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

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CONTENTS

List of Figures and Tables	v
Preface and Acknowledgments	xvii
About the Author.....	xix
Notes on Sources	xxi
Chapter One: Introduction.....	1
Chapter Two: Launch Systems.....	17
Chapter Three: Space Transportation/Human Spaceflight.....	187
Chapter Four: Space Science.....	571
Index.....	989
The NASA History Series	1041

LIST OF FIGURES AND TABLES

Chapter One: Introduction

Table 1-1	Programs Within the R&D Appropriation	9
Table 1-2	Centers of Excellence	11
Table 1-3	Program Office Functional Areas	12

Chapter Two: Launch Systems

Figure 2-1	NASA's Fleet of Launch Vehicles	20
Figure 2-2	Office of Space Flight	24
Figure 2-3	Office of Space Flight	25
Figure 2-4	Office of Space Systems Development	26
Figure 2-5	Office of Advanced Concepts and Technology	28
Figure 2-6	Office of Space Access and Technology, September 1994	29
Figure 2-7	Office of Space Flight	31
Figure 2-8	Office of Space Flight	31
Figure 2-9	Expendable Launch Vehicle Success Rate	38
Figure 2-10	Athena I and Athena II	42
Figure 2-11	Atlas I Components	45
Figure 2-12	Atlas IIAS Launch Vehicle	47
Figure 2-13	Delta II Components	52
Figure 2-14	Delta II 7925	53
Figure 2-15	Delta 3920/PAM-D, Delta II 6925, and Delta II 7925	54
Figure 2-16	Delta II Mission Profile	54
Figure 2-17	Pegasus Mounted Under B-52 Wing	56
Figure 2-18	Pegasus Vehicle	57
Figure 2-19	Pegasus XL Mission Profile	58
Figure 2-20	Taurus Launch Vehicle Configuration	60
Figure 2-21	The First Stage of the Titan IV ELV	63
Figure 2-22	Drawing of Space Shuttle External Tank	66
Figure 2-23	Space Shuttle Solid Rocket Booster	68
Figure 2-24	Space Shuttle Main Engine Components	69
Figure 2-25	Ulysses atop the Payload Assist Module-S and IUS Combination	71
Figure 2-26	Pratt & Whitney RL10 Engine	71
Figure 2-27	Atlas-Centaur Upper Stage	73
Figure 2-28	The Magellan Spacecraft with its Attached Inertial Upper Stage Booster	75
Figure 2-29	First Test Flight of the DC-XA	76
Figure 2-30	The X-34 Testbed Demonstrator	82
Figure 2-31	Aerospike Engine	83
Figure 2-32	The X-33 and VentureStar	87
Table 2-1	Authorized/Appropriated Budget (FY 1989-FY 1998)	89
Table 2-2	Programmed Budget (FY 1989-FY 1998)	91

Table 2-3	Space Transportation Capability Development/ Payload and Utilization Operations	96
Table 2-4	Upper Stages	97
Table 2-5	Engineering and Technical Base	97
Table 2-6	Payload Operations and Support Equipment	98
Table 2-7	Advanced Programs	98
Table 2-8	Advanced Projects	98
Table 2-9	Tethered Satellite System	99
Table 2-10	Orbital Maneuvering Vehicle	99
Table 2-11	Advanced Concepts and Technology/Space Access and Technology	100
Table 2-12	Advanced Space Transportation	100
Table 2-13	Advanced Transportation Technology/New Launch System	101
Table 2-14	Reusable Launch Vehicle-Systems Engineering and Analysis	102
Table 2-15	Reusable Launch Vehicle-Technology Program	102
Table 2-16	Reusable Launch Vehicle-Initial Flight Demonstration Program (FDP)	102
Table 2-17	X-33 Advanced Technology Demonstrator	102
Table 2-18	X-34 Technology Demonstration Program	103
Table 2-19	Transportation Technology Support	103
Table 2-20	Space Shuttle Production and Operational Capability/ Safety and Performance Upgrades	103
Table 2-21	Orbiter (Orbiter Operational Capability)	104
Table 2-22	Systems Integration (Orbiter Operational Capability)	104
Table 2-23	Orbiter Improvements	104
Table 2-24	Extended Duration Orbiter (Orbiter Operational Capability)	105
Table 2-25	Structural Spares (Orbiter Operational Capability)	105
Table 2-26	Orbiter Spares (Orbiter Operational Capability)	105
Table 2-27	Flight Operations Upgrades	106
Table 2-28	Launch Site Equipment (Launch and Mission Support)	106
Table 2-29	Mission Support Capability (Launch and Mission Support)	106
Table 2-30	Mission Operations Capability (Launch and Mission Support)	107
Table 2-31	Mission Operations and Support Capability Funding History	107
Table 2-32	Space Shuttle Main Engine Upgrades	107
Table 2-33	Solid Rocket Booster (Propulsion Systems)	108
Table 2-34	Solid Rocket Booster Improvements	108
Table 2-35	External Tank (Propulsion Systems)	108
Table 2-36	Super Lightweight Tank	108
Table 2-37	Construction of Facilities	109
Table 2-38	Advanced Solid Rocket Motor (Propulsion Systems)	109
Table 2-39	Assured Shuttle Availability	109
Table 2-40	Space Transportation (Space Shuttle) Operations	110
Table 2-41	Mission Support (Flight Operations)	110
Table 2-42	Integration (Flight Operations)	111
Table 2-43	Support (Flight Operations)	111
Table 2-44	Orbiter (Flight Hardware)	111
Table 2-45	Space Shuttle Main Engine (Propulsion Systems)	112

