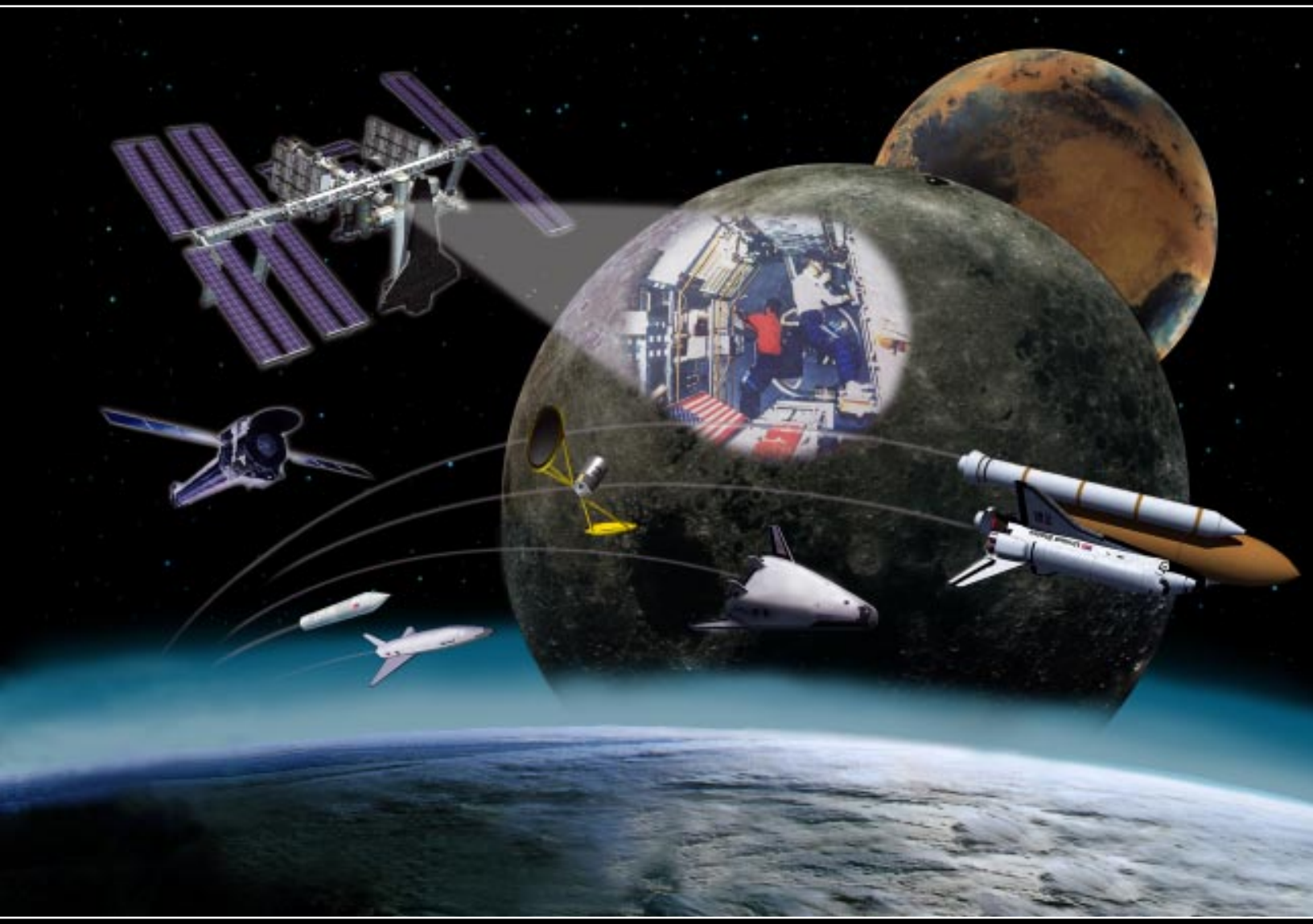
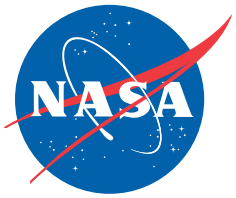


Marshall Space Flight Center FY 1999 Implementation Plan

September 1998



The NASA Vision

NASA is an investment in America's future. As explorers, pioneers, and innovators, we boldly expand frontiers in air and space to inspire and serve America and to benefit the quality of life on Earth.

The NASA Strategic Enterprise Goals

Human Exploration and Development of Space

- Prepare to conduct human missions of exploration to planetary and other bodies in the solar system.
- Use the environment of space to expand scientific knowledge.
- Provide safe and affordable access to space, establish a human presence in space, and share the human experience of being in space.
- Enable the commercial development of space and share HEDS knowledge, technologies, and assets that promise to enhance the quality of life on Earth.

Aeronautics and Space Transportation Technology

- Enable U.S. leadership in global civil aviation through safer, cleaner, quieter, and more affordable air travel.
- Revolutionize air travel and the way in which aircraft are designed, built, and operated.
- Enable the full commercial potential of space and expansion of space and exploration.
- Enable and provide world-class Research and Development services including facilities and expertise, and proactively transfer technologies in support of industry and U.S. Government Research and Development.

Space Science

- Establish a virtual presence throughout the solar system, and probe deeper into the mysteries of the Universe and life on Earth and beyond—a goal focused on the fundamental science we will pursue.
- Pursue space science programs that enable and are enabled by future human exploration beyond low-Earth orbit—a goal exploiting the synergy with the human exploration of space.
- Develop and utilize revolutionary technologies for missions impossible in prior decades—a goal recognizing the enabling character of technology.
- Contribute measurably to achieving the science, mathematics, and technology education goals of our Nation, and share widely the excitement and inspiration of our missions and discoveries—a goal reflecting our commitment to education and public outreach.

Earth Science

- Expand scientific knowledge of the Earth system using NASA's unique capabilities from the vantage points of space, aircraft, and in situ platforms.
- Disseminate information about the Earth systems.
- Enable productive use of Mission To Planet Earth science and technology in the public and private sectors.

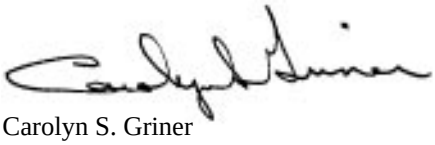
Director's Message

The *Marshall Space Flight Center FY 1999 Implementation Plan* defines our approach and metrics to implement the Agency and Enterprise goals and objectives. In addition, goals are included that have been specifically developed to address the direction of improvement of the Center as an institution. In response to and supporting the changing environment, directions, and processes throughout the Agency, we must not only meet the needs of the Enterprises but must forge a stronger Center through emphasis on quality and safety, directed focus on the Lead Center and Center of Excellence assignments, and improved ways of doing business through better leveraging and partnerships.

With safety as our first priority, we are committed to excellence in engineering and science, management, business, and personnel development in a safe and productive environment for our employees, our customers, our community, and our country.

FY 1999 is a critical year for both the Agency and the Marshall Space Flight Center (MSFC). The focused development of cutting edge technologies in space transportation to enable the development of space through lower cost access to orbit, the delivery of additional Shuttle capability to improve reliability and safety, the support to the Shuttle elements and launch manifest, the beginning of the assembly of the *International Space Station (ISS)*, expanded microgravity research and development to use the orbiting *ISS* laboratories, and the launch and operation of the Advanced X-Ray Astrophysics Facility are all major emphasis projects for MSFC in FY 1999. In addition, many new business systems and processes will be put in place, including the Integrated Financial Management System for which MSFC is the first implementation site.

We depend on the creative and skilled team at Marshall and all our partners and contractors to meet the metrics defined. We must continue to challenge everything we do for improvement in effectiveness, efficiency, and productivity. It is essential that all employees read and understand this plan and how the work you do directly contributes to the success of the Center and the NASA vision, mission, and goals.



Carolyn S. Griner
Acting Center Director

Marshall Space Flight Center

Mission

Bringing people to space; bringing space to people.

