aeronautics laboratory, the center currently devotes more than half of its programs to aeronautics, and the rest to space. Between 1958, when NASA started Project Mercury and 1963, Langley served as the main office of the Man-In-Space program, with the office transferred to the Manned Spacecraft Center (now the Lyndon B. Johnson Space Center) in Houston in 1962-63.

After the Shuttle was developed, Langley moved heavily into aeronautics research in the 1980s and 1990s. In the late 1990ss, NASA cancelled two major programs (high speed research and advanced supersonics).. Since then, the center has been trying to "find its way" and is now undergoing a significant transition from primarily an aeronautics center to one with a more balanced program: exploration and aeronautics, with some science. It is still heavily engaged in aeronautics. Officials noted that while 25 percent of Langley's funding is programmed for aeronautics, between 35 percent and 40 percent of the workforce remains dedicated to this discipline.

Langley has an annual average budget of around $600 million.[24] Under President Bush's FY 2007 budget request for NASA of 16.8 billion dollars, Langley would have received $608 million budget, which is $52 million below its current financing. Center officials were expecting their aeronautics budget to fall by 17 percent, or $50 million dollars, and total funding for science programs to decline by $12 million largely because its biggest program—a cloud experiment—had been completed and will soon be launched. At the same time, they expected the center's funding for space exploration programs would increase nearly 50 percent, going from approximately $80 million to $118 million. As discussed in Volume 1, Congress ultimately did not pass appropriation bills before the November 2006 elections, and the incoming congressional leaders have stated they intend for the federal government to be on a Continuing Resolution throughout FY 07, with the possible addition of an Emergency Supplemental. It is unclear what impact this will have on NASA's total level of funding for FY 07.

Langley officials said they had developed a good working relationship with JSC and Marshall. Among other things, Langley officials are looking forward to working on the first un-crewed test of the Aries 1-1 vehicle in April 2009. They are also excited about their roles with Orion (but described these as being at a lower level). Given NASA's experience at working with other nations on the International Space Station, they do not believe that it should be too difficult to work across centers.

Like the other research centers, Langley has a significant age gap between those over 60 and those under 30. The center has very few people in their 30s. They have "crash-coursed" their systems engineers by making them leads of small projects with mentors.

The previous center director believed that the center needed additional interaction with its contractors. He established the Executive Contract Steering Council as a forum to share problems and search for solutions. Contractors are also invited to the NASA Family Breakfast and to the Executive Safety Council. These activities have helped to improve civil service-

[24] The Center for Land Use Interpretation, Langley Research Center. See http://ludb.clui.org/ex/i/VA3129/

contractor relations. Still, the center does not have a good sense of the competencies of contractors.

Langley's Advanced Planning and Partnership Office recently worked with the Futures Strategy Group to host a scenario-based planning exercise for Langley 2025. They viewed this as a strategic alignment exercise to determine what Langley needed to do to meet the nation's future needs. The group examined several key factors (globalization, role of Asia, US economy, climate change, and terrorism) to establish five different worlds. Through five days of workshops, participants lived in their assigned world and worked to develop appropriate strategies. Later in the week, participants began to collaborate with one another across the five worlds—the goal being to identify a set of "robust strategies" that would likely work for all the worlds.

In summary, Langley officials described these major challenges:

- Need to develop project management skills
- Short-term skill mix (Senior managers acknowledged this as a short-term issue; center workforce planners, however, made recommendations on work assignments based on the premise that engineers are engineers who can do research and development regardless of their specialty..
- Longer-term workforce and leadership pipeline
- Center Management & Operations budget cutbacks expected in the out-years will harm Langley because the center has very old infrastructure
- New and emerging skills, which Langley must identify and bring into the center

Langley officials said their major challenges were similar to those of other research centers.

Kennedy Space Center

The team and Panel Chair visited Kennedy Space Center in October 2006. Kennedy is the NASA space vehicle launch facility (spaceport) near Cape Canaveral on Merritt Island in Florida. Established as NASA's Launch Operations Center on July 1, 1962, the center was renamed in honor of the nation's 35th president following his death. KSC is the only launch complex for manned operation in the United States. It handles multiple Space Shuttle, military, and commercial launches for missions around the earth and beyond. The center has an $800 million center for launching space vehicles; all other launch operations occur at Cape Canaveral Air Force Station, which is operated by the U.S. Air Force. It is from KSC that NASA sends astronauts to the ISS. KSC processes each spaceflight element before it is delivered and attached to the ISS.

Kennedy has undertaken a reorganization to realign with the agency's changing mission and associated programmatic changes, with a primary goal of enhancing the center's ability to

respond to future changes and to facilitate strategic planning. In addition to establishing the Constellation Program Office and Advanced Planning Office, it consolidated the 600 engineers spread across the center into a new Engineering Directorate. This new directorate separates engineering from programs in a manner consistent with NASA's new governance model. The center operates in a matrix fashion and sends engineers to various programs and projects to make the center more adaptable.

Although the next generation launch vehicles are not expected to be as labor intensive as the Shuttle, and there is potential for short-term uncovered capacity after 2010, KSC does not anticipate future reductions or involuntary separations in its civil service workforce. Instead, KSC officials believe that existing Shuttle civil servants will transition to exploration work. They do not expect skill imbalances because they believe KSC can productively use operational engineers working on such activities as Shuttle processing for design, development, test, and evaluation work. To smooth the transition, they are providing some Shuttle employees with part-time Constellation work. The center plans to use all existing capabilities and facilities, molding them as appropriate to fit the needs of the Constellation program. Lockheed Martin will be using KSC facilities for some of its CEV work.

KSC officials, however, expressed concern about their contractor workforce due to significant uncertainty about the role of the contractors in future Constellation work. Contractors are working closely with KSC to determine identify key areas of potential responsibility. With the Shuttle Program, each contractor is in a different position. NASA is currently negotiating with United Space Alliance (USA) about how to establish incentives that will retain their workforce through 2010. USA is worried that it will lose personnel once Lockheed Martin starts staffing. Most contractors with USA are probably not going to stay at KSC because of financial concerns. The center has tried to assure USA that, even though the current contract ends in four years, there is likely to be additional Shuttle work needed after 2010, for which the company could compete.

If the contracting workforce declines in a sharp and unpredictable way, it will hinder the center's ability to meet its launch schedules, adversely affect the realization of the *Vision*, and create budgetary problems. In working with the contractor organizations, senior center officials have assured them that they will have the opportunity to compete for work once the requirements, competencies, and workforce implications for the Constellation program become clearer. Center officials have had to walk a fine line, however, because they cannot guarantee that contractor organizations will continue to receive the same level of funding.

Senior management officials expressed pride in their use of term appointments. KSC hires all new employees on two-year term appointments and reserves the option of extending to six years. The procurement office is one of the few places at Kennedy where managers can hire perms. Procurement talent is usually derived from other federal agencies. The use of term appointments has not resulted in degradation in the quality of people hired. The center has succeeded in hiring permanent civil servants from other federal agencies into term positions at NASA, including accountants.

KSC has been through transformation processes in years past as the Apollo program ended and the Shuttle Program began. Center officials believe that transforming the center will be a long-term undertaking because the Shuttle is currently the largest program at the center. Continuing to fly the Shuttle safely while transitioning to Constellation work will be a challenge. The center is gradually transforming the center to match the technical requirements of building the CLV and components of the CEV. For example, they have begun to consider how the launch complex will need to be changed for the next generation launch vehicles.

Jet Propulsion Laboratory

The team visited the Jet Propulsion Laboratory (JPL) in November 2006. Located in the Los Angeles metropolitan area, JPL is the only NASA center that is a Federally Funded Research and Development Center (FFRDC). It has a NASA Management Office of about 30 civil servant FTEs responsible for the contract, finance, safety, and the environment.