Table 2-46	Solid Rocket Booster (Flight Hardware)	112
Table 2-47	Redesigned Solid Rocket Motor (Flight Hardware)	113
Table 2-48	External Tank (Flight Hardware)	113
Table 2-49	Launch and Landing Operations	113
Table 2-50	Launch Operations (Launch and Landing Operations)	114
Table 2-51	Payload and Launch Support (Launch and Landing Operations)	114
Table 2-52	Expendable Launch Vehicles and Services	115
Table 2-53	Small Class (Expendable Launch Vehicles and Services)	115
Table 2-54	Medium Class (Expendable Launch Vehicles and Services)	116
Table 2-55	Intermediate Class (Expendable Launch Vehicles and Services)	116
Table 2-56	Large Class (Expendable Launch Vehicles and Services)	117
Table 2-57	Launch Services Mission Support	117
Table 2-58	Expendable Launch Vehicle Success Rate by Year and Launch Vehicle	118
Table 2-59	Athena Launches (1989-1998)	119
Table 2-60	Athena I Characteristics	120
Table 2-61	Athena II Characteristics	121
Table 2-62	Atlas Launches (1989-1998)	122
Table 2-63	Atlas E Characteristics	127
Table 2-64	Atlas G Centaur Characteristics	128
Table 2-65	Atlas I Characteristics	129
Table 2-66	Typical Atlas Launch Events Sequence for a Geosynchronous Mission	130
Table 2-67	Atlas II Characteristics	131
Table 2-68	Atlas IIA Characteristics	132
Table 2-69	Atlas IIAS Characteristics	133
Table 2-70	Conestoga 1620 Characteristics	135
Table 2-71	Delta Launches (1989-1998)	136
Table 2-72	Delta 3920/PAM-D Characteristics	142
Table 2-73	Delta II 6925 Characteristics	143
Table 2-74	Delta 7925 Characteristics	144
Table 2-75	Representative Delta II Mission Profile Events	145
Table 2-76	Pegasus Launches (1989-1998)	146
Table 2-77	Standard Pegasus Characteristics	149
Table 2-78	Pegasus XL Characteristics	150
Table 2-79	Scout G1 Characteristics	151
Table 2-80	Scout Launches (1989-1998)	152
Table 2-81	Taurus 2210 Characteristics	153
Table 2-82	Taurus Launches (1989-1998)	154
Table 2-83	Titan Launches (1989-1998)	155
Table 2-84	Titan II Characteristics	158
Table 2-85	Space Shuttle Flights (1989-1998)	159
Table 2-86	External Tank Characteristics	165
Table 2-87	Solid Rocket Booster Characteristics	166
Table 2-88	Space Shuttle Main Engine Characteristics	166
Table 2-89	Titan Centaur Upper Stage Characteristics	167

Table 2–90	Inertial Upper Stage Characteristics	167
Table 2–91	Inertial Upper Stage Launches	168
Table 2–92	DC-X Characteristics	169
Table 2–93	DC-X and DC-XA Flight Tests	170
Table 2–94	X-34 Characteristics	171
Table 2–95	X-33 Characteristics	171
Table 2–96	Reusable Launch Vehicle Chronology	172