We are world leaders in access to space and the use of space for research and development to benefit humanity.

Goals

- Establish MSFC as number one in safety within NASA.
- Develop and maintain the NASA preeminence in space propulsion to enable the exploration and development of space.
- Lead the research and development of space transportation technologies and systems that support our customers' needs.
- Lead the NASA Microgravity Research Program and develop and maintain capabilities required to meet National research objectives.
- Lead the research and development of space optics fabrication, metrology, and testing that supports and enhances the NASA advanced propulsion and science programs.
- Enhance and sustain a highly skilled, diverse, and motivated workforce committed to safety while working in a creative and productive environment in support of cutting-edge systems and technology development.

Center of Excellence

- Space Propulsion

Mission Areas

- Space Transportation Systems Development
- Microgravity Research
- Space Optics Fabrication, Metrology, and Testing

Commitment to Safety and Mission Success

Our goal: Establish MSFC as number one in safety within NASA.

MSFC's Safety Philosophy

Senior management commitment to flight crew, employees, facilities, and program hardware safety

- Safety is an integral part of the life cycle of all MSFC programs and operations.
- Safety success requires commitment and involvement of the total workforce at and away from the workplace.
- A comprehensive safety and risk management program enhances the probability of mission success.

Crystal Growth Furnace being tested.

Rapid Prototyping Laboratory.

Safety Management Programs and Techniques

MSFC has implemented unique and innovative management techniques to improve safety performance.

Current Safety Processes

- Collocation of key Safety and Mission Assurance personnel in the major project offices and at contractor plants.
- Maintaining safety of flight while transitioning from oversight to insight and reducing Government Mandatory Inspection Points on Shuttle projects.
- Senior management safety review of all MSFC payloads.
- Internet web pages with payload assurance information.
- Center employee Safety Concern Reporting System.
- Use of state-of-the-art system safety tools for hazard identification and control.
- Risk assessments to prioritize management decisions on corrective actions.
- MSFC Safety Day Stand Down.

FY 1999 Safety Initiatives

- Augment training to implement safety focus which ensures line management and employee responsibility and accountability.
- Obtain certification in the Occupational Safety and Health Administration Voluntary Protection Program.

Space Shuttle *Endeavour* (STS–47) launch with MSFC's Spacelab-J.

- Integrate quality and safety into the MSFC ISO 9000 Management System.
- Use world-class Probabilistic Risk Assessment capability to model and quantify Shuttle enhancements for risk management decisions.
- Emphasize safety improvement criteria in all Performance Evaluation Board deliberations with our contractors.
- Include Safety Program performance briefings in MSFC senior management meetings.
- Communicate safety program performance.
- Add safety performance to all manager and supervisor performance plans.

Safety and Mission Success Metrics

- Achieve a 60 percent increase in predicted reliability of the Space Shuttle over the 1995 baseline.
- Reduce lost time mishap rate 20 percent per year over a 5-year period.
- Implement safety into the MSFC ISO 9000 Management System by the beginning of FY 2000.
- Complete certification in the Occupational Safety and Health Administration Voluntary Protection Program by the beginning of FY 2000.

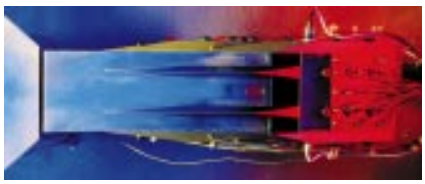
Center of Excellence:
Space Propulsion

Our goal: Develop and maintain the NASA preeminence in space propulsion to enable the exploration and development of space.

We support—

- Human Exploration and Development of Space Enterprise
- Aeronautics and Space Transportation Technology Enterprise
- Space Science Enterprise
- Industry and Commercial Needs
- Other Federal Agencies

Test of the low-cost Fastrac rocket engine.



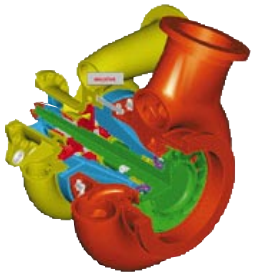
Air-augmented rocket engines for increased mission specific impulse.

As the NASA Center of Excellence for Space Propulsion, Marshall is leading the development of advanced earth-to-orbit and in-space propulsion systems and technologies.

NASA engineers are working to enable significantly lower cost propulsion systems with higher performance and aircraft-like operability. Technologies will be developed and demonstrated at several levels including component, subsystem, and system in both ground and flight test, where appropriate.

Marshall provides space propulsion services to all Enterprises and provides critical leadership for efforts among NASA field centers, industry, academia, and other Government agencies.

The world-class capability of skilled personnel, processes, and facilities will be maintained and enhanced to develop new and innovative space propulsion technologies .



Lightweight, low-cost turbomachinery.

Earth-to-Orbit Propulsion

A critical element to lowering the cost of space access is lowering the operations, development, and manufacturing costs while increasing the performance of earth-to-orbit propulsion systems.

Near term activities are focused on enabling a rocket-based reusable launch vehicle around the end of the decade. These technologies include advanced nozzle concepts (aerospike, expansion-deflection), lightweight composite thrusters, composite lines and ducts, ceramic turbines, composite housings, and other low cost components.

Building on near term developments, mid term technology activities are centered around enabling an air-augmented rocket engine. Building on synergy between space and aeronautics activities, Marshall has initiated flowpath demonstrations of these bold, new concepts.

Long term technologies include revolutionary off-board energy sources, such as magnetic levitation catapults and ground-based laser propelled systems.

Space Propulsion Metrics

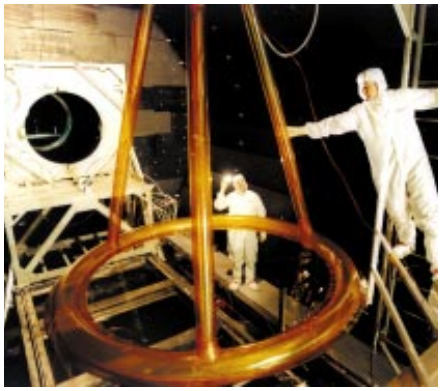
- Deliver Fastrac engine to X–34 in 1999.
- Complete Rocket Based Combined Cycle flowpath testing in 1999.
- Demonstrate the viability of a ceramic matrix composite blisk and nozzle in 1999.
- Fly NSTAR ion engine on Deep Space–1 in 1999.
- Demonstrate capability to store cryogens for long-term missions (30 days) in 1999.
- Demonstrate the viability of large-scale metal matrix composite housings and polymer matrix composite lines and ducts in 2000.
- Flight demonstrate an air-augmented system by 2002.

In-Space Propulsion

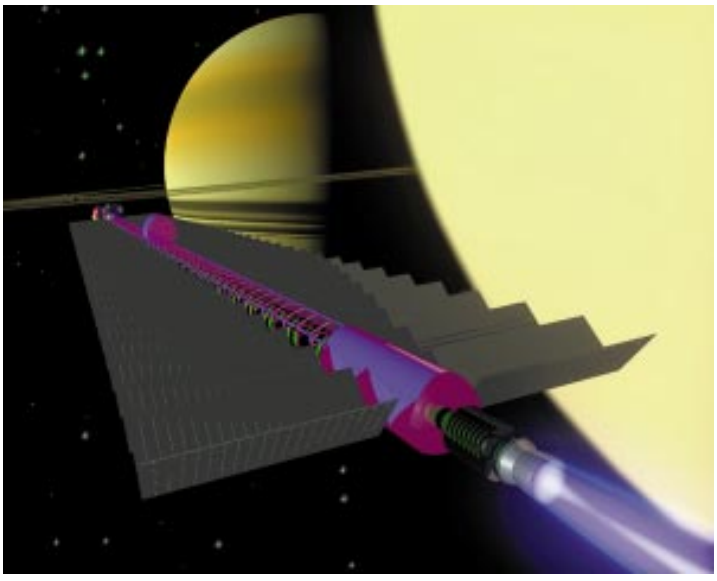
Over 70 percent of all payloads need transportation beyond low-earth orbit. A primary driver to enabling these systems is increasing the efficiency while decreasing the mass of the propulsion system.