The California Institute of Technology (Caltech) established JPL was established in the 1930's, when the President of the university, Theodore von Karman, began running rocket propulsion experiments on the site. Despite its name, JPL is no longer focused on turbojets or other air-breathing jet engines (rocket engines were often called "jets" or "ramjets" before the mid-1940s). Caltech has a five-year prime contract for JPL with NASA, last renewed in 2003. JPL's NASA missions are implemented through prime contract provisions.[25] JPL is NASA's lead center for robotic exploration of the solar system, building and operating unmanned spacecraft for the agency. Center officials described their core competency as end-to-end implementation of unprecedented robotic space and earth science missions[26], requiring the integration of specialties in science, engineering, and technology. To date, JPL has sent unmanned missions to every planet in the solar system. In addition, the center has also done extensive mapping missions of the Earth.

As an FFRDC, JPL has some key differences with the civil service-run centers:

- **Uses very few contractors**—only 200 to 300 contractors at a time, no more than 10 percent of its workforce. The center relies on its hands-on, in-house experienced workforce.

- **Employees not subject to Title 5**—they are subject to Caltech employment regulations, which establish a merit principle. JPL terminates personnel only for inadequate performance or lack of work. The center recently had a significant layoff because the business base did not support the number of employees at the center. Senior officials identified the disciplines in which they no longer needed as many people, rated personnel by discipline, and made lay-off decisions based on work performance.

[25] JPL performs work as designated in unilateral task orders issued by the Contracting Officer (the NASA Management Office). The effort under these task orders must be with the purpose and mission of JPL as an FFRDC that are defined in core competencies listed in the prime contract. JPL may also perform work for non-NASA sponsors, on a non-exclusive basis, if these fall within the listed core competencies. JPL is required to operate in the public interest with objectivity and independence, as well as freedom from conflicts of interest. JPL may not compete with non-FFRDC entities in response to federal agencies' Requests for Proposal.

[26] End-to-end includes the three phases of NASA missions: (1) formulation, (2) implementation, and (3) operations.

- **Normal curve age distribution**—because JPL has had more flexibility to adjust its workforce over time, its age distribution is much healthier than that found in the civil service-run centers. The JPL Director has included progress in hiring fresh-outs as one of the Human Capital Director's performance standards.

- **Pay for performance**—JPL implemented a broad-band pay system in 1997. Center officials said that their performance appraisal system does a good job of distinguishing between gradations of performance.

- **Uses a different competency system**—JPL does not use the Competency Management System. Instead, it developed its own Capabilities Inventory, which includes both JPL employees and their onsite contractors, based on how officials actually request staffing, hire personnel, and assign them to work. The inventory produces numerous reports that help with work allocation decisions and succession planning.

JPL officials emphasized that a robust space program must include both robotic and human exploration. Although human exploration receives much more funding, they said that most of what is known about the universe has been discovered through robotic missions. JPL's workforce planning has become more complicated because the distribution of its work is moving away from missions assigned directly by headquarters to competed missions.[27] The center is not concerned about their ability to win merit-based competitions, but does believe the changed distribution will make workforce planning more difficult.

In general, JPL does not believe it is doing enough for Constellation. NASA is currently asking for narrowly targeted help from JPL, such as a specific number of systems engineers. The center wants to move beyond this approach toward a major, accountable ("whole") role for robotic missions and its precursors. JPL officials believe that their center has significant skills to contribute to this endeavor. They said that other centers, for example, often seek JPL's help in such areas as project management, project practices, systems engineering, and successful mission practices. The JPL Flight Programs and Projects Directorate led an agency-wide effort to develop flight project management standards and offers highly regarded project management classes for all NASA employees.

JPL officials identified several challenges. First, the center cannot work on anything without direct funding. The center does not have any institutional funding for current employees who no longer have projects, but who will likely be needed on future projects. Second, the high cost of living in Southern California (especially the cost of housing) is a major challenge in recruitment and retention. This is compounded by a tight labor market, with JPL being forced to compete with a wide array of government, academic, industry, and nonprofit organizations. Finally, as an FFRDC, JPL's role within NASA is heavily dependent on its relationship with the

[27] Of the 10 JPL launches from 2000 to 2005, 6 were assigned and 4 competed against other centers. Over the next five years, the distribution of the 10 scheduled launches is quite different: 2 have been assigned and 8 competed against other centers. Of the 15 launch opportunities over the first half of the next decade, 3 are assigned; 10 will be competed; and 2 will be determined.

Administrator. Despite the challenges of being an FFRDC, JPL officials believe it works well for the research center functions.

B-2: LESSONS LEARNED CHART

Based on interviews at the eight field centers visited by the Academy team, Table 8 provides a summary of insights on six key issues:

- **Uncovered capacity**—key topics on this issue included whether the center had problems with uncovered capacity, either current or projected, as well as the strategies adopted to respond to it.

- **Full Cost Accounting**—key topics on this issue included the impact of the implementation of Full Cost Accounting on the center, as well as center perspectives on the simplified version to be fully implemented in FY 2007.

- **Competency Management System**—key topics on this issue included how the center was using the Competency Management System, as well as any concerns related to it.

- **Permanent-Term Issues**—key topics on this issue included how the center was using each type of appointment to achieve flexibility and scalability, as well as the center's overall view on the value of term appointments and any challenges resulting from them.

- **Contractor issues**—key topics on this issue included how the center decides to use a contractor, how it manages contracts, and any overall concerns about civil service-contractor relations.

- **Center health**—key topics on this issue included suggestions for healthy center criteria and metrics, as well as perspectives on the overall health of the center being visited.

Table 8
Summary of Lessons Learned from Key Field Visit Interviews

Center *(Visit date)*	**Uncovered Capacity Approach**	**Full Cost Accounting**	**Competency Management System**	**Perm-Term Issues**	**Contractor Issues**	**Health**
GODDARD *(June 2006)*	Not a problem in FY 06, but anticipate difficulties in future years Working on proposals for more work; feel not a prime center for VSE work.	With historically low overhead rate, possibly disadvantaged by the standard NASA-wide CM&O rate[28] Concerned about limited Center Director discretion with CM&O (must appeal to HQ)	Center sees little value in CMS. Need center-specific competencies incorporated into CMS Need real-time workforce data Will use previous workforce planning tool as much as possible	Term works for engineers Attracting scientists to term is challenging because they have tenure track options. Attracting some key admin. personnel to term is difficult due to significant DC metro-area competition Associate Director approves all hires at the center	Contractors are used for surge capacity Decisions about bringing contractor work in-house are delegated to the branch chief. Many contractors embedded, with long-time NASA careers	Believe center's current health is strong Future concern about level of work (not concerned about the center's capabilities, just concerned about having the necessary workload)

[28] CM&O is the Center Management and Operations account.

Center *(Visit date)*	**Uncovered Capacity Approach**	**Full Cost Accounting**	**Competency Management System**	**Perm-Term Issues**	**Contractor Issues**	**Health**
AMES *(July 2006)*	Significant uncovered capacity at time of visit Focused on finding work for uncovered employees Established a "transition workforce" to systematize use of uncovered FTE; but these employees not always used for core mission functions Not proactively attempting to transfer large blocks of FTE to other places within NASA or outside the agency	Given center's small size and the high cost of living in the Bay Area, Ames will benefit from the standard NASA-wide CM&O rate Concerned about limited Center Director discretion with CM&O	CMS has been helpful, in conjunction with WIMS, to help managers staff new functions. Using with WIMS to determine whether can bid for new work Will use CMS text-box for center-specific competencies	Very limited hiring; essentially use terms to protect existing permanent workforce Use perm for scientists because competing with universities offering tenure and want experienced personnel Faces significant competition from Stanford University and Silicon Valley	Substantial cuts in contractor capabilities (3,200 contractor personnel a few years ago to 1,200 now) "Skeleton crews" of 1 or 2 run some major facilities Many contractors embedded, with long-time NASA careers Believe FAIR Act limits ability to move work in-house	Significant concerns expressed about center health Want "anchor tenant" (for example, small satellites and spacecrafts) Believe the center is a sub-contractor to primary centers; concerned about not being part of the core mission. Large cuts in major programs (example: Astrobio) Believe the center has technically competent personnel Highest avg. age of any center Highest # of inactive facilities