Chapter Three: Human Spaceflight

Figure 3–1	Space Shuttle Program Organization, December 1997	195
Figure 3–2	Space Shuttle Program Elements and Projects, December 1997	195
Figure 3–3	Headquarters Office of Space Station, December 1988	197
Figure 3–4	Tiered Space Station Organizational Structure, April 1989	198
Figure 3–5	Marshall Space Flight Center Space Station Organization, April 1989	199
Figure 3–6	Johnson Space Center Space Station Organization, April 1989	200
Figure 3–7	Goddard Space Flight Center Space Station Organization, April 1989	201
Figure 3–8	Lewis Research Center Space Station Organization, April 1989	201
Figure 3–9	Kennedy Space Center Space Station Organization, April 1989	202
Figure 3–10	Space Station Freedom Program Office, May 1990	204
Figure 3–11	Office of Space Systems Development	205
Figure 3–12	Space Station <i>Freedom</i> Three-Level Program Management, 1992	207
Figure 3–13	Space Station <i>Freedom</i> Work Package and International Partner Development Responsibilities	207
Figure 3–14	Office of Space Flight, October 1995	209
Figure 3–15	Space Shuttle Vehicle Configuration	216
Figure 3–16	Orbiter Structure	218
Figure 3–17	Spacelab on Orbit	224
Figure 3–18	Spacelab Components	225
Figure 3–19	Typical SPACEHAB Interior Configurations	229
Figure 3–20	SPACEHAB Configuration 1	230
Figure 3–21	SPACEHAB Configurations 2 (top) and 3	231
Figure 3–22	Extravehicular Mobility Unit (Spacesuit)	235
Figure 3–23	Astronaut F Story Musgrave	236
Figure 3–24	The Long Duration Exposure Facility (LDEF)	241
Figure 3–25	The Gamma Ray Observatory	243
Figure 3–26	On Board Space Shuttle <i>Discovery</i>	245
Figure 3–27	ATLAS-1 Payload Configuration	246
Figure 3–28	Tethered Satellite System (TSS-1) Deployment	248
Figure 3–29	TDRS-F (6) On-Orbit Configuration	250
Figure 3–30	Space Shuttle <i>Columbia</i> Blasts Off	251

Figure 3–31	EURECA Mission Scenario	253
Figure 3–32	ORFEUS-SPAS and ACTS/TOS	254
Figure 3–33	ORFEUS-SPAS Configuration	254
Figure 3–34	The SIR and X-SAR	257
Figure 3–35	Payloads on STS-59	257
Figure 3–36	IML-2 Module Racks	259
Figure 3–37	<i>Mir</i> Space Station with <i>Discovery</i>	262
Figure 3–38	SPARTAN-204	263
Figure 3–39	Astro-2 Suite of Telescopes	264
Figure 3–40	The SPAS-2	271
Figure 3–41	The SPACEHAB Double Module	273
Figure 3–42	Dave Williams with the Virtual Environment Generator on <i>Columbia</i>	275
Figure 3–43	Space Station <i>Freedom</i> Configuration	285
Figure 3–44	U.S. Laboratory Module	285
Figure 3–45	U.S. Habitation Module	286
Figure 3–46	European Space Agency Attached Pressurized Module	286
Figure 3–47	Japanese Experiment Module	287
Figure 3–48	Japanese Experiment Module Exposed Facility	289
Figure 3–49	Canada’s Special Purpose Dexterous Manipulator (SPDM)	289
Figure 3–50	Man-Tended Capability	290
Figure 3–51	Permanently Manned Capability Configuration	291
Figure 3–52	Space Station <i>Freedom</i> Assembly Stages	292
Figure 3–53	<i>Mir</i> Space Station	299
Figure 3–54	<i>Atlantis</i> Docked with <i>Mir</i>	301
Figure 3–55	Undocking of <i>Atlantis</i> and <i>Mir</i>	302
Figure 3–56	Processing of Leonardo, the First Multi-Purpose Logistics Module	311
Figure 3–57	Commemorative Plaque, ISS Agreements	316
Figure 3–58	The Unity Module Inside <i>Endeavour</i>	318
Figure 3–59	Diagram of Unity Connecting Module	319
Figure 3–60	Construction of the International Space Station	319
Figure 3–61	Unity and Zarya Modules	320
Figure 3–62	Artist’s conception of Completed ISS	321
Figure 3–63	Drawing Showing the Completed ISS and Contributions by each of the International Partners, 1998	322
Figure 3–64	X-38 Flight Test	323
Table 3–1	Percent of NASA’s R&D or HSF Budget Allocated for Space Station	324
Table 3–2	Authorized/Appropriated Budget (FY 1989–FY 1998)	325
Table 3–3	Programmed Budget (FY 1989–1998)	327
Table 3–4	Spacelab Funding History	332
Table 3–5	Space Station (Total) Funding History	333
Table 3–6	U.S./Russian Cooperative Program Funding History	334
Table 3–7	Russian Space Agency Contract Support Funding History	335
Table 3–8	<i>Mir</i> Support Funding History	335
Table 3–9	Russian Program Assurance Funding History	335

