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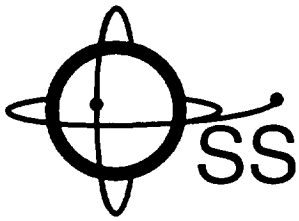

Office of Space Science

Integrated Technology Strategy

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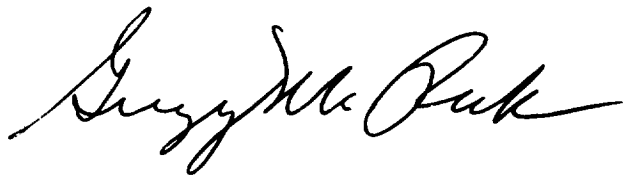
Preface

This document is the product of the Office of Space Science (OSS) Integrated Technology Strategy Process Action Team. The Team, formed in May 1993, was chartered to recommend the process by which OSS would strategically align itself to successfully respond to technology issues currently facing OSS, NASA, and the nation. Members of the Team included representatives from the different OSS divisions, the Office of Advanced Concepts and Technology (OACT), the Office of Space Communications, and the Goddard Space Flight Center.

OSS investment in advanced technology development is critical to ensure that new technologies continue to be available for future space science missions. However, OSS recognizes the need to work closely with its technology providers to improve the processes by which new technologies are infused into NASA's space science programs. OSS must accept its responsibility to actively promote the timely transfer of commercially relevant space science technologies to the private sector and thereby provide tangible returns to the U.S. economy.

Development of the Integrated Technology Strategy represents an important milestone for OSS. It lays the foundation for developing strong strategic alliances between OSS and its technology providers in government and industry. In particular, OSS recognizes that collaboration with OACT is essential for success. The OSS Technology and Information Systems Office will be responsible for monitoring and regularly reporting progress on strategy implementation.

Wesley T. Huntress, Jr.
Associate Administrator for
Space Science



Gregory M. Reck
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Advanced Concepts and Technology

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Executive Summary

Over the past year, the nation has witnessed significant change. The Clinton Administration has focused the American agenda on improving the U.S. economy. Emphasis is placed on accelerating the development of civilian technologies to stimulate economic growth. The formation of partnerships among government, industry, and universities is considered a necessary catalyst for this process.

Similarly, NASA has recently witnessed significant change. 1992 was a year marked by intense self-evaluation. In the technology arena in particular, it was recognized that the Agency needed to better integrate its processes in order to successfully infuse new technologies into its programs and to strengthen the mechanisms by which it transferred its technologies to the private sector.

NASA's Office of Space Science (OSS) faces many challenges in the near future. The most significant of these is to succeed in utilizing new technologies to achieve space science goals on smaller, less expensive missions, while at the same time providing tangible returns to the economy. Development of an Integrated Technology Strategy represents an important first step taken by the Office of Space Science to meet these challenges.

The Office of Space Science recognizes that, to achieve its missions, it must satisfy its principal stakeholders, including its primary customers (the scientific community, the American taxpayer, and Congress–who represents the taxpayer's interests); management (the President and the NASA Administrator); and its partners in implementing the strategy (the Office of Advanced Concepts and Technology, the Office of Space Communications, industry, the field centers, the Jet Propulsion Laboratory, and other government agencies).

The OSS vision of success for its Integrated Technology Strategy is the embodiment, at all levels and across all disciplines, of a continued commitment to develop, utilize and transfer technologies that provide scientific and globally competitive economic returns to the nation. To attain this vision, OSS strives to meet four primary goals: (1) OSS will identify and support the development of promising new technologies which will enable or enhance space science objectives and reduce mission life-cycle costs; (2) OSS will infuse these technologies into space science programs in a manner that is cost effective, with acceptable risk; (3) OSS will establish technology transfer as an inherent element of the space science project life cycle; and (4) OSS will support the development of strong and

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lasting implementing partnerships among industry, academia and government to assure the nation reaps maximum scientific and economic benefit from its Space Science Program.

With its Integrated Technology Strategy, the Office of Space Science establishes the policy that each OSS mission will contribute to the advancement of spacecraft, science instrument or ground systems technologies to ensure that new technologies continue to become available for use on future missions. Research solicitations and plans will reflect programmatic objectives to develop and transfer promising technologies to the private sector. Partnerships with industry will be formed to facilitate this process.

The Integrated Technology Strategy outlines selection and funding criteria for OSS required technologies. It establishes the annual process by which technology requirements will be identified and communicated to technology providers, and the process by which funding commitments for technology development, infusion and transfer will be agreed upon and documented. It introduces roles and responsibilities for OSS, OACT and OSS discipline divisions/offices with respect to strategy implementation, for OSS's newly formed Technology and Information Systems Office, and for Project Technologists within OSS projects. It establishes the charter for a Technology Advisory Panel reporting to both the Space Science Advisory Committee and the Technology and Commercialization Advisory Committee.

The OSS Integrated Technology Strategy lays a foundation for developing strong, lasting strategic alliances between OSS, its primary technology provider (NASA's Office of Advanced Concepts and Technology) and other technology providers, both in government and industry. The strategy represents a beginning, and in many respects, a new way of doing business within the Office of Space Science. It is anticipated that the strategy will change over time, as relationships and processes are clarified and strengthened.

OSS looks forward to working with its stakeholders to successfully implement its Integrated Technology Strategy and meet the challenges facing NASA and the nation.