Center *(Visit date)*	**Uncovered Capacity Approach**	**Full Cost Accounting**	**Competency Management System**	**Perm-Term Issues**	**Contractor Issues**	**Health**
JOHNSON *(August 2006)*	No center-wide uncovered capacity problem (a few individuals without charge code) Overall work requests from programs and mission directorates exceed center FTE ceiling JSC has three major programs (ISS, Shuttle, and Constell-ation mgt.)	FCA Simplification (CM&O) seen as very positive for NASA and JSC FCA does have many codes, so there are many logistical issues to manage Can be difficult to predict split of employees b/w programs, track movement between jobs and organization, and determine impact on salary budgets Significant delays in getting funds from headquarters; center has a reasonably smooth process after HQ releases funds Inter-center funds transfers must go through HQ, which causes delays	JSC sees little value in CMS.	All new hires are terms. 13% of civil service workforce is term. Typically convert to perm after two years No difficulty getting quality applicants for term positions	Joint Leadership Team Center Director monthly meeting with 15 contractors Largest contractor workforce of any center (total EP: 20,002) Use of contractors for core functions (ex: in Flight Control Center) Human Capital plans required of four prime shuttle contractors Most shuttle civil servants say they intend to stay with shuttle until its retired. Concerned about shuttle contractors leaving for CEV contractor	JSC sees itself as a healthy center. Clear VSE role (Constell-ation mgt; lead for crew module; will plan missions, train, and run mission control) Outgrown existing facilities Challenging to manage three programs Developing virtual engineering model for transferring work to other centers Integration concerns about work transferred to other centers RIF of 30 – 40 technicians a few years ago

Center *(Visit date)*	**Uncovered Capacity Approach**	**Full Cost Accounting**	**Competency Management System**	**Perm-Term Issues**	**Contractor Issues**	**Health**
GLENN *(August 2006)*	Significant uncovered capacity reported at time of visit	FCA was major transition for Glenn. Requires training of managers and good project management skills FCA has improved project management insight into resource utilization. FCA led to an increased emphasis on workforce planning Budget staff had to increase by 10% Takes too long to get money from HQ	CMS not mentioned as a problem by center management	Used terms during significant transition period (FY 04 – 06); most have been for clerical appts. Center mgt supports expanded use of terms for new hires	Lost a lot of contractor support Fewer procurement dollars	Significant skill mix challenges Need fewer FTE in aero research and space-related research "Turned a corner," but concerned about long-term future due to aging infrastruc-ture and need for durable work

Center *(Visit date)*	**Uncovered Capacity Approach**	**Full Cost Accounting**	**Competency Management System**	**Perm-Term Issues**	**Contractor Issues**	**Health**
MARSHALL *(September 2006)*	No uncovered capacity currently or projected, but did have significant uncovered capacity in FY 04 and FY 05 Realigned twice for VSE programs Previously uncovered scientists put under new directorate with NEX head Philosophy is to treat all employees with respect and to have every employee assigned to meaningful work; reassign within center and retrain as appropriate	FCA Simplification is beneficial: it reduces administrative burdens, eliminates center cost competition, establishes predictable overhead costs, and facilitates agency analysis of center M&O Center will continue to refine center budget formulation tools	Center management supports CMS Used extensively at Marshall; integrated with WIMS	129 Terms out of 2,554 civil servants Center mgt strong supporter of Term hires Some concerns in technical directorates about Terms	Almost two times as many contractors as civil servants (2,600 civil servants and 4,400 contractors) After an initial drop when two programs were cancelled, the contractor workforce is increasing due to CEV and CLV. Examining work of contractors to ensure retaining core capabilities in-house	Significant workforce realignment has contributed to health Substantial role in exploration programs Concern about retaining civil servants and especially contractors due to area job openings in FY 09/BRAC (local area gaining jobs)

Center *(Visit date)*	**Uncovered Capacity Approach**	**Full Cost Accounting**	**Competency Management System**	**Perm-Term Issues**	**Contractor Issues**	**Health**
LANGLEY *(September 2006)*	Despite significant problems with uncovered capacity earlier in FY 06, the center had a small number of uncovered by time of team's visit. Workforce planners equate uncovered capacity and skill mismatches.	Support FCA Simplification as way to ensure small centers have a "level playing field" Center desires a budgetary "planning wedge" as tool to overcome uncertainty	CMS not a major concern at Langley Sees CMS as reinforcing NASA's people-centered approach to workforce	Center hires term unless labor market dictates otherwise Most new hires (90%) have been terms (even for admin. positions) Difficulty attracting quality terms to some positions (ex: software) Terms want to be permanent (will apply to perm positions as soon as they are announced)	Interacting more with contractors; meet monthly now with Exec. Contract Steering Council and NASA Family Breakfast Some technical directorate concerns about HQ funds for exploration being mandated for civil servants (not contractors), which may reduce future flexibility and scalability. Believe center procurement staff is strong, but under-staffed Contractors would like to be civil servants.	Norm at the center is lifetime Langley employment "Old center" in terms of infra-structure RIF of 18 technicians in FY 2005; many RIFed employees are now returning to Langley for exploration work. Workforce planners view engineers as having fungible skills. Transition from aeronautics research to spaceflight develop-ment requires changes to the reward system, increased project mgt. skills, and work re-alignment (aeronautics workforce is larger than available funding)

Center *(Visit date)*	**Uncovered Capacity Approach**	**Full Cost Accounting**	**Competency Management System**	**Perm-Term Issues**	**Contractor Issues**	**Health**
KENNEDY *(October 2006)*	No problems with uncovered capacity Significant hiring limitations due to FTE restriction (program demands exceed existing workforce numbers) Potential longer-term challenge as Shuttle phases out and ISS completion (believes most civil servant engineers will be able to transition to exploration) Contractor orgs. will need fewer operational people.	Difficulty with initial FCA approach (admin. complex and created unhealthy competition between centers) Strong supporters of FCA Simplification because it will reduce burdens and allow the budget staff to have time to do content management and analysis. No concerns about FCA Simplification	CMS developed at KSC and seen as helpful for macro-level workforce planning process CMS leads in the right direction to ID existing people with needed skills	All external hires are terms. Approach to terms differs from other centers because KSC hires terms for two years and only converts by exception. If employee is successful and still needed, they will be given up to an additional four-year term. No problems recruiting Terms	Over 6-to-1 ratio of contractors to civil servants (13,000 contractors) to 2,000 civil servants) Contractors processing shuttle and ISS face significant workforce reductions. United Space Alliance negotiating with NASA on a tailored retention strategy Procurement embedding personnel in project offices to help with early planning and acquisition; established new division to support exploration activities.	Ctr. Mgt. is strong supporter of healthy center initiative—believes it will help KSC get other work when the Shuttle is retired. Technical personnel concerned about the resulting FTE restrictions required to send work to other centers; they believe work related to operational launching and processing work must be done at KSC. Recent consolidation of engineering functions into separate directorate is consistent with NASA's new governance model. Uncertain about their future exploration role Challenge in balancing design and operations engineering needs/skills

Center *(Visit date)*	**Uncovered Capacity Approach**	**Full Cost Accounting**	**Competency Management System**	**Perm-Term Issues**	**Contractor Issues**	**Health**
JPL *(November 2006)*	As an FFRDC, JPL is not included in the uncovered capacity concept. Conducted a significant layoff in 2005 because funding was insufficient for workforce	Has always used Full Cost Accounting; cannot fund activities without a direct charge code Disadvantage of FCA is no ongoing funding for institutional and program transitions is unavailable unless this was specifically provided by HQ Not subject to NASA Full Cost Accounting or FCA Simplification	Not required to use CMS Developed a Capabilities Inventory for JPL employees and contractors that has been successful because it was based on the needs of hiring officials	Not subject to Title 5: JPL employees are Caltech employees governed by the university's HR rules and regulations. Hybrid center: "Not quite civil service, not quite a contractor" Employees can be fired only for performance and laid off only for lack of work.	JPL uses few other contractors (under 10% of workforce) because it specializes in end-to-end work in-house	Available Space Sciences Mission Directorate funding is closely linked to center health (75% of JPL funding comes from SSMD) Wants major VSE anchor program Healthier age distribution than civil service-run centers FFRDC valuable to NASA because it can serve as the experiment-al base for science and administrative reforms JPL believes ultimate test of healthy center is whether the right people are doing the right jobs Based on HQ decisions, a much larger number of JPL's future science missions will be competed v. other centers rather than assigned directly—increases the complexity of workforce planning. JPL officials believe it is a very healthy center that has bounced back after the loss of the 1998 Mars Climate Orbiter.