Marshall is pursuing technologies to enable Earth-orbital and planetary transportation that include advanced chemical engines, solar thermal and solar electric propulsion systems, and electrodynamic tethers.

Interstellar missions will require several orders-of-magnitude reduction in trip times. Technologies being researched include fusion and breakthrough propulsion physics including matter/antimatter and gravity field manipulation.



Inflatable solar thermal concentrator assembly for Earth orbital transfer.



Fusion propulsion for interstellar transportation.

Pulse detonation rocket engine for upper stage applications.

Mission:
Space Transportation Systems Development

Our goal: Lead the research and development of space transportation technologies and systems that support our customers' needs.

We support—

- Human Exploration and Development of Space Enterprise
- Aeronautics and Space Transportation Technology Enterprise
- Industry and Commercial Needs
- Other Federal Agencies

Marshall plays a vital part of every launch.

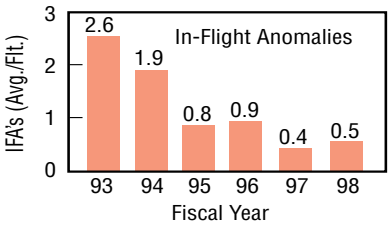
MSFC has responsibility for research, technology maturation, design, development, and integration of space transportation and propulsion systems. This includes both reusable space transportation systems for Earth-to-orbit applications, as well as vehicles for orbital transfer and deep space transportation.

Space Shuttle Elements

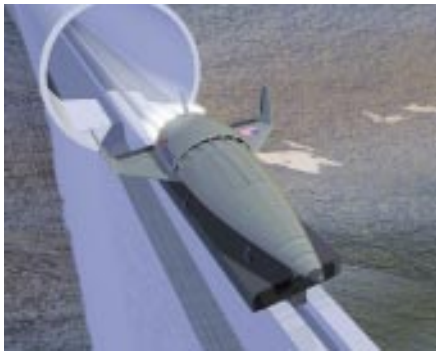
MSFC's Space Shuttle projects manage safe, continuous, robust, and cost-effective operations for the Space Shuttle propulsion elements: external tank, solid rocket booster, reusable solid rocket motor, and Space Shuttle main engine. MSFC will continue to streamline operations and aggressively develop and implement significant upgrades to improve safety, supportability, and reliability, and to reduce costs to efficiently sustain the Space Shuttle for its lifetime.

Space Shuttle Metrics

- Maintain less than one in-flight anomaly (IFA) per mission.



- Streamline operations.
  a. Transition routine operations from a government role of oversight to insight.
  b. Transition Shuttle prime contracts to the Space Flight Operations Contract, based on project maturity and stability:
     – Solid rocket booster: July 1998
     – External tank, Space Shuttle main engine, and reusable solid rocket motor under assessment.
- Achieve a 60 percent increase in predicted reliability of the Space Shuttle over the 1995 baseline.
  - Projections based on the Quantitative Risk Assessment indicate a 95 percent improvement (48 percent risk reduction) for ascent upon incorporation of Space Shuttle main engine upgrades:
    – Block I: July 1995
    – Block IIA: January 1998
    – Block II: May 1999.



Left: The X–34 demonstrates technologies for the Reusable Launch Vehicle Program. Right: Rocket-Based Combined Cycle and magnetic sled concept.

Advanced Space Transportation Technology

MSFC's Advanced Space Transportation Technology Programs Office will significantly reduce the cost of future space transportation systems while improving reliability, operability, responsiveness, and safety. MSFC, in partnership with the space launch industry and other NASA centers, is dedicated to developing advanced technologies and systems to enable new civil, commercial, and military mission capabilities; and encourage commercial investment in, and operation of, space transportation systems.

MSFC leads the Nation in space transportation by combining the development of ground-based state-of-the-art technologies with the validation of key technology products in a series of flight demonstrations (X–33 advanced technology demonstrator, X–34 small demonstrator, and Future-X demonstrations). MSFC efforts are focused on substantially reducing the risk associated with developing a full-scale operational Reusable Launch Vehicle (RLV) early in the next decade while setting the stage for hundredfold reductions in the cost of future space transportation systems.

The Advanced Space Transportation Program (ASTP) will pursue the development of revolutionary advancements in space access with the potential to reduce costs to hundreds of dollars per pound of payload versus the thousands of dollars measured today. ASTP will provide the basic building blocks of propulsion and airframe systems technologies to support flight demonstration projects, while focusing on future break-through technologies beyond the next generation.

Space Transportation Metrics

- Begin flight tests of the X–33 and demonstrate key technologies in 1999.
- Initiate flight tests of the X–34 and demonstrate key technologies in 1999.
- Realize tenfold reduction in the cost of space transportation within 10 years.
- Realize another tenfold reduction within 25 years.
- Reduce the cost of in-space transportation systems by an order of magnitude within 15 years.
- Realize 2–3 times reduction in mass and trip times.

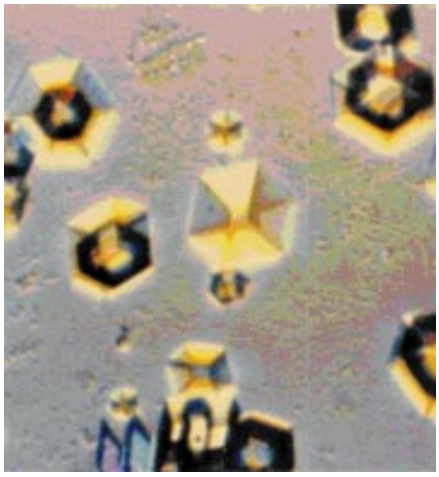
X–33 technology demonstration for a low-cost single-stage-to-orbit rocket.

Mission:
Microgravity Research

Our goal: Lead the NASA Microgravity Research Program and develop and maintain capabilities required to meet National research objectives.

We support—

- Human Exploration and Development of Space Enterprise
- NASA Approved Principal Investigators
- National Scientific Community
  - Academia
  - Industry
  - Government
- Commercial Space Centers and Industry Partners
- American Companies/Industry



Insulin crystals grown in microgravity.

MSFC's Microgravity Research Program Office is responsible for implementing the Agency's microgravity initiatives. MSFC's efforts enable scientific and commercial researchers the unique opportunity to use the low-gravity environment of space as a catalyst to generate new knowledge, products, and services that improve the quality of life on Earth.

Microgravity research is conducted in the low-gravity environment of space.

Microgravity Research Program

The purpose of the Microgravity Research Program is to use the low-gravity environment of space as a tool to advance knowledge. Microgravity researchers are provided the unique opportunity to study physical, chemical, and biological processes and phenomena in the near absence of gravity. Comparison between ground- and space-based research data allows scientists to accurately understand the role gravity plays in everyday life. Low-gravity research also allows scientists the opportunity to explore phenomena normally obscured by the effects of gravity. Scientists selected into the program perform peer-reviewed investigations in the research areas of biotechnology, combustion science, fluid physics, fundamental physics, and materials science. MSFC manages the implementation of the program, including the development of major facilities to be permanently housed on the *International Space Station (ISS)* and available to the science community for unique low-gravity research opportunities. In addition to its programmatic assignment, MSFC serves as a world leader in the areas of biotechnology and materials science research, working with selected scientists to transfer knowledge about the microgravity environment and provid-

ing science and engineering expertise necessary to aid the scientist in the successful execution of his investigation.

Microgravity Research Metrics

- Increase the number of microgravity researchers to 400 in FY 1999.
- Conduct research on 16 parabolic aircraft flights and three suborbital rocket flights in FY 1999.
- Build four Glovebox experiments in FY 1999.
- Achieve the steady-state goal of 425 microgravity researchers starting in FY 2000.
- Begin utilization of the *ISS* for microgravity research in FY 2000.