Table 3–10	Space Station Development Funding History	336
Table 3–11	Development–Management and Integration Funding History	336
Table 3–12	Development–Pressurized Modules Funding History	337
Table 3–13	Development–Assembly Hardware/Subsystem Funding History	337
Table 3–14	Development–Platforms and Servicing Funding History	337
Table 3–15	Development–Power Systems Funding History	338
Table 3–16	Development–Operations/Utilization Capability Funding History	338
Table 3–17	Development–Flight Hardware Funding History	338
Table 3–18	Development–Test, Manufacturing and Assembly Funding History	339
Table 3–19	Development–Operations Capability and Construction Funding History	339
Table 3–20	Development–Transportation Support Funding History	339
Table 3–21	Development–Flight Technology Demonstrations Funding History	340
Table 3–22	Development–Operations Capability and Construction Funding History	340
Table 3–23	Shuttle/Spacelab Payload Mission Management and Integration Funding History	340
Table 3–24	Space Station Integration Planning and Attached Payloads Funding History	341
Table 3–25	Assured Crew Return Vehicle Funding History	341
Table 3–26	Flight Telerobotic System/Servicer Funding History	341
Table 3–27	Space Station Utilization Support Funding History	342
Table 3–28	Space Station Operations Funding History	342
Table 3–29	Space Station Research Funding History	343
Table 3–30	Space Station Transition Definition/Advanced Programs Funding History	343
Table 3–31	Life Sciences Funding History	344
Table 3–32	Life Sciences Flight Experiments Funding History	344
Table 3–33	Human Spaceflight and Systems Engineering Funding History	345
Table 3–34	Space Biological Sciences Funding History	345
Table 3–35	Life Sciences Research and Analysis Funding History	345
Table 3–36	Lifesat/Radiation Biology Initiative History	346
Table 3–37	Life and Microgravity Sciences (Total) Funding History	346
Table 3–38	Centrifuge Funding History	346
Table 3–39	Search for Extraterrestrial Intelligence Funding History	347
Table 3–40	Life Sciences Flight Program Funding History	347
Table 3–41	Advanced Human Support Technology Program Funding History	347
Table 3–42	Biomedical Research and Countermeasures Program Funding History	348
Table 3–43	Gravitational Biology and Ecology Program Funding History	348

Table 3–44	Orbiter Characteristics	349
Table 3–45	<i>Endeavour</i> Construction Milestones	350
Table 3–46	Space Shuttle Payload Accommodation	351
Table 3–47	Spacelab Module Characteristics	353
Table 3–48	Spacelab Missions	354
Table 3–49	SPACEHAB Missions	355
Table 3–50	Space Shuttle Extravehicular Activity (1989–1998)	356
Table 3–51	Space Shuttle Missions Summary (1989–1998)	360
Table 3–52	STS-29 Mission Characteristics	376
Table 3–53	STS-30 Mission Characteristics	379
Table 3–54	STS-28 Mission Characteristics	380
Table 3–55	STS-34 Mission Characteristics	382
Table 3–56	STS-33 Mission Characteristics	384
Table 3–57	STS-32 Mission Characteristics	385
Table 3–58	STS-36 Mission Characteristics	387
Table 3–59	STS-31 Mission Characteristics	388
Table 3–60	STS-41 Mission Characteristics	390
Table 3–61	STS-38 Mission Characteristics	392
Table 3–62	STS-35 Mission Characteristics	394
Table 3–63	STS-37 Mission Characteristics	399
Table 3–64	STS-39 Mission Characteristics	401
Table 3–65	STS-40 Mission Characteristics	403
Table 3–66	STS-43 Mission Characteristics	409
Table 3–67	STS-48 Mission Characteristics	411
Table 3–68	STS-44 Mission Characteristics	413
Table 3–69	STS-42 Mission Characteristics	415
Table 3–70	STS-45 Mission Characteristics	420
Table 3–71	STS-49 Mission Characteristics	422
Table 3–72	STS-50 Mission Characteristics	425
Table 3–73	STS-46 Mission Characteristics	427
Table 3–74	STS-47 Mission Characteristics	429
Table 3–75	STS-52 Mission Characteristics	435
Table 3–76	STS-53 Mission Characteristics	438
Table 3–77	STS-54 Mission Characteristics	440
Table 3–78	STS-56 Mission Characteristics	441
Table 3–79	STS-55 Mission Characteristics	444
Table 3–80	STS-57 Mission Characteristics	449
Table 3–81	STS-51 Mission Characteristics	453
Table 3–82	STS-58 Mission Characteristics	455
Table 3–83	STS-61 Mission Characteristics	458
Table 3–84	STS-60 Mission Characteristics	460
Table 3–85	STS-62 Mission Characteristics	464
Table 3–86	STS-59 Mission Characteristics	467
Table 3–87	STS-65 Mission Characteristics	469
Table 3–88	STS-64 Mission Characteristics	471
Table 3–89	STS-68 Mission Characteristics	476
Table 3–90	STS-66 Mission Characteristics	479
Table 3–91	STS-63 Mission Characteristics	482