CONTRACTING ISSUES

As mentioned throughout Volume 1, NASA's multisector workforce relies heavily on contractors—many who are long-term, on-site contractors at the agency's headquarters and field centers—to achieve its mission. This appendix provides additional background information on the following areas:

- Federal context for contracting
- An overview of the agency's primary contractors
- Summary data on issues related to NASA's Contracting Officer Technical Representatives
- Summary of data collected from a survey of the procurement offices at the ten centers.
- Langley procurement metrics

C-1. FEDERAL CONTEXT FOR CONTRACTING

Privatization of public services has been one of the most significant developments in public administration over the last several decades.[29] Since 2001, the President's Management Agenda (PMA) has promoted "competitive sourcing" as a way to expose the commercial activities performed by the government to the dynamics of competition between the public and private sectors. As a result, between 50 – 75 percent of the civil servants in some federal agencies are subject to competition. Both the public and the private sectors can bid for the competed work. The public sector's bid is for a "Most Efficient Organization" (MEO) that, if the government is selected, will perform the work promised at specific levels of service for the competed price (cost). Most of these bids are based on administrative consolidations, process reengineering, and new degrees of automation. As of February 2006, the government had won the bids between 80 – 90 percent of the time.[30]

While privatization as a service delivery method dates back to at least the 16th century, the use of privatization as a public tool has increased considerably over the past two decades, A-76,[31] the

[29] Fernandez, Sergio, Rainey, Hal G., and Lowman, Carol E., Chapter entitled, ":Privatization and Its Implications for Human Resources Management, *Public Personnel Management, 3rd ed.,* June 2005, p. 1 of Chapter. The Academy acknowledges this critical work as the foundational basis for the government-wide analysis of privatization contained in this paper.

[30] See National Academy of Public Administration, *New Tools for Implementing 'Most Efficient Organizations' (MEOs) in the Federal Government*, February 6, 2006.

[31] A-76 refers to OMB's Circular which states that "certain functions are inherently governmental in nature, being so intimately related to the public interest as to mandate performance by federal employees."

Federal Activities Inventory Reform (FAIR) Act of 1998,[32] and competitive sourcing have firmly entrenched this mode of service delivery into our system of governance.[33] In the mid-1990s, government agencies increasingly sought out "body shops," companies providing personnel to augment a shorthanded federal workforce or an agency lacking the skills for a particular job.[34] Some historically research-oriented contractors also expanded to meet the growing federal need for "professional services," an ambiguous label typically implying a willingness to become more involved in operational functions related to physical products.[35]"

Governments at all levels have pursued privatization, contracting out, and competitive sourcing in order to attain:

- Cost savings
- Higher service quality
- Improved performance
- Access to new alternatives
- Needed skills

Economists and political theorists of the public choice school contend that bureaucrats, lacking a competitive market for their outputs and protected from competition, have more incentive to maximize their own organization's budgets than to maximize efficiency or to be responsive to citizens. Other economic theorists assert that, in the absence of competition and profit incentives, public agencies, like NASA, are unlikely to produce public goods or services at minimal cost. By allowing profit maximizing business to bid competitively for a specified output, government can guarantee that a product will be produced at the lowest cost, [36] services will be more efficiently delivered, and government will be more effective.[37] Challengers to this view of privatization caution that successful privatization requires effective management by government officials. One critic noted that "the chief irony of privatization is that proponents tout it as a cure for bad government, but it takes excellent government to make it work."[38]

While the value of privatization and contracting out remains controversial, most parties nonetheless agree that they will continue to represent a major alternative for government decision-makers seeking flexibility and skills and services not readily available in government.[39]

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[32] The FAIR Act established a formal, statutory process for federal agencies to identify functions that are not inherently governmental; resolve disputes over the identified functions; and inform Congress and the public about functions that could be performed by private entities.
[33] Ibid, Fernandez, p.1.
[34] Harris, Shane, "Contractor's rise shows blurred government, industry lines," *Government Executive,* July 7, 2006, p. 2.
[35] Ibid., Harris, p.2.
[36] Ibid., Fernandez, p. 4.
[37] Ibid, Fernandez, p. 5.
[38] Rainey, H.G., *Understanding and Managing Public Organizations,* Third Edition, San Francisco, p. 371.
[39] Fernandez, p. 7.

In *The True Size of Government*, Paul Light estimated that federal contracts in 1996 generated 5.6 million jobs and federal grants an additional 2.4 million.[40] As of 2006, Light estimated that the government's hidden workforce of contractors numbered 10.5 million, an increase of 2.5 million since 2002.[41] NASA, ranked in FY 2000 as third among all federal agencies[42], in the number of total dollars spent on contracting, is clearly a major contributor to what Light terms the "shadow of government." And that shadow continues to grow, with an 87 percent increase in government contract spending during the period from 1997 to 2004. [43]

Employee and Union Reaction to Privatization and Contracting Out

In addition to the staffing and technical challenges discussed in more detail below, "public employees and public unions pose a formidable barrier to contracting out of services at all levels of government."[44] Scholars note that these public employees tend to vote more frequently than the average citizen, and their collective voting power can have significant impact on the results of local elections.[45] A 1988 study by the National Commission for Employment Policy concluded the impact on public sector workers to be the most contentious issue associated with contracting out.[46] Other scholars have found a negative relationship between public employee strength and the incidence of privatization.[47] The Heritage Foundation, commenting on a bill, introduced in 2001, with 158 co-sponsors, to suspend the awarding of any new federal service contracts until changes were made to benefit federal employees, noted: "Entrenched interests─largely the existing federal workforce and managers─will defend the status quo because they fear the competition."[48] While wages paid by contractors are typically competitive and not a significant issue, civil servants opposed to privatization raise contracting out concerns, such as: job displacement;[49] loss of wages; disproportionate harm to minorities employed in the

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[40] Light, Paul C., *The True Size of Government,* Washington, DC., 1999, p. 1-8. Estimates generated by Eagle Eye Publishers, Inc., a data research firm, which looked at all contracts and grants spent on the purchase of goods and services and removed all questionable dollars. Data did not include purchases under $25,000 and did not contain a multiplier for foreign purchases. Light believes, as a result of these factors, that his estimates of the contract workforce likely understate the actual workforce by 15 percent.

[41] Lee, Christopher, *Big Government Gets Bigger,* washingtonpost.com, October 6, 2006, p 1. Light notes that this growth since 2002 is primarily attributable to tasks associated with the war on terror.

[42] Merit Systems Protection Board, *Contracting Officer Representatives: Managing the Government's Technical Experts to Achieve Positive Contract Outcomes,* December 2005, p. 58. Source of data, Federal Procurement Data System (FPDS), which showed NASA as having spent $10,912,591,000 in contracting, with 11,363 actions and 5.4 percent of the government's contract dollars, during FY 2000.

[43] Mandel, Jenny, "Report recommends better management of contracting technical staff," *GovExec.com,* May 12, 2006, p.1.

[44] Fernandez, p. 15.