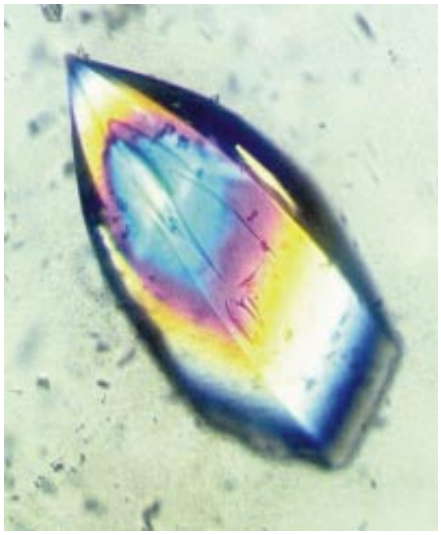
Space Product Development Program

In fulfilling NASA's responsibility to encourage the fullest commercial use of space, the Space Product Development (SPD) Program is managing an organization of Commercial Space Centers (CSC's) that has successfully employed methods for encouraging private industry to exploit the benefits of space-based research. Unique research opportunities of the space environment are being made available to private industry in an effort to develop new competitive products, create jobs, and enhance the quality of life. The success of the CSC's research is evidenced by the increasing amount of industrial participation in commercial microgravity research and the potential products nearing marketability.

Aerogel insulation protection properties are capable of shielding a delicate flower from intense heat.

Space Product Development Metrics

- Conduct 30 commercial investigations on STS–95 in 1998.
- Increase CSC industrial affiliates by 10 percent in 1999.
- Establish two new CSC's in 1999
  - Food Technology
  - Environmental Systems
- Establish a virtual center for metal casting processes in 1999.
- Successfully conduct 25 commercial investigations on STS–107 in 2000.



Near-perfect crystals grown in space aid pharmaceutical research on Earth.

Marshall Space Flight Center Implementation Plan Linkage to the FY 1999 NASA Performance Plan

Human Exploration and Development of Space Enterprise

NASA Near-Term Goals	NASA Objectives	NASA Performance Targets	MSFC Implementation	FY 1999 MSFC Metrics
• Explore the role of gravity in physical, chemical, and biological processes.	• Enable the research community to use gravity as an experimental variable.	• Publish at least 90 percent HEDS sponsored research data; make it accessible on the Internet. • Expand the number of sponsored investigations to 795. • Analyze data from *Mir* to achieve: – A three-crew year "jump start" for cell culture and protein crystal growth research. • Improve our predictive capabilities of soot processes by at least 50 percent through the analysis of MSL–1 data. • Use the MSL–1 results to eliminate one of three primary fluid flow regimes from consideration by casting engineers. • Use the data obtained by fluid physics experiment on suspensions of colloidal particles on MSL–1 to answer fundamental questions in condensed matter physics.	• Conduct science results symposiums for completed research flights; archive sponsored science findings in Internet accessible data bases. • Communicate the benefit and relevance of the Microgravity Program to the academic and research community through workshops, site visits, and printed materials. • Enable and support selected microgravity ground investigators. • Successfully transition flight definition researchers to flight approved status. • Successfully develop flight science and hardware. • Analyze biotechnology techniques utilized on *Mir* to advance cell culture and protein crystal growth research in the *ISS* era. • Provide low-gravity research opportunities and program management to selected microgravity investigators.	• Hold the MSL–1 science results symposia to describe research results to the media and public. • Increase the number of microgravity researchers to 400. • Obtain research opportunities on upcoming Space Shuttle missions and make these available to microgravity researchers. • Conduct research on 16 parabolic aircraft flights and three suborbital rocket flights. • Implement the recommendations of the Materials Science Research Board in the Materials Science Research Facility design. • Build four Glovebox experiments.
• Continue to open and develop the space frontier: – Develop and assemble the *ISS* and utilize it to advance scientific and commercial activities.	• Deploy and operate the *ISS* for research, engineering, and exploration activities.	• Deploy the Service Module, and the U.S. Laboratory Module; establish a three-person human presence; and establish initial *ISS* research capability. • Complete integration for the first EXPRESS rack with five payloads ready for launch at the beginning of FY 2000. • Complete preparations for the launch of the first rack of the Human Research Facility and the Window Observational Research Facility on the first utilization flight.	• Develop life-support systems; two Node elements; Multipurpose Logistics Module; Interim Control Module; EXPRESS rack and other research facilities; responsible for experiment operations for U.S. research and integration of Spacelab pallets and support equipment for *ISS* assembly.	• Deliver to KSC: Minipressurized Logistics Module: August 1998; Flight 6A Spacelab pallet and support equipment: December 1998. • Complete integration for the first EXPRESS rack with five payloads ready for launch: 1st quarter of FY 2000.
– Provide safe and affordable access to space.	• Improve Space Shuttle program operations by safely flying the manifest and aggressively pursuring a systems upgrade program.	• Achieve seven or fewer flight anomalies per mission. Achieve a 60 percent increase in predicted reliability.	• Aggressively develop and implement significant upgrades that would increase safety, improve mission supportability, meet the Shuttle manifest, and reduce cost.	• Maintain less than one IFA per mission. • Achieve a 60 percent increase in predicted reliability of the Space Shuttle over the 1995 baseline.
• Prepare to conduct human missions of exploration.	• In partnership with the Space Science Enterprise, carry out an integrated program of robotic exploration of the solar system to characterize the potential for human exploration and development.	• Initiate a collaborative program to design and develop radiation and soil/dust measuring devices.	• Funded PI for Mars Robotic Mission to examine soil/dust properties.	• Evaluate hardware to meet scientific objectives. • Develop software for science data analysis.
• Aggressively seek investment from the private sector: – Increase the affordability of space operations through privatization and commercialization. – Share HEDS knowledge, technologies, and assets that promise to enhance the quality of life on Earth.	• Reduce cost of Space Shuttle operations through privatization, eventual commercialization, and flying payloads. • Promote investments in commercial assets as pathfinders in *ISS* commercial operations and reduce the cost of Space Shuttle operations through privatization, eventual commercialization, and flying payloads.	• Complete development of a commercialization plan for Space Shuttle in partnership with the research and commercial investment communities.	• Streamline Space Shuttle operations. Transition routine operations to a government role of insight.	• Transition Shuttle prime contracts to the Space Flight Operations Contract: – Solid rocket booster: July 1998. – External tank, Space Shuttle main engine, and reusable solid rocket motor under assessment.
	• Foster consortia of industry, academia, and government; leverage funding, resources, and expertise to identify and develop commercial space opportunities.	• Increase industry investment in space research to $50M in FY 1999. • Establish two new CSC's: one for food technology and one for environmental systems.	• Provide research opportunities and project management to microgravity Commercial Space Centers (CSC) through implementation of the SPD Program. • Establish CSC Cooperative Agreements.	• Increase CSC industrial affiliates by 10 percent. • Conduct 30 commercial investigations on STS–95. • Cooperative Agreements in place in 1999.
	• Involve our Nation's citizens in the adventure of exploring space and transfer knowledge and technologies to enhance the quality of life on Earth.	• Expand the microgravity research program World Wide Web (WWW)-based digital image archive established in 1998 by 50 percent.	• Verify and improve the process by which researchers submit images for the microgravity WWW archive.	• Achieve 50 percent increase of new images in the archive.