Table 3–92	STS-67 Mission Characteristics	485
Table 3–93	STS-71 Mission Characteristics	487
Table 3–94	STS-70 Mission Characteristics	489
Table 3–95	STS-69 Mission Characteristics	491
Table 3–96	STS-73 Mission Characteristics	494
Table 3–97	STS-74 Mission Characteristics	496
Table 3–98	STS-72 Mission Characteristics	498
Table 3–99	STS-75 Mission Characteristics	500
Table 3–100	STS-76 Mission Characteristics	502
Table 3–101	STS-77 Mission Characteristics	505
Table 3–102	STS-78 Mission Characteristics	508
Table 3–103	STS-79 Mission Characteristics	512
Table 3–104	STS-80 Mission Characteristics	514
Table 3–105	STS-81 Mission Characteristics	517
Table 3–106	STS-82 Mission Characteristics	519
Table 3–107	STS-83 Mission Characteristics	521
Table 3–108	STS-84 Mission Characteristics	523
Table 3–109	STS-94 Mission Characteristics	525
Table 3–110	STS-85 Mission Characteristics	528
Table 3–111	STS-86 Mission Characteristics	531
Table 3–112	STS-87 Mission Characteristics	533
Table 3–113	STS-89 Mission Characteristics	536
Table 3–114	STS-90 Mission Characteristics	538
Table 3–115	STS-91 Mission Characteristics	541
Table 3–116	STS-95 Mission Characteristics	545
Table 3–117	STS-88 Mission Characteristics	549
Table 3–118	Space Station <i>Freedom</i> Prime Contractor	552
Table 3–119	Space Station <i>Freedom</i> Characteristics	553
Table 3–120	Shuttle-Mir Flights	555
Table 3–121	ISS Contributor	556
Table 3–122	ISS Major Milestones (as of April 1994)	557
Table 3–123	ISS Assembly Schedule (June 1994)	557
Table 3–124	Columbus Characteristics	558
Table 3–125	Partial Revised Manifest, Revision C, Through 1999 (as of 15 May 1997)	559
Table 3–126	ISS Assembly Sequence Revision D, Through 1999	560
Table 3–127	Functional Cargo Block (Zarya) Specification	561
Table 3–128	Unity Characteristic	561
Table 3–129	Zarya-Unity Orbital Events Summary	562
Table 3–130	Science Laboratories Accommodations	563
Table 3–131	Space Station Chronology	564

Chapter Four: Space Science

Figure 4–1	Office of Space Science and Applications, 1981–1993	581
Figure 4–2	Office of Space Science, 1993	583
Figure 4–3	Office of Space Science, November 1995	585
Figure 4–4	COBE Configuration	594