[45] See http://en.wikipedia.org/wiki/voter_turnout . Also see "Voting and Non-Voting: a Multi Election Perspective", *American Journal of Political Science,* 1985, p. 74.

[46] Ibid. Fernandez, p. 15.

[47] Fernandez, p. 15 citing Boyne, G.A., The Determinants of Variations in Local Service Contracting: Garbage in, Garbage out?, *Urban Affairs Review*, 34, pp.149-162.

[48] June 25, 2001 re Truthfulness, Responsibility and Accountability in Contracting Out, HR.721. See http://www,heritage.org?Research/GovernmentReform?BG1452.cfm,

[49] A 1988 National Commission for Employment Policy study concluded that federal employee job displacement from contracting out was very low, with only about one in twenty federal workers becoming unemployed as a result of contracting out with the private sector. A study of city and county government contracting out found that former public employees hired by contractors tended to work for them for less than two years.

public sector;[50] lower retirement benefits; lower family health care coverage; and loss of other benefits.

Unions such as the United Steelworkers assert that "[c]ontracting out can fragment and weaken a workforce. Employers try to introduce contract work to undermine unions and erode hard-won union density. They use it to put downward pressure on wages, benefits, safety standards, and job security."[51] "Public employee unions have mounted both local and national public relations campaigns against privatization in order to garner political support and public sympathy for their cause."[52] There are some possible ameliorative measures managers may employ to reduce barriers: minimizing the number of employees who lose civil service jobs, contracting out only for new or expanding services, assisting affected employees with outplacement, and relying on attrition for the majority of reductions.[53] Regardless of the steps taken, contracting out will likely engender labor union opposition.

Acquisition Challenges Facing the Federal Government

As the federal government increasingly relies upon private and nonprofit "third-parties" to deliver public services, its acquisition function has become more important than ever. This section discusses two major challenges facing the federal government in this area: acquisition workforce sufficiency among contracting professionals and COTRs, who are typically professionals in non-contracting disciplines and the critical link to the technical quality of contracting products and services.

Acquisition Workforce Sufficiency

With the growing demand for contractors, experts have raised concerns about the government's ability to obtain the best value for goods and services and to implement acquisition reform in the absence of a sufficient number of qualified procurement employees. Specifically, government organizations successful in utilizing contractors must:

- Be capable of specifying clearly the product or service it desires
- Ensure the presence of effective competition in order to realize gains in efficiency
- Establish well-designed contract administration and monitoring systems to ensure accountability
- Design effective contracting processes
- Improve contract management practices

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[50] Fernandez, p. 16.
[51] United Steelworkers, *Steelworkers Contracting Out Newsletter,* March 2006
See http://www.usw.ca/program/content/3225.php
[52] Fernandez, p. 17.
[53] See Fernandez for a fuller discussion of possible methods for overcoming barriers to union opposition to contracting out.

- Utilize frameworks for deciding which functions to contract out

- Make fair and accurate comparisons of public and private service delivery[54]

In August 2006, an OMB Federal Acquisition Advisory Panel provisionally adopted a series of findings as well as recommendations to address under-capacity in the acquisition workforce. The panel's Acquisition Workforce Working Group found: "Without a workforce that is qualitatively and quantitatively adequate and adapted to its mission, the government reforms of the last decade cannot achieve their potential, and successful federal procurement cannot be achieved."[55] It also noted that it would be "penny wise and pound foolish" for the government to acquiesce to inadequacies in its acquisition workforce, which would ultimately seriously undermine "the pursuit of good value for the expenditure of public resources."[56]

Some of the panelists attributed failure "to effectively manage contracts to hiring gaps that leave acquisition staffs barely able to keep up with the burden of awarding contracts, let alone overseeing them once signed."[57] The group generally agreed that procurement reforms in the 1990's dramatically changed the nature of government acquisition, "simplifying small procurements while greatly increasing the complexity of some larger ones and emphasizing time-intensive strategies,"[58] such as best value contracting. The panel particularly noted that training during this same period also lagged behind the pace of change and that many agencies have acute shortages of procurement personnel with five to 15 years of experience.

Among the panel's provisional recommendations were that the Office of Federal Procurement Policy (OFPP): (1) ensure consistent and sensible definitions of the acquisition workforce; (2) consistently collect and analyze data about all relevant workforce categories across all agencies; (3) identify and eliminate obstacles to the speedy hiring of acquisition workforce personnel; and (4) create and use incentives for qualified senior, experienced acquisition personnel to remain in the acquisition workforce

The panel further recommended that each agency should:

- Formulate a distinct acquisition workforce human capital strategic plan, as part of its overall human capital plan, and that this plan should include an assessment of the role played by contractor personnel in the acquisition workforce

- Identify gaps between needed resources and available resources

- Assign responsibility to the Agency Chief Administrative Officers for measuring and predicting the agency's needs for procurement personnel

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[54] See Fernandez, pp. 5-6.
[55] OMB Acquisition Advisory Panel, Acquisition Workforce Working Group, August 10, 2006, p. 1.
[56] OMB Acquisition Advisory Panel, Acquisition Workforce Working Group, August 10, 2006, p. 5, Finding #5-5.
[57] Mandel, Jenny, "Panel agrees OMB needs official dedicated to acquisition workforce," *GovExec.com,* July 14, 2006, p. 1.
[58] Ibid. Mandel, July 14, 2006, p.2.

- Qualitatively assess the acquisition workforce and whether the agency is able to optimize the contribution of private sector capabilities, secured through the market, to the accomplishment of its mission

- Take aggressive action to improve the acquisition workforce immediately[59]

The OMB panel is not alone in its concern. The Federal Acquisition Institute noted, in an April 2005 report, that acquisition offices government-wide had 1,000 fewer employees in 2004 than they did in 1998. [60] In spite of a post-September 11th spike in government-wide procurement spending, the government has not undertaken any meaningful effort to recruit staff to manage the increased burden.[61] Steven Kelman, former administrator of OFPP, has called contract management the "neglected stepchild" of acquisition reform and noted that the crisis will likely deepen because the majority of the procurement workforce is now retirement eligible.[62] Citing congressional action that singled out this segment of the workforce for major reductions, the Defense Department Inspector General noted that the Defense acquisition workforce[63] was almost cut in half from FY 1990 to FY 1999.[64] While accounting for about two-thirds of federal procurement spending and employing what many consider to be the most experienced and thoroughly trained acquisition workforce, Defense is not unique in its acquisition staffing challenges. Other agencies as well are facing increased reliance on larger contracts, decreased competition, and overburdened operations that must keep buying. GAO, noting this increased reliance on contracting and looser management, has recently added interagency contracting to its high-risk list.[65]

Technical Representative Challenges

As the OMB Acquisition Advisory Panel noted, throughout the government, the acquisition workforce is inconsistently defined, often excluding Contracting Officer Technical Representatives (COTRs).[66] Yet COTRs are an agency's critical, technical link in assuring that contractors deliver quality products meeting agency specifications, schedules, and costs. These individuals provide the technical expertise necessary to convey the government's technical requirements, oversee the technical work of the contractor, and ensure that deliverables meet the government's technical requirements.

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[59] OMB Acquisition Advisory Panel, August 2006, pp. 7-10.
[60] Rutzick, Karen, "OPM approves direct-hire authority for acquisition jobs," *GovExec.com,* August 25, 2005, p. 1.
[61] Schooner, p. 2.
[62] *Ibid*.
[63] The Defense Department IG based this assessment on analysis of the acquisition organization methodology, which counts employees performing procurement functions at about two dozen Defense agencies.
[64] Schooner, Steven L., "Keeping Up with Procurement," *GovExec.com,* July 5, 2006, p. 1-2. Schooner cites a reduction in Defense procurement workers from 460, 516 to 230, 556.
[65] Schooner, p. 2. and January 2005 Highlights of GAO-05-207, a report to Congress on GAO's High Risk Series .
[66] See GAO-07-45SP, *Federal Acquisition Forum* (October 2006), pp.10-11, for a suggestion that the profile of this position needs to be elevated government-wide.