Aeronautics and Space Transportation Technology Enterprise

• Access to space—Enable the full commercial potential of space and expansion of space research and exploration.	• Develop low-cost space launch technologies.	• Complete the X–33 in preparation for flight testing.	• X–33 – Program management. – Technical analysis/test per TTA's.	• Begin flight tests and demonstrate key technologies in 1999.
		• Begin flight tests of the X–34 and demonstrate key technologies for reducing the cost of space transportation.	• X–34 – Program management. – Fastrac engine. – MPS design. – Technical analysis/test per TTA's.	• Begin flight tests and demonstrate key technologies in 1999. • Deliver Fastrac engine to X–34 in 1999.
• Research and Development (R&D) Services—Enable on a National basis, world-class aerospace R&D services, including facilities and expertise. and proactively transfer cutting-edge technologies in support of industry and U.S. Government R&D.	• Provide world-class aerospace research and development services, facilities, and expertise.	• Transfer at least 10 new technologies and processes to industry.	• ASTP Focused and Core Technology – Small payloads. – RLV focused. – Upper stages.	• Demonstrate the viability of a ceramic matrix composite blisk and nozzle in 1999. • Complete Rocket Based Combined Cycle flowpath testing in 1999. • Demonstrate capability to store cryogens for long-term missions (30 days) in 1999. • Define airframe and propulsion system concepts and initiate technology by 1999.

Space Science Enterprise

• Chart the evolution of the Universe from origins to destiny and understand its galaxies, stars, planets, and life.	• Solve the mysteries of the Universe.	• AXAF—record 100 images and spectra of galaxies at a resolution of better than an arcsecond and record data on approximately 50 compact stellar objects.	• Manage the development of Advanced X-Ray Astrophysics Facility.	• Launch readiness—December 1998. • System level imaging resolution: subarcsecond.
			• Manage the development of Gravity Probe-B.	• Complete integrated payload testing. • Complete delivery of all flight electronics systems.
			• Manage the development of Solar-B.	• Complete Phase A and requirements review. • Begin Phase B.
			• Manage the development of Solar X-Ray Imager.	• Complete integration and test for planned launch (August 1999). • Full-disk soft x-ray imaging of the Sun, including solar flares and coronal holes.
• Develop new critical technologies to enable innovative and less costly mission and research concepts.	• Develop innovative technologies for Enterprise missions and external customers.	• None listed.	• World-class leadership in space optics manufacturing technology.	• In a three-phase process, beginning in 1998 and completing in 2002, increase mirror diameter four times while decreasing the mass by a factor of six and improving the resolution by 33 percent. Capability to optically test large optical systems at cryogenic temperatures.

Earth Science Enterprise

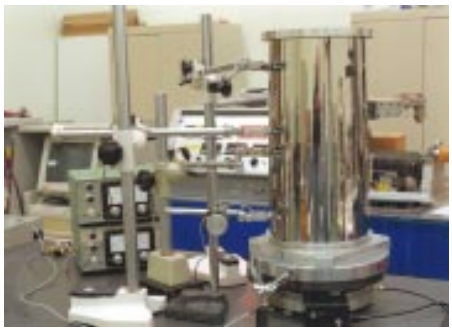
• Expand scientific knowledge by characterizing the Earth system.	• Understand the causes and consequences of land-cover/land-use change, especially in urban areas. • Detect long-term climate change, causes, and impacts.	• Refresh the global archive of 30-m land imagery from Landsat 7. • Collect near-daily measurements of terrestrial biosphere.	• Project ATLANTA. • Use spacebased detection of lightning to assess tropical rain rates and processes. • Lead inter-Center effort to begin design for free-flyer Doppler lidar instrument to be proposed in Earth System Science Pathfinder Program. • Manage the development of Shuttle based New Millenium Program Doppler lidar wind instrument (SPARCLE). • Manage the development of Lightning Mapper Sensor (LMS).	• Complete land-use/land-cover change analysis. • Complete technology development and preliminary design of LMS. • Develop a lightening mapper to be flown on a GOES satellite. • Complete design for SPARCLE. • Develop technique to assimilate lidar wind data into regional climate models in 1999.
• Disseminate information about the Earth system.	• Improve dissemination of Earth Science research results. • Incorporate education and enhanced public understanding of science as an integral component of Earth Science missions and research.	• Make available data on prediction, land surface, and climate users within 5 days. • Double the volume of data archived compared to FY97.	• Develop links for application of scientific results. • Cooperative work with faculty and graduate students.	• Acceptance of at least one journal article per scientist. • Routine communication of science results through the public media.
• Enable the productive use of Earth Science and technology in the public and private sectors.	• Make major scientific contributions to national and international environmental assessments. • Extend the used Earth Science research to national, state, and local applications.	• Contribute to the Intergovernmental Panel on Climate Change Report. • Establish at least five new Regional Earth Science Applications Centers.	• Continue to monitor global, stratospheric, and tropospheric temperatures for regional and global temperature trends. • Perform the Southeast U.S. regional assessment.	• Produce regular updates of global temperature and display on WWW, and publish at least one paper per year on results. • Successfully compete in solicitation to be chosen as Southeast Regional Earth Science Application Centers; initiate two applications projects with stakeholders.

Mission:
Space Optics Fabrication, Metrology, and Testing

Our goal: Lead the research and development of space optics fabrication, metrology, and testing that supports and enhances the NASA advanced propulsion and science programs.

We support—

- Aeronautics and Space Transportation Technology Enterprise
- Space Science Enterprise
- Industry and Commercial Needs
- Other Federal Agencies

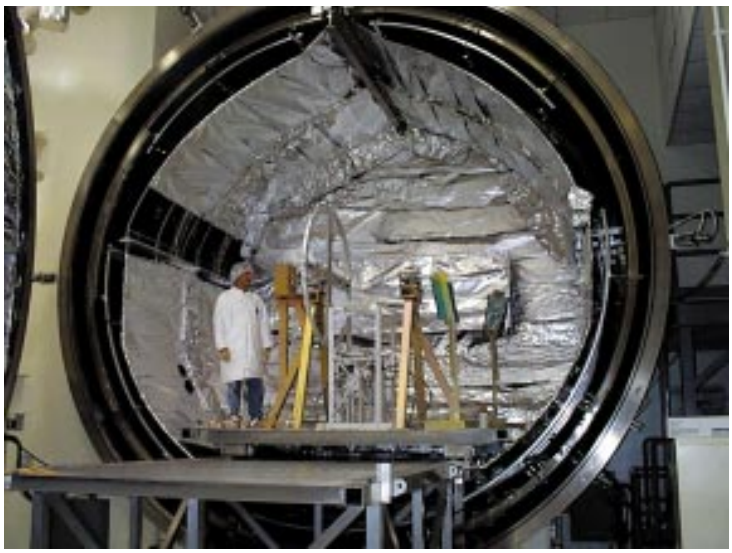


Metrology Circularity Test Stand.

As a world leader in Space Optics Manufacturing Technology, MSFC will foster research and development to advance the state of the art in optical manufacturing and testing; and serve as a repository of technical knowledge and as a focal point for technology transfer among government, industry, and academia. New technologies for the coating and fabrication of large, lightweight, inflatable reflectors and Fresnel lenses are being pursued in support of the Aeronautics and Space Transportation Enterprise for future applications in solar thermal propulsion. New technologies for large, low-cost, lightweight optics in space are being pursued for the Next Generation Space Telescope and other future programs. Low-energy x-ray telescope mirrors are needed to support future Space Science Enterprise missions such as the Constellation X-Ray Mission planned for the period of 2003–2009. MSFC optical testing will be enhanced with the unique capability to test large optical systems at cryogenic temperatures.

Space Optics Fabrication, Metrology, and Testing Metrics

- In a three-phase process, beginning in 1998 and completing in 2002, increase mirror diameter four times while decreasing the mass by a factor of six and improving the resolution by 33 percent.
- Capability to optically test large optical systems at cryogenic temperatures.



Large-Optic Coating Facility.

50-cm x-ray mandrel for diamond turning.

Other Programmatic Assignments

The following is a brief summary of program related assignments being implemented by MSFC for the NASA Enterprises and other Lead Centers.