Figure 4–5	COBE’s Infrared View of the Universe	596
Figure 4–6	EUVE Spacecraft	597
Figure 4–7	SAMPEX Spacecraft	599
Figure 4–8	Rossi X-Ray Timing Explorer	602
Figure 4–9	FAST Small Explorer Satellite	603
Figure 4–10	ACE L1 Orbit	606
Figure 4–11	Expanded View of ACE	607
Figure 4–12	SNOE Spacecraft Structure	609
Figure 4–13	Filament Eruption Observed by TRACE	611
Figure 4–14	SWAS Telescope	612
Figure 4–15	ROSAT Spacecraft	616
Figure 4–16	ROSAT Spacecraft Configuration	618
Figure 4–17	HST’s “First Light” Image	622
Figure 4–18	Images of Spiral Galaxy M100	624
Figure 4–19	Light Path for the Main Telescope	626
Figure 4–20	Hubble Space Telescope Configuration	627
Figure 4–21	First Servicing Mission of HST	630
Figure 4–22	Close-up of HST	633
Figure 4–23	HST Image of Jupiter	635
Figure 4–24	Ring Structure Around Supernova 1987A	636
Figure 4–25	HST Image of Eta Carinae	637
Figure 4–26	HST Image of Supernova 1987A Debris	638
Figure 4–27	G1 Orbits the Andromeda Galaxy	639
Figure 4–28	Black Holes	640
Figure 4–29	Collision of Two Galaxies	641
Figure 4–30	Quasar Host Galaxies	642
Figure 4–31	Spiral Galaxy NGC 4603	642
Figure 4–32	Image of Gamma-Ray Burst GRB 970228	643
Figure 4–33	Supernovae	644
Figure 4–34	Release of the GRO Spacecraft	645
Figure 4–35	Compton Gamma Ray Observatory	647
Figure 4–36	Chandra Optical Bench Assembly at TRW	655
Figure 4–37	Chandra X-Ray Observatory	656
Figure 4–38	Ulysses Primary Mission	663
Figure 4–39	Ulysses Configuration	663
Figure 4–40	Deep Space 1 Spacecraft	670
Figure 4–41	Geotail Spacecraft Configuration	676
Figure 4–42	Wind Spacecraft	677
Figure 4–43	Location of Polar Spacecraft Instruments	680
Figure 4–44	SOHO Images	682
Figure 4–45	Yohkoh Images of the Solar Cycle	685
Figure 4–46	IUE Images	688
Figure 4–47	The Four-Stage Black Brant	692
Figure 4–48	A Scientific Balloon Ready for Launch	694
Figure 4–49	Magellan Earth-to-Venus Trajectory	695
Figure 4–50	Magellan Venus Orbital Operations	696
Figure 4–51	Magellan Spacecraft	699
Figure 4–52	Magellan Radar Image of Venusian Volcano	700

Figure 4–53	Magellan Radar Image of Venusian Crater	701
Figure 4–54	Galileo Spacecraft	702
Figure 4–55	Galileo Trajectory	703
Figure 4–56	Galileo Image of Asteroid 951 Gaspra	705
Figure 4–57	Galileo Image of Asteroid 243 Ida	707
Figure 4–58	Comet Collides with Jupiter	707
Figure 4–59	Galileo Probe Mission to Jupiter	708
Figure 4–60	Galileo’s Primary Mission Orbits	711
Figure 4–61	Lunar Prospector Mission Profile	719
Figure 4–62	Artist’s Conception of Lunar Prospector About to Impact the Moon	720
Figure 4–63	South Pole of the Moon	723
Figure 4–64	Mars Global Surveyor	727
Figure 4–65	Martian “Face”	729
Figure 4–66	Light and Dark Layers in Martian Canyon Walls	730
Figure 4–67	Mars Pathfinder Entry, Descent and Landing	731
Figure 4–68	Mars Pathfinder’s Sojourner Microrover	732
Figure 4–69	Mars Pathfinder Lander	734
Figure 4–70	Mars Climate Orbiter	737
Figure 4–71	Radioisotope Thermoelectric Generator	742
Figure 4–72	Cassini Interplanetary Trajectory	743
Figure 4–73	Cassini Spacecraft	745
Figure 4–74	Pioneer 10 and Pioneer 11 Pictorial Plaque	747
Figure 4–75	Voyager 2 Image of Neptune’s Rings	749
Figure 4–76	The SPARTAN 201–04 Satellite	760
Figure 4–77	ORFEUS-SPAS II	762
Figure 4–78	ORFEUS-SPAS I Configuration	765
Table 4–1	Space Science Launched Missions (1989–1998)	767
Table 4–2	Attached/Retrieved NASA Space Science Missions	774
Table 4–3	Authorized Budget (FY 1989–FY 1998)	776
Table 4–4	Programmed Budget (FY 1989–1998)	777
Table 4–5	Physics and Astronomy Funding History	778
Table 4–6	Hubble Space Telescope Development Funding History	778
Table 4–7	Gamma Ray Observatory Funding History	778
Table 4–8	Global Geospace Science Funding History	779
Table 4–9	Advanced X-Ray Astrophysics Facility Funding History	779
Table 4–10	Payload and Instrument Development Funding History	780
Table 4–11	Shuttle/Spacelab Payload Mission Management and Integration Funding History	780
Table 4–12	Explorer Development Funding History	781
Table 4–13	Physics and Astronomy Mission Operations and Data Analysis Funding History	781
Table 4–14	Physics and Astronomy Research and Analysis Funding History	782
Table 4–15	Space Science Supporting Research and Technology Funding History	782