A report released in May 2006 by the Merit Systems Protection Board (MSPB),[67] which included NASA as one of ten surveyed agencies,[68] reviewed the critical area of managing COTRs.[69] The head of the MSPB concluded that "even the best managed contract is not successful if its deliverables fail to meet the technical requirements."[70]

The report urged agencies to take the following measures to achieve improved contract management results:

- Establish and use criteria for assigning COTRs
- Identify COTRs and manage them strategically
- Recognize COTRs as a critical workforce
- Involve COTRs early in the contracting process
- Ensure that pre- and post-award contract duties are performed by COTRs
- Work with COTRs to balance time requirements with non-contracting responsibilities
- Rate COTRs on their contracting performance
- Strengthen other elements of the contracting team.[71]

Congressional Responses to Federal Acquisition Workforce Challenges

Congress has also recognized the need for enhanced professionalism among federal personnel involved in procurement and contracting out. Through the Defense Acquisition Workforce Improvement Act (DAWIA) and subsequent broader legislation of the 1996 Clinger-Cohen Act (CCA), Congress has imposed new requirements for all federal procurement/acquisition personnel.[72] These civil servants must:

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[67] The ten agencies surveyed accounted for 90 percent of the government's contracting dollars during the subject Fiscal Year. NASA's roughly 160 respondents comprised 11 percent of MSPB's survey participants.

[68] December 2005 letter from Neil A.G. McPhie to the President, President of the Senate, and Speaker of the House of Representatives

[69] MSPB officials noted that a survey of the COTR population was made more difficult by virtue of the fact that most federal agencies do not centrally track their COTR population. Since COTRs are not classified in a singular job series, but rather fall into the classification associated with their technical expertise, it is not possible to use the Central Personnel Data File to locate these individuals. Additionally, the survey planned for a representational sample from each agency, but the response rate was relatively low. MSPB sent survey forms to roughly 500 to 600 NASA COTRs, but received responses from only 160.

[70] December 2005, McPhie Letter.

[71] Merit Systems Protection Board, p. 55.

[72] NASA developed a Procurement Training Policy as a means of implementing CCA. The latest version of this policy is found at: http://ec.msfc.nasa.gov/hq/library/training.html. The policy is out of date and is being revised to be in compliance with the Office of Federal Procurement Policy (OFPP) policy letter 05-01, found at: http://www.whitehouse.gov/omb/procurement/policy_letter_05-01.html. Effective 1/1/07, there will be a new federal certification system. If an employee is certified by NASA in the new OFPP series and later leaves NASA,

- Have a college degree or 24 hours of college credit in business topics
- Meet certification requirements
- Complete 80 hours of continuing education every two years

C-2. NASA'S MAJOR CONTRACTORS

As discussed throughout Volume 1, especially in Chapters IV and VI, NASA's multisector workforce includes hundreds of contracting organizations. In an era of consolidation and merger, however, it is increasing using a limited number of contractors such as:

- **United Space Alliance (USA),** a partnership between Lockheed Martin and Boeing, is NASA's principal partner and private contractor for the day-to-day management of the Space Shuttle fleet as well as planning and training for the International Space Station. USA began in 1995, when Rockwell International and Lockheed Martin Space Operations first formed this alliance after NASA announced its intention to consolidate Space Shuttle programs under a single prime contractor.

- **The Boeing Company** is working with NASA to outline a path from expendable to next-generation Reusable Launch Vehicles. Boeing is helping to define the robotic Mars Exploration Program, which will culminate in sample return missions beginning in 2013. As the prime International Space Station (ISS) contractor, Boeing is also responsible for design, development, construction and integration of the ISS and assisting NASA in operating the orbital outpost. Boeing built all of the major U.S. elements. NASA Systems[73] is also responsible for integrating the systems, procedures, and components of 16 participating countries in this worldwide enterprise.

- **Lockheed Martin Missiles and Fire Control—Dallas** is under contract to design and develop the large-scale heat rejection system (HRS) radiator and the photovoltaic radiator (PVR) assemblies for the International Space Station. The company produced and delivered six 2,470-pound HRS radiator assemblies and four 1650-pound PVR assemblies to NASA.

- **Lockheed Martin** won the $3.9 billion contract for the Crew Exploration Vehicle in 2006. It also has a role in the Hubble Space Telescope (HST) program. Lockheed began

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that certification would still be effective for all other federal agencies. However, for individuals wishing to be hired as an 1102 by NASA, they still have to meet the qualification standards that are applicable under the particular statute. For NASA, up to the grade of GS-12, the applicant must have EITHER 24 semester credits of business related courses OR a bachelor's degree from an accredited institution. To be hired at the GS-13 or higher level, the applicant must have BOTH of these. In addition, NASA requires that an 1102 employee be Level III certified in order to be promoted to the GS-14 level.

[73] NASA Systems is an 8000-person division of Boeing, headquartered in Houston, and the leading global supplier of reusable and human space systems and services.

in the 1970s, when the company was selected as the prime integration contractor. Today, the Lockheed Space Systems Company provides a wide range of HST-related service and support functions for NASA, including helping to plan and execute the servicing missions and providing telescope operations support at Goddard Space Flight Center in Greenbelt, Maryland. Lockheed Martin designed and built the Hubble Support Systems Module, performed overall telescope integration, and provided mission support services to the program after launch. Under a Flight Systems & Servicing contract with Goddard Space Flight Center, the Space Systems Company continues to provide numerous support functions for the HST servicing missions, including assisting with astronaut training and monitoring and troubleshooting of spacecraft hardware performance. It also serves as the contractor for the Mission Operations, Systems Engineering & Software contract, which has company specialists assist Goddard in performing day-to-day spacecraft operations in support of health and safety.

C-3. INSIGHTS FROM MERIT SYSTEMS PROTECTION BOARD STUDY OF CONTRACTING OFFICER TECHNICAL REPRESENTATIVES

As discussed in Chapter IV of Volume 1, the Merit Systems Protection Board (MSPB) in 2003[74] surveyed COTRs across the federal government, including 150 randomly selected individuals from NASA. Although respondents were a small sample of the thousands of NASA COTRs, this data is a useful resource for the agency to consider for further insights into contract quality, cost, and timeliness.

Key insights from the NASA data included:

- **Occupational Background.** From an occupational perspective,[75] 11.5 percent of NASA COTR respondents were in administrative occupations; 72.3 percent were professional; 14.9 percent were technical; and 1.4 percent were support personnel. By far the largest occupational grouping among NASA COTRs was engineering, with 77.6 percent

- **Accountability.** Almost 15 percent of NASA COTR respondents said they disagreed or strongly disagreed with a statement that they were held accountable for the performance of their contract activities. Because almost 19 additional percent neither agreed nor

[74] The MSPB study was based on a survey of COTRs from 10 agencies that accounted for 90 percent of the government's contracting dollars. MSPB worked with agencies to obtain 14,163 COTR names and addresses. MSPB used a random sample of 5,285 possible COTRs and distributed surveys to 4,895, of whom a total of 1,707 replied (a 36 percent response rate). MSPB noted that it was difficult to identify COTRs as many agencies do not centrally track COTRs, who have different occupational series and are not centrally located. See Appendix A, p. 57 of MSPB report.

[75] MSPB used the classic federal labor relations definitions of occupational groups for its study. NASA separates out scientists and engineers as a separate group, while MSPB and most other federal agencies include scientists and engineers in the professional category, along with other occupations that have a positive educational requirement, such as attorneys. Likewise, MSPB includes in its administrative category occupations such as management analyst, budget analyst, human resources specialist, and other occupations that do not positively require a specific educational degree. NASA captures these employees in a category it calls professional and administrative.

disagreed with this statement, it is fair to conclude that 34 percent of NASA COTRs are uncertain about how they might be held responsible for contract outcomes.