International Space Station

We support—

- Human Exploration and Development of Space Enterprise

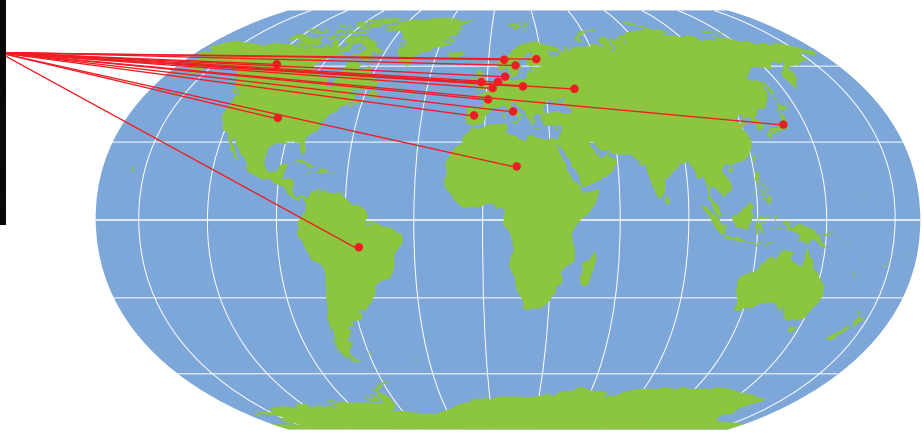
International Space Station.

Payload Operations and Integration Center.

The *International Space Station* (*ISS*) is a U.S.-led, international partnership program to build and operate a unique, world-class orbiting laboratory, free from the effects of gravity. Long-term scientific and technology development will be conducted for the benefit of life on Earth. MSFC is responsible for: development of the regenerative life support systems for *ISS*'s crew and research animals; management oversight of two node elements and the Multipurpose Logistics Module being built by the Italian Space Agency; and the Interim Control Module being built by the Naval Research Laboratory; development of research facilities including the EXPRESS rack; integration support of Spacelab pallets and support equipment for *ISS* assembly; environmental qualification testing of major *ISS* elements and systems; and management of the payload operations and utilization activities for research onboard the *ISS*.

International Space Station Metrics

- One Minipressurized Logistics Flight Module delivered to Kennedy Space Center (KSC)—August 1998.
- Flight 6A Spacelab pallet flight support equipment delivered to KSC—December 1998.
- Complete integration for the first EXPRESS rack with five payloads ready for launch at the beginning of FY 2000.
- Complete preparations for the launch of the first rack of the Human Research Facility and the Window Observational Research Facility on the first utilization flight.
- The Payload Operations and Integration Center will be ready to support payload operations for Flight 7A.1, March 2000.



***International Space Station* Participation—**
United States • Canada • Japan • Russia • Brazil
Italy • France • Belgium • Netherlands • Denmark • Norway
Spain • Germany • United Kingdom • Sweden • Switzerland

continued

Advanced X-Ray Astrophysics Facility.

Advanced X-Ray Astrophysics Facility

We support—

- Space Science Enterprise

MSFC is responsible for managing the overall design, development, integration, and testing of the Advanced X-Ray Astrophysics Facility (AXAF). The program's goals are to determine the nature of celestial objects from normal stars to quasars, understand the nature of physical processes that take place in and between astronomical objects, and understand the history and evolution of the Universe. These goals will be accomplished by extending the range of astrophysical observations significantly beyond that of previous x-ray observatories through increases in sensitivity and resolution. Images taken will be 10 times sharper than those from previously flown x-ray telescopes.

Advanced X-Ray Astrophysics Facility Metrics

- Launch readiness—December 1998.
- Five-year life.
- System level imaging resolution: subarcsecond.
- Time on orbit above 60,000 km: ≥68 percent.

Gravity Probe-B.

Scientific Payloads and Research

We support—

- Space Science Enterprise

MSFC manages the Gravity Probe-B, Solar X-Ray Imager, and Solar-B scientific payloads and instruments, and conducts research in high-energy astrophysics, solar magnetic fields, and low-energy space plasma physics.

Scientific Payloads and Research Metrics

- Gravity Probe-B
  - Launch readiness by October 2000.
  - Mission lifetime of 16 months.
  - Measurement accuracy for relativistic drift of 0.5 milliarcsecond/year.
- Solar-B
  - Launch readiness by February 2004.
  - Mission lifetime of 3 years.
  - Engineering models by October 2000.
  - Focal plane instrument delivery to ISAS by June 2002.
  - 0.5-Meter Optical Telescope resolution of 0.25 arcseconds.
- Solar X-Ray Imager
  - Launch on GOES-M August 1999.
  - Mission lifetime of 3 years.
  - Full-disk soft x-ray imaging of the Sun, including solar flares and coronal holes.

Climate studies and lightning observations.

Global Hydrology and Climate Center

We support—

- Earth Science Enterprise
- National Oceaneering and Atmospheric Administration (NOAA)

Through the Global Hydrology and Climate Center (GHCC), a joint venture with academia, MSFC engages in research, education, and the development of Earth-science applications. The GHCC focuses on using advanced technology to observe and understand the global climate system, and applies this knowledge to agriculture, urban planning, water resource management, and operational meteorology. Areas of emphasis include observations of lightning, winds, and the use of other measurements for the study of Earth's global hydrologic and energy cycles. MSFC manages the development of the Lightning Mapper Sensor (LMS) and the Shuttle-based Lidar Wind Measurement Demonstration (SPARCLE).

Global Hydrology and Climate Center Metrics

- Develop and publish a global lightning data base on a seasonal and annual basis.
- Deliver LMS by the end of FY 2001 for flight on Geostationary Operational Environmental Satelite (GOES) mission.
- In 1999, complete the SPARCLE design.
- Develop the technique to assimilate lidar wind data into regional climate models.
- Be selected as Southeast Regional Earth Science Application Centers and initiate two application projects.

Agency Support Activities

A broad range of personnel, facility, and operational support services is required to support NASA's mission. NASA Headquarters has assigned the following Agency support activities to MSFC.

Lead Center Support Activities

- **Communications Architecture and Providing Agencywide Area Network (WAN) Services**
  Develop an Agencywide communications architecture to support NASA's Enterprises that incorporates flexibility of technologies, efficiency in sustaining costs, and standards insuring full interoperability. The WAN shall incorporate these principles while successfully transitioning the WAN to the CSOC with no loss of availability.
- **Consolidated Mainframe and Administrative Server Operations**
  Provide cost effective mainframe computing support for the Agency's Strategic Enterprises.
- **NASA Digital Television Transition**
  Provide policy dissemination, planning, and implementation guidelines to efficiently transition from NASA's current analog television and video systems architecture to the U.S. digital standard.
- **Earned-Value Management (EVM)**
  Establish an effective, value-added NASA EVM program and provide the oversight and guidance for the implementation of EVM policy throughout the Agency.
- **NASA Metric Transition**
  Transition the Agency's activities to the SI/metric systems of units in lieu of the inch-bound system.
- **NASA Operational Environment Team**
  Provide a central environmental technology resource to ensure that all NASA programs and projects comply with environmental standards as provided by the Environmental Protection Agency.
- **Preferred NASA Engineering Standards**
  Provide an integrated system of NASA-wide preferred engineering standards, guidelines, specifications, and handbooks.
- **Space Environments and Effects**
  Serve as NASA's lead for identifying, developing, and maintaining the technologies required to mitigate effects of hazardous space environments on spacecraft required for future missions.

Other Support Activities

- **AdminSTAR**
  Provide leadership in implementing and sustaining a training administration business system across the Agency.
- **Electronic Meeting System**
  Provide leadership in implementing and sustaining a collaborative performance improvement tool across the Agency.
- **Human Resource and Payroll Information Systems**
  Increase the operational efficiency and effectiveness of the program functional manager activities associated with the Agency Human Resource and Payroll Information Systems.
- **Integrated Financial Management Program (IFMP)**
  Integrate the Agency's administrative processes and procure and implement commercial off-the-shelf software applications to facilitate those re-engineered processes. Provide Agencywide training for IFMP.
- **Logistics Business Systems Operations and Maintenance**
  Provide responsive and cost effective logistics business systems to all NASA Strategic Enterprises, business partners, and logistics business process customers.