Table 4-16	Space Infrared Telescope Facility (SIRTF) Funding History	782
Table 4-17	Thermosphere, Ionosphere, Mesosphere Energetics and Dynamics (TIMED) Funding History	783
Table 4-18	Stratospheric Observatory for Infrared Astronomy Funding History	783
Table 4-19	Suborbital Program Funding History	783
Table 4-20	Gravity Probe-B Development/Relativity Mission Funding History	784
Table 4-21	Information Systems Funding History	784
Table 4-22	Planetary Exploration Funding History	784
Table 4-23	Galileo Development Funding History	785
Table 4-24	Ulysses Funding History	785
Table 4-25	Magellan Funding History	785
Table 4-26	Mars Observer Funding History	785
Table 4-27	Planetary Exploration Mission Operations and Data Analysis Funding History	786
Table 4-28	Planetary Exploration Research and Analysis Funding History	786
Table 4-29	Comet Rendezvous Asteroid Flyby (CRAF)/Cassini Funding History	787
Table 4-30	Mars Balloon Relay Experiment Funding History	787
Table 4-31	Mars '94 Funding History	788
Table 4-32	Discovery Funding History	788
Table 4-33	Mars Surveyor Funding History	789
Table 4-34	Space Science New Millennium Funding History	789
Table 4-35	Advanced Space Technology Funding History	789
Table 4-36	Explorer Missions (1989-1998)	790
Table 4-37	Cosmic Background Explorer Mission Characteristics	791
Table 4-38	Extreme Ultraviolet Explorer Mission Characteristics	793
Table 4-39	Solar Anomalous and Magnetospheric Particle Explorer Mission Characteristics	796
Table 4-40	Rossi X-Ray Timing Explorer Mission Characteristics	801
Table 4-41	Fast Auroral Snapshot Explorer Mission Characteristics	804
Table 4-42	Advanced Composition Explorer Mission Characteristics	806
Table 4-43	Student Nitric Oxide Explorer Mission Characteristics	810
Table 4-44	Transition Region and Coronal Explorer Mission Characteristics	812
Table 4-45	Submillimeter Wave Astronomy Satellite Mission Characteristics	814
Table 4-46	Roentgen Satellite Mission Characteristics	816
Table 4-47	Combined Release and Radiation Effects Satellite Mission Characteristics	819
Table 4-48	Hubble Space Telescope Mission Characteristics	823
Table 4-49	Compton Gamma Ray Observatory Mission Characteristics	833
Table 4-50	Advanced X-Ray Astrophysical Facility (Chandra) Mission Characteristics	838

Table 4-51	Ulysses Milestones Characteristics	842
Table 4-52	Ulysses Mission Characteristics	843
Table 4-53	ASCA/Astro-D Mission Characteristics	849
Table 4-54	BeppoSAX Mission Characteristics	854
Table 4-55	Deep Space 1/SEDSAT Mission Characteristics	856
Table 4-56	High Energy Transient Experiment, Satellite de Aplicaciones Cientificas-B Dual Mission Characteristics	860
Table 4-57	Geotail Mission Characteristics	862
Table 4-58	Wind Mission Characteristics	866
Table 4-59	Polar Mission Characteristics	871
Table 4-60	Solar and Heliospheric Observatory Mission Characteristics	875
Table 4-61	Solar-A/Yohkoh Mission Characteristics	879
Table 4-62	NASA Sounding Rocket Launches (1989-1998)	882
Table 4-63	NASA Balloon Flights (1989-1998)	906
Table 4-64	Magellan Mission Events	926
Table 4-65	Magellan Mission Characteristics	927
Table 4-66	Galileo Major Mission Events (1989-1999)	930
Table 4-67	Galileo Encounters at Jupiter (1995-1999)	931
Table 4-68	Galileo Mission Characteristics	932
Table 4-69	<i>Discovery</i> Missions Approved by NASA, 1993-1998	938
Table 4-70	Near Earth Asteroid Rendezvous Mission Characteristics	939
Table 4-71	Lunar Prospector Mission Characteristics	944
Table 4-72	Clementine Mission Characteristics	948
Table 4-73	Mars Observer Mission Characteristics	952
Table 4-74	Mars Global Survey Mission Characteristics	954
Table 4-75	Mars Pathfinder Mission Characteristics	960
Table 4-76	Mars '96 Instruments	964
Table 4-77	Mars Climate Orbiter Mission Characteristics	967
Table 4-78	Mars Polar Lander Mission Characteristics	969
Table 4-79	Cassini-Huygens Mission Characteristics	971
Table 4-80	Voyager Events	980
Table 4-81	Astro Mission Characteristics	981
Table 4-82	Astro-2 HUT Scientific Achievements	984
Table 4-83	Spartan 201 Mission Characteristics	987
Table 4-84	ORFEUS-SPAS Science Payload	988