1.0 Introduction

In its February 1993 report "Technology for America's Economic Growth, A New Direction to Build Economic Strength," the Clinton Administration formally recognizes technology as the engine of economic growth and scientific advances as the foundation upon which technical progress is built. NASA, along with many other federal agencies, is currently working with the Administration's Office of Science and Technology Policy, the Office of Management and Budget, and the Congress to promote technology as a means for economic growth.

NASA's Office of Space Science (OSS) will support this national technology thrust by:

- Exercising world leadership in basic science, mathematics, and engineering through sponsorship of scientifically and technically challenging space science missions;
- Supporting the development and infusion of state-of-the-art technologies into its science missions; and
- Establishing partnerships with U.S. industry to transfer these technologies to the private sector, thereby providing tangible benefits to the economy.

This document outlines the strategy by which the Office of Space Science, in collaboration with the Office of Advanced Concepts and Technology and the Office of Space Communications, will meet the challenge of the national technology thrust. The document:

- Highlights the legislative framework within which OSS must operate;
- Evaluates the relationship between OSS and its principal stakeholders;
- Outlines a vision of a successful OSS integrated technology strategy;
- Establishes four goals in support of this vision;
- Provides an assessment of how OSS is currently positioned to respond to the goals;
- Formulates strategic objectives to meet the goals;
- Introduces policies for implementing the strategy; and
- Identifies metrics for measuring success.

The OSS Integrated Technology Strategy establishes the framework through which OSS will satisfy stakeholder expectations by teaming with partners in NASA and industry to develop the critical technologies required to: enhance space exploration, expand our knowledge of the universe, and ensure continued national scientific, technical and economic leadership.

2.0 Background

The National Aeronautics and Space Act of 1958 established NASA's mandate to conduct activities in space that contribute substantially to the expansion of human knowledge and "to the preservation of the role of the United States as a leader in aeronautics and space science and technology and in the application thereof to the conduct of peaceful activities within and outside the atmosphere." Reinforcing the Space Act is the Directive on National Space Policy (1989), which states "a fundamental objective guiding the United States space activities has been, and continues to be, space leadership."

NASA is mandated to take positive action to place the results of its research and development (R&D) into the hands of those who can apply it for public and private benefit, particularly U.S. industry. The Stevenson-Wydler Technology Innovation Act of 1980 (Public Law 96-480) states that it is the policy of the federal government to strive to transfer federally-funded technology to the private sector. The Federal Technology Transfer Act of 1986 (Public Law 99-502) makes technology transfer a responsibility of all federal laboratory scientists and engineers and mandates that technology transfer responsibility be considered in laboratory employee performance evaluations. Executive Order 12591 (1987) emphasizes U.S. commitment to technology transfer. And, most recently, the Clinton Administration, in its 1993 report entitled "Technology for America's Economic Growth" states that all laboratories managed by DOE, DOD, and NASA that can make a productive contribution to the civilian economy will be reviewed with the aim of devoting at least 10-20 percent of their budgets to R&D partnerships with industry. The report also stated that all federal support for technology development will be reviewed to ensure research priorities address industry needs, and every federal technology program will be regularly evaluated to determine if it should remain part of the national program.

OSS is responsive to these legislative and executive imperatives to fuel the U.S. economy with new technology. The fundamental mission of OSS is to further our understanding of the universe, its origin, and the stellar and solar system and to direct this understanding to practical applications where appropriate. To achieve this mission, OSS must foster the development of new technologies to continually improve scientific capabilities, and transfer science and technology advances to the public and private sector to assure U.S. scientific and technical leadership and benefit quality of life for all.

3.0 Stakeholder Analysis

To succeed in its overall mission, OSS must satisfy its key stakeholders. Stakeholders include OSS's primary customers: the scientific community and ultimately, the American taxpayer, who realizes scientific and economic returns through OSS's interaction with the space science community and the private sector. Congress represents the taxpayers interests. OSS's management—first, the NASA Administrator and then, the President—are key stakeholders. OSS's partners in implementing the strategy are also key stakeholders: OACT and OSC, industry, the field centers, including the Jet Propulsion Laboratory, and other government agencies. Table 1 on the following page reflects an analysis of stakeholder influence on OSS, what OSS needs from its stakeholders, and the criteria stakeholders use to judge OSS performance. Recognition of the relationship between OSS and its stakeholders is considered a necessary prerequisite for establishing OSS's vision of a successful Integrated Technology Strategy.

4.0 Vision of a Successful OSS Integrated Technology Strategy

The following synopsis represents the OSS "vision of success" for its Integrated Technology Strategy:

The Office of Space Science embodies, at all levels and across all disciplines, a continued commitment to develop, utilize, and transfer technologies that provide scientific and globally competitive economic returns to the nation.

OSS technology policy and guidelines have been clearly communicated to its principal stakeholders and are accepted by them. The responsibilities and processes to identify, develop, infuse and transfer technologies are recognized, supported, and routinely implemented within OSS projects.

Accurate, timely life cycle costing is addressed as a standard project requirement. It highlights, through clearly recognizable cost savings, the long-term benefits of developing and infusing new technologies into space science projects.

Timely fiscal support for technology development is an agency priority and is provided through well-defined and coordinated efforts across NASA. OSS funds are highly leveraged, with maximum benefit garnered from technology development programs both internal and external to the agency.

Principal Stakeholders	How Stakeholder Influences OSS	What OSS needs from Stakeholder	Criteria Stakeholder Uses to Judge OSS
CUSTOMERS			
Space Science Research Community	Identifies Missions and Formulates Science Requirements	Science and Mission Strategic Guidance	Research and Mission Opportunities Provided
	Provides Advisory Recommendations	