Institutional Functions and Capabilities

Our goal: Enhance and sustain a highly skilled, diverse, and motivated workforce committed to safety while working in a creative and productive environment in support of cutting-edge systems and technology development.

Functions	Goals	Metrics
Safety and Mission Assurance	Enhance MSFC's effectiveness in roles supporting NASA's Strategic Enterprises by ensuring that safety, reliability, maintainability, and quality assurance are integrated early into and throughout the life cycle of all programs and projects.	• Initiate Center-wide safety initiative to enable NASA to be #1 in safety
Center Operations	Enhance customer satisfaction by simplifying processes and reducing costs associated with providing and delivering quality support services, protecting and preserving physical assets, providing a safe and healthy environment for the MSFC workforce, and promoting harmonious industrial labor relations. • Environmental Engineering and Management Services • Facilities Services • Information Systems Services • Logistics Services • Protective Services • Technical Information and Operations	• Ninety percent customer satisfaction by FY 2000. • Ninety percent services provided at competitive rates by FY 2000. • Eighty percent of processes simplified through integrated support services by FY 2000. • Ninety percent availability rate for primary mission-related facilities, systems, and equipment by FY 1999. • 100 percent of MSFC Mission Critical Systems complete; "Year 2000 Implementation" by March 1999.
Customer and Employee Relations	Facilitate and coordinate the MSFC strategic and implementation planning process and communicate, internally and externally, clear, consistent messages that are traceable to the MSFC Implementation Plan. Ensure an effective workforce that enables MSFC to succeed in a dynamic external environment, and provide quality products and services to our customers. • Education Programs • Employee and Organizational Development • Government and Community Relations • Human Resources • Internal Relations and Communications • Media Relations • Technology Transfer	• Reduce the MSFC civil servants FTE while maintaining a diverse workforce. • Provide frequent updates to the public for all missions. • Expand the scope of NASA teacher programs to include workshops that serve state-level urban and rural systems and science centers/museums. • Increase the number of NASA Educator Resource Centers in our six-state geographical service region from four to six. • Increase the employee and organizational development opportunities. • Increase the number and value of partnerships established, patents obtained, licenses issued, and releasable success stories.
Equal Opportunity	Promote and strive for equal opportunity; equity and diversity in all occupational groups, grade levels, organizational units; MSFC programs and activities; and fully-accessible facilities. Conduct educational programs with historically black and other minority universities.	• Strive for representation in all grade and organizational levels and occupational skill groups. • Provide fully-accessible facilities. • Increase research opportunities with historically black and other minority universities.
Financial Management	As stewards of Government resources, we will develop and maintain processes and systems that ensure accurate financial control across the Center.	• Obligate 95 percent of authorized funding for the current Program Year. • Ensure that the IFMP Phase 1 systems and processes are successfully implemented by June 1, 1999.

Legal Support	Support MSFC's assigned roles and missions by providing timely and sound professional legal counsel and representation to all MSFC organizational elements. Administer the ethics program and patent prosecution for MSFC.	• Ensure that all court-imposed filing dates are met. • Review financial disclosure forms within 60 days of submission.
Procurement	Improve effectiveness and efficiency of Center acquisitions through increased use of techniques and management tools that enhance contractor innovations and performance.	• Increase obligated funds available for Performance-Based Contracts to 80 percent. • MSFC will award 20 percent of its budget to Small Business concerns in FY99. • MSFC will award 8 percent of its budget to SDB concerns in FY99.

Engineering and Science Capabilities

(Goals and metrics to be developed in 1999)

Program Development

Program Development (PD) implements and manages a wide range of technical and programmatic planning efforts to provide project plans, advanced systems conceptual definitions, technical feasibility analyses, and preliminary designs in support of space systems definition activities and proposed new initiatives to achieve the goals and objectives of MSFC and NASA. The mission of PD is to provide its customers with innovative concepts, plans, designs, and advanced mission studies, including high-quality technical, programmatic, and economic analyses. PD supports diverse technical disciplines and projects including advanced space transportation systems, advanced launch vehicles, propulsion systems, upper stages, scientific experiments and payloads, space exploration, and related mission planning.

Science and Engineering

MSFC's highly skilled engineers and scientists of the Science and Engineering (S&E) Directorate use state-of-the-art equipment and world-class facilities to accomplish research and development (R&D) for MSFC, other NASA Centers and government agencies, industry, and academia. Our prime responsibility to the Agency is for R&D of Space Transportation Technologies and Systems, Space Propulsion, Microgravity R&D, Payloads, and Space Optics Manufacturing. MSFC's space systems architecture and engineering expertise design, develop, test and deliver crosscutting projects and services to a variety of customers. These motivated and highly-trained professionals make up two thirds of MSFC employees and reside in seven unique laboratories described below.

Astrionics: Plans, performs, and directs R&D in engineering and analysis of electrical systems, guidance and control systems, optical and radio frequency systems, computer and communication systems, software, and avionics simulation systems related to space vehicles, payloads, and support equipment.

Materials and Processes: Provides science, technology, and engineering design, development, and test of materials, processes, and products to be used in space vehicle applications, including related ground facilities, test articles, and support equipment.

Mission Operations: Performs mission operations by analyzing and developing mission operations requirements on flight and ground systems, implementing mission support systems, and conducting preflight planning and on-orbit flight operations from the Huntsville Operations Support Center.

Propulsion: Plans, establishes, directs, and conducts engineering R&D relative to propulsion and mechanical design systems, and evaluates the launch and operation of space vehicles, payloads, and support equipment.

Space Sciences: Plans, coordinates, directs, and conducts original and supporting theoretical, experimental, and observational research in space science, microgravity science, and Earth system science.

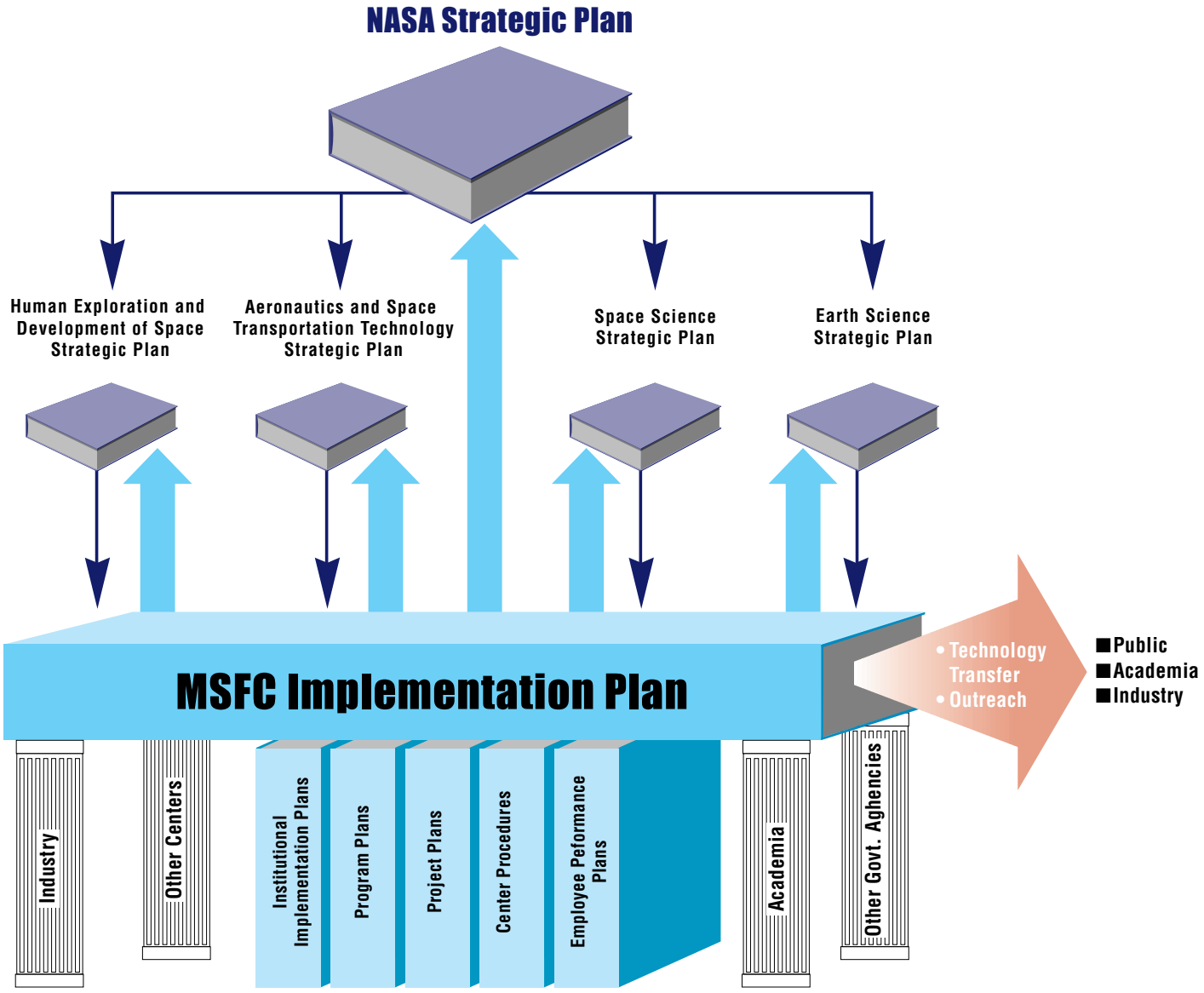
Structures and Dynamics: Plans, conducts, and directs R&D in structures and dynamics for the analysis, design, and/or qualification testing of space and launch vehicles, payloads, and systems.