PREFACE AND ACKNOWLEDGMENTS

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

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

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

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

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

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

Their work improved the quality of this document immensely.

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

ABOUT THE AUTHOR

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

NOTES ON SOURCES

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

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

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

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

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

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

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

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

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

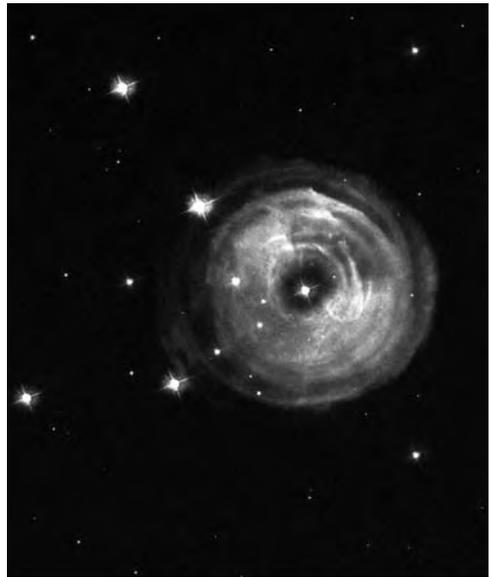
Faster, Better, Cheaper: Low-Cost Innovation in the U.S. Space Program, by Howard McCurdy: This book offers an excellent introduction to NASA's management approach, describing what very likely was the dominant philosophy at NASA during this decade.

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

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

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

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



CHAPTER ONE

INTRODUCTION

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

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

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

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

Overview of the Agency

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

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

Program and Project Development

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

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

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

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

NASA’s Budget

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

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

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

³ NPG 7120.5A.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

1989	1990	1991	1992	1993
Office of Aeronautics and Space Technology <ul style="list-style-type: none"> • Aeronautical Research and Technology • Transatmospheric Research and Technology • Space Research and Technology 		Office of Aeronautics and Space Technology <ul style="list-style-type: none"> • Aeronautical Research and Technology • Transatmospheric Research and Technology • Space Research and Technology • Exploration Mission Studies 	Office of Aeronautics and Space Technology <ul style="list-style-type: none"> • Aeronautical Research and Technology • Transatmospheric Research and Technology • Space Research and Technology 	
				Office of Space Exploration
Office of Safety, Reliability, Maintainability, and Quality Assurance <ul style="list-style-type: none"> • Safety, Reliability, and Quality Assurance 				
Office of Space Tracking and Data Systems <ul style="list-style-type: none"> • Advanced Systems 				
	University Space Science and Technology Academic Programs Technology Academic Programs	Academic Programs		

Table 1–2. Centers of Excellence

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

Table 1–3. Program Office Functional Areas

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

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

Programs Within the R&D/Science, Aeronautics and Technology Appropriation (Continued)				
1994	1995	1996	1997	1998
Office of Mission to Planet Earth				
Office of Advanced Concepts & Technology	Office of Advanced Concepts & Technology	Reallocated to Space Access and Technology and other programs		
<ul style="list-style-type: none"> • Space Research and Technology • Commercial Programs • Technology Transfer • Commercial Use of Space 	<ul style="list-style-type: none"> • Advanced Concepts and Technology (combined functional areas) 			
		Office of Space Access and Technology		Program office dissolved; activities moved to Aeronautics and Space Transportation Technology
		<ul style="list-style-type: none"> • Space Access and Technology 		Moved to Human Space Flight appropriation
	Launch Services	Included with Space Access and Technology		

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

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

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

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