- **Training.** Over 54 percent of responding COTRs said they had received no training relating to contract close-out, terminations, or appeals. Approximately 48 percent said they received no training on documentation. Approximately 20 percent of respondents said they had received no training on contracting law and regulations.

- **Retirement Eligibility.** 26.2 percent of NASA COTRs were in 2003 eligible for retirement, with 57 percent eligible for retirement within 10 years.

The MSPB study also provided important insights from respondents on such topics as COTR assessment of contractor reasonableness of cost, quality, timeliness, contribution to the agency mission, degree of success, accountability, contractor behavior and conduct, contract problems, and availability.

C-4. NASA ACQUISITION SURVEY

Recognizing that the acquisition function plays a critical role in helping NASA attain a flexible and scalable workforce, the Academy conducted an online survey as part of its study designed for NASA's procurement offices. Reviewed by the Headquarters Office of Procurement and piloted by Goddard, the survey collected current and consistent data on procurement strengths and challenges, including procurement and COTR workforce data. The study team received responses from each of NASA's ten centers. The respondents were the center's Procurement Officer, or his or her designee.

The survey was divided into two sections:

- **Management Questions** focused on broad management issues and intended for the reply of the center's Procurement Officer.

- **Statistical Data Questions** requested statistical information about each center's acquisition workforce and contractual activity. These questions were intended for reply by a Procurement Office staff member.

As presented in C-5, this data was reviewed and analyzed by center. In keeping with the confidentiality norms of surveys, the Academy has not quoted individuals on open-ended questions.

The survey questions were as follows:

Respondent's Contact Information

1. Please enter your name, title and center.

Management Questions

2. What is your office's greatest challenge?

3. Please describe significant changes in your center's procurement and acquisition function in the past ten years.

4. Please describe your center's contract obligations for FY 2006. Do you expect an increase or decrease in your center's contract obligations in FY 2007?

5. Please describe your center's hiring patterns in the last ten years.

6. How would you assess the technical expertise and sufficiency of your center's COTRs?

7. Does your center anticipate bringing in some civil service work that is currently performed by contractors? If so, please provide a range of work in terms of position equivalents, brought in-house during FY 2006 and in fiscal year FY 2007.

Statistical Data

8. What is the size of your center's acquisition office?

Total workforce Size	
• Permanent Staff	
• Part-Time Staff	
• Term Staff	
• Temporary Staff	
• Other Staff (such as IPA's, reimbursable details, and consultants)	

9. Does your acquisition function have any contractor staff? If so, please indicate how many.

10. What is the total number of current vacancies in the acquisition function?

11. Please indicate the current acquisition function vacancies in each of the following grade levels.

GS 1 – GS 5	
GS 6 – GS 10	
GS 11 – GS 15	
Senior Executive Service	
NASA Excepted Authority	

12. Please indicate the number of acquisition employees who left in the following years:

FY 1996	
FY 2001	
FY 2005	
FY 2006	

13. Please indicate the number of acquisition employees, in the following grades, who left the center function in FY 1996:

GS 1 – GS 5	
GS 6 – GS 10	
GS 11 – GS 15	
Senior Executive Service	
NASA Excepted Authority	

14. Please indicate the number of acquisition employees, in the following grades, who left the center function in FY 2001:

GS 1 – GS 5	
GS 6 – GS 10	
GS 11 – GS 15	
Senior Executive Service	
NASA Excepted Authority	

15. Please indicate the number of acquisition employees, in the following grades, who left the center function in FY 2005:

GS 1 – GS 5	
GS 6 – GS 10	
GS 11 – GS 15	
Senior Executive Service	
NASA Excepted Authority	

16. Please indicate the number of acquisition employees, in the following grades, who left the center function in FY 2006:

GS 1 – GS 5	
GS 6 – GS 10	
GS 11 – GS 15	
Senior Executive Service	
NASA Excepted Authority	

17. What is the number of staff eligible for optional retirement in FY 2006 and FY 2011?

18. How many procurement actions did your acquisition office have in FY 1996, FY 2001, and FY 2005?

19. Please indicate the dollar value of your FY 2005 contract obligations.

20. How many entry-level professionals (including those in the agency's contracting intern program) did the acquisition office at your center hire in the following years?

FY 1996	
FY 2001	
FY 2005	
FY 2006	

21. How many co-op students did the acquisition office hire in:

FY 1996	
FY 2001	
FY 2005	
FY 2006	

22. Please indicate the number of months in the following years when hiring was not allowed in the acquisition office:

FY 1996	
FY 2001	
FY 2005	
FY 2006	

23. Do you have any contracts that include clauses restricting a contractor's ability to hire additional personnel after the contract has been signed, or requiring center management pre-approval?

24. If so, how many such contracts do you have?

25. What is the number of Contracting Officer's Technical Representatives (COTR) at your center?

26. What system(s), if any, do you use for tracking names, training and certifications of COTRs?

27. What is the number of COTRs currently trained?

28. What is the number of COTRs granted waivers in the absence of full training? Please explain if necessary.

C-5. RESULTS OF ACADEMY-SPONSORED SURVEY OF CENTER PROCUREMENT OFFICES

Table 9 presents summary data on eight key areas addressed by the survey.

Table 9
Summary of Survey Results on Key Indicators

CENTER	Number of Civil Servants	Number of Vacancies	Number of Employees Eligible for Optional Retirement		Number of Employees Who Left in FY 2005-FY 2006	Number of Procurement Actions in FY 2005	FY 2005 Contract Obligations ($)	Number of COTRS	Ratio of Civil Service Employees to Procurement Action[76]
			FY 06	FY 11					
Ames	50	0	11	17	11	3337	$605M	220	1:67
Dryden	17	0	2	6	5	269	$103M	68	1:16
Glenn	60	2	12	28	6	4567*	$441M	270	1:78
Goddard[77]	220	15	60	80	51	33,000	$4B	300	1:150
Johnson	143	4	3	3	19	5.034	$4B	534	1:35
Kennedy	97	7	9	26[78]	17	1,836	$1.184B[79]	107[80]	1:14
Langley	54	4	6	13	20	3,734	$509M	150	1:69
Marshall	111	5	19	41	23	4,054	$2.2B	120	1:37
Stennis	20	0	4	8	10	122	$21M	127	1:6
JPL[81]	16	2	0	1	5	500	$1.5B	2	1:31
TOTAL	788	39	126	223	167	56,543	$14.563B	1,898	1:72

*Glenn processed 2668 simplified acquisitions, 509 grants and cooperative agreements, and 1480 contracts and modifications.

[76] This ratio reflects November 2006 civil service employment to FY 2005 number of procurement actions. FY 2006 data on procurement actions was not available at the time of the study. Number of procurement actions does not reflect ongoing contract management responsibilities from previous year actions or differentiate the complexity of the actions counted.
[77] Goddard has more civil servants in procurement than the other centers because it is responsible for processing its own procurement actions, as well as headquarters.
[78] Kennedy's anticipated retirement eligibles in FY 11 include 6 employees newly eligible in FY 11 as well as 20 eligible in previous years.
[79] This dollar value for Kennedy does not include the center's ground portion under the Johnson Space Flight Operations Contract.
[80] Kennedy has 620 employees currently trained and capable of being assigned as COTRs.
[81] As an FFRDC, JPL has a very different structure from the other nine centers, which are civil service-based. JPL has a small cadre of NASA civil servants who are the agency's representative in a Management Office; it has very few COTRs.

The survey, in combination with interviews at headquarters and the field centers, indicates that NASA procurement offices are facing the following workforce trends and challenges:

- Half of the **Headquarters** Office of Procurement is eligible to retire in three years.

- **Ames,** which currently has 50 full time acquisition employees, had more than 60 civil servants in its procurement function five years ago and a staff of 95 in 1991. Ames finds it challenging to deal with the additional preparatory work required for contract terminations and mission redirection with this smaller staff. Over the past two fiscal years, 11 staff members have left the office.