Systems Analysis and Integration: Performs systems engineering, analysis, integration, and test functions for MSFC, other NASA Centers, industry, academia, and state and federal agencies.

MSFC's Link to the Future

The *NASA Strategic Plan* defines the Agency's vision, mission, and fundamental questions of science and research that provide the foundation for our goals. The four Strategic Enterprises identify their objectives to meet the Agency's goals in their individual Strategic Plans.

The *MSFC FY 1999 Implementation Plan* provides the link for the Center Program Plans, Project Plans, Institutional Implementation Plans, Center Procedures, and Employee Performance Plans to the Agency and Enterprise Strategic Plans. Our implementation is supported by industry, other Centers, other federal agencies, and academia. The Implementation Plan reflects MSFC's dedication to NASA's goals and communicates to the Strategic Enterprises, our employees, and our partners and customers the implementation of our roles and missions through metrics tied to the Agency budget.



Points of Contact

For further information regarding the *Marshall Space Flight Center FY 1999 Implementation Plan*, please contact the following individuals.

Center of Excellence for Space Propulsion

http://photo3.msfc.nasa.gov/propulsion.html	RA01	Garry Lyles	256–544–9203

Human Exploration and Development of Space

Microgravity Research—http://microgravity.msfc.nasa.gov/	MG01	Joel Kearns	256–544–5506
Flight Projects Office—http://snail.msfc.nasa.gov/ppo/welcome.html	JA01	Dick Marmann	256–544–1883
Space Shuttle—http://liftoff.msfc.nasa.gov/	SA01	Alex McCool	256–544–0718

Aeronautics and Space Transportation Technology

Space Transportation Systems Development—http://stp.msfc.nasa.gov/	XX01	Rick Bachtel	256–544–7210
Advanced Space Transportation Program—http://astp.msfc.nasa.gov/	RA01	Garry Lyles	256–544–9203
X–33 Program—http://rlv.msfc.nasa.gov/	RA20	Robert Austin	805–572–2134
X–34 Program—http://rlv.msfc.nasa.gov/	RA30	John London	256–544–0454

Space Science Enterprise

Space Optics Fabrication, Metrology, and Testing	EB51	Robert Jayroe	256–544–1968
Space Science—http://wwwssl.msfc.nasa.gov/	ES01	Greg Wilson	256–544–1628
Observatory Projects Office (AXAF)—	TA01	Fred Wojtalik	256–544–0647
http://spacelink.nasa.gov/NASA.Projects/Space.Science/Universe/Advanced.X-Ray.Astrophysics.Facility.AXAF/.index.html			

Earth Science Enterprise

Global Hydrology and Climate Center (GHCC)—			
http://wwwghcc.msfc.nasa.gov/ghcc_home.html	HR01	Ray Arnold	256–922–5861

Agency Support Activities

NASA Payroll Operations Consolidation	BK01	John Alexander	256–544–7290
Integrated Financial Management Program	BF01	Jonathon Pettus	256–544–9271
Lead Center for Communications Architecture and Providing Agencywide WAN Services	AI51	Terry Luttrell	256–544–0130
Lead Center for Consolidated Mainframe and Administrative Server Operations	AI11	Portia Dischinger	256–544–8650
Lead Center for Earned Value Performance Management	BJ01	Jeff Saxon	256–544–0109
Lead Center for NASA Operational Environment Team	DA01	Bob Schwinghamer	256–544–1001
Lead Center for Preferred NASA Engineering Standards	EL01	Gabe Wallace	256–544–4359

continued

Agency Lead for Space Environments and Effects	DA01	Bob Schwinghamer	256–544–1001
NASA Digital Television Transition	AI41	Rodney Grubbs	256–544–4582
Sustaining Engineering Support for Agencywide Administrative Systems	AI51	Marcellus Graham	256–544–5633
Logistics Business Systems Operations and Maintenance	AC01	Nikita Zurkin	256–544–6326
NASA Metric Transition	EL01	Darlene Springer	256–544–1312
AdminSTAR and Electronic Meeting System	CO20	Greg Walker	256–544–7558

MSFC Institutional Functions and Capabilities—http://www.msfc.nasa.gov/

Science and Engineering	EA01	William Taylor	256–544–1000
Program Development	PA01	Axel Roth	256–544–0451
Chief Counsel	CC01	Bill Hicks	256–544–0010
Educational Programs	CO60	Jim Pruitt	256–544–0213
Equal Opportunity	CE01	Charles Scales	256–544–4927
Financial Management	BC01	David Bates	256–544–0092
Human Resources	CO10	Danny Hightower	256–544–7496
Internal Relations & Communications	CO40	Norm Brown	256–544–0505
Media Relations	CO70	John Taylor	256–544–0031
Government & Community Relations	CO50	Lynne Lowery	256–544–5549
Employee and Organizational Development	CO20	Greg Walker	256–544–7558
Information Systems	AI01	Charles Houston	256–544–5772
Facilities Services	AB01	Peter Allen	256–544–7909
Environmental Engineering	AE01	Rebecca McCaleb	256–544–4367
Logistics Services	AC01	Roy Malone	256–544–0506
Technical Information & Operations	AT01	Dale McElyea	256–544–0372
Procurement	GP01	Steve Beale	256–544–0257
Safety & Mission Assurance	CR01	Amanda Harris	256–544–0043
Technology Transfer	CO30	Sally Little	256–544–4266

The Marshall Commitment

We are committed to—

- **Safety**—human life, both in space and on Earth, is our first priority.
- **Excellence**—responsive and accountable to our customers in supplying high-quality products and services.
- **Our Employees**—our most valuable asset. We will build and maintain a unified, interdependent Marshall team.
- **Partnerships**—building with other Centers, academia, industry, and other Government agencies.
- **Change**—innovative thinking and flexibility in adapting to change.
- **Communication**—open and effective communications with each other, our customers, and the public.
- **Community and Environment**—maintain a valuable and active role in our community and environment.
- **Continual Learning**—increase core capabilities by enhancing core competencies.