- **Dryden,** which had 22 acquisition staff members in 1996, now has 17 civil servants in the procurement function. Management anticipates that 8 of its staff members will be eligible for optional retirement by FY 2011. Five staff members have left in the last two fiscal years.

- **Glenn** acquisition management expressed concern about maintaining adequately trained requesters, evaluators, and technical representatives as well as a high quality procurement workforce. Many employees desire an environment that is not as stressful and charged. The Procurement Division has lost people due to retirement, resignations, and transfers to other organizations. "Some people have retreated to quieter places in the agency." Given increased educational requirements for certification of acquisition professionals across government, there is also concern about the "increasingly small pool eligible to move within the federal acquisition system.

- **Goddard** is challenged to attract and retain acquisition professionals in the DC metropolitan area, where other federal agencies seek out NASA acquisition staff for their vacancies. The creation of the NASA Shared Services Center (NSSC) has also created uncertainty in the Goddard staff, some of whom may be geographically reassigned with this function. Restricted hiring opportunities have impacted the organization's ability to implement necessary improvements to internal controls in support of the agency's effort to obtain a clean opinion. This office currently has 15 vacancies.

- **Johnson** experienced a wave of retirements in the 1990s and expects another wave in about 10 years. In the last two fiscal years, this office has loft 19 procurement staff members. It is currently 4 under its FTE ceiling and is limited to replacement hiring only. Its major challenge is creating a multi-capable workforce and maintaining technical expertise through turnover.

- **Kennedy** has averaged 6.5 losses annually over the past five years in its procurement workforce, with nine departures in 2006. Four of these recent losses were to the new NSSC, where several Kennedy employees found professional advancement opportunities. The organization, which as of November 2006 had 97 employees on board, had as many as 113 employees in 1993 and 1994, but a 1996 consolidation of

space shuttle program contracts precipitated a decline in the procurement workforce. The office, which reorganized effective October 1, 2006, has authorization to hire up to 104 to support exploration activities. It anticipates that, by FY 2011, 26 of its employees will be eligible for optional retirement. Unlike most offices at KSC, procurement has permission to hire permanent, rather than term employees.

- **Langley** has utilized General Services Administration contract evaluation boards, consolidated contracting tools, and eliminated those that were under-utilized to combat a shortage of staff. While the office had 72 civil service employees a few years ago, it underwent a major downsizing in 2004 and 2005 and had a significant number of retirements; it currently has 54 civil service employees and 20 contractor staff. According to office metrics, the ideal civil service staffing level would be 60. With a staff shortage, the year-end workload has forced employees to work nights and weekends to meet programmatic demands. Center procurement officials are concerned about employee burnout. By FY 2011, some 19 staff members will be eligible for optional retirement.

- **Marshall's** acquisition function has had trouble keeping pace with attrition in its workforce, with losses to several nearby Army commands over the past several years, and the likelihood of further losses when the Army fully implements its Base Realignment and Closing (BRAC) in the Huntsville area over the next couple of years. The Procurement Office requires highly specialized experience to support its missions and has primarily inherently governmental work. Accordingly, it has contracted out the functions of purchasing agents, contract administration, and clerical support because of lack of civil servants. This office also has concerns about employee burn-out and ensuring that new procurement employees are properly and sufficiently trained in a timely manner. Marshall has five vacancies in its procurement function.

- **Stennis** has 20 acquisition staff members as of November 2006, six of whom are eligible for optional retirement in FY 2007. It anticipates 13 will be eligible in FY 2011. Within the past ten years, the office has experienced a complete turnover of procurement professionals, including transfers of employees for higher grades at other agencies or NASA centers, retirements, etc. Various e-government initiatives and added duties related to system administration, resources, and financial management require that procurement staff now have business management competencies.

Such data may provide a reference point for agency discussions of potential healthy center metrics for acquisition.

C-6. LANGLEY PROCUREMENT METRICS

As noted in Volume 1, Chapter IV's discussion of effective practices within the NASA acquisition community, the Office of Procurement at Langley Research Center has developed a

set of performance metrics to help it provide efficient, quality services that meet customer expectations and promote the center's mission. These metrics are developed from such sources as:

- Performance indicators identified in the Office of Procurement's organizational plan
- Systemic areas of concern identified through internal self assessments and/or NASA headquarter surveys
- Topics deemed necessary for improving the quality of overall performance

The current metrics covered four major areas, with the specific sub-elements described below:

- **People:** employee development, training, timely performance reviews, employee feedback, and intern development.
- **Customer Satisfaction:** major procurements timeline, lead-time from receipt to award, grant lead-time from receipt to award, contract and for profit cooperative agreement lead-time, and workload follow-ups.
- **Support of agency goals and programs:** socioeconomic program goals, as established by headquarters.
- **Quality:** self-assessments, support service contractor assessment, and past performance evaluations.

While some of these metrics remain the same from year to year, the center procurement office revises others based on changes in performance, processes, regulations or NASA headquarters areas of interest. For each metric, the office establishes a goal and an individual lead for evaluating the topic (metric) and holds quarterly metric meetings during the fiscal year with both the senior management of the office and the metrics leads. These meetings result in a consensus score for each metric, based on a "stoplight" system of Green (good), Yellow (needs attention), and Red (bad). Action items with completion dates are developed and assigned to individuals based on ratings to sustain or improve performance. The office tracks the status of action items for the next quarter, with the report card and status updates posted and updated quarterly in the office's conference room.

Table 10 provides a visual depiction of some Langley procurement metrics that could be adapted by other centers.

Table 10
Langley Procurement Office Metrics

Category	Year End Goal	Leader	Quarterly Evaluation			
			1st	*2nd*	*3rd*	*4th*
I. PEOPLE						
Employee Development						
Training (Internal and DAWIA)						
Timely Performance Reviews						
Employee Feedback						
Intern Development						
II. CUSTOMER SATISFACTION						
ASMs/Major Procurement Timeline						
SAP Lead-time (receipt to award)						
Grant Lead-time						
Contract/For-Profit Cooperative Agreement Lead-time						
Workload Tag-Ups						
III. SUPPORT OF AGENCY GOALS AND PROGRAMS						
Socioeconomic Programs						
IV. QUALITY						
Self-Assessments						
Support Service Contractor Assessment						
Past Performance Evaluations						
			Rating Scale: *Red=BAD* *Green=GOOD* *Yellow=NEEDS ATTENTION*			

APPENDIX D

PANEL AND STAFF LISTING

PANEL

Sallyanne Harper,* *Panel Chair*—Chief Administrative Officer and Chief Financial Officer, U.S. Government Accountability Office. Former positions with the U.S. Environmental Protection Agency: Chief Financial Officer/Acting Assistant Administrator for Administration and Resources Management; Deputy Assistant Administrator for Management and Administration/Deputy Chief Financial Officer; Finance Director; Associate Director, Superfund Procurement Operations. Former Contract Specialist and Contracting Officer in major weapons systems acquisition with the Naval Air Systems Command and the Naval Regional Contracting Office.

Benita A. Cooper—Consultant. Former Associate Administrator for Management Systems and Facilities, National Aeronautics and Space Administration (NASA); Assistant Administrator for Headquarters Operations (NASA); Director of Management Operations for Goddard Space Flight Center (NASA); and Director of Manpower Utilization, Goddard Space Flight Center. Recipient of Meritorious and Distinguished Executive Rank awards, NASA Exceptional Performance Award, and NASA Exceptional Service Medal. Education: BA Political Science—Earlham College; MA Government—Indiana University; and MS Management—Massachusetts Institute of Technology.

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Harriett G. Jenkins*—Consultant. Former Director, Office of Senate Fair Employment Practices, U.S. Senate; Assistant Administrator, Equal Opportunity Programs, National Aeronautics and Space Administration; Teacher, Principal, Director of Elementary Education, and Assistant Superintendent for Instruction, Berkeley Public School System.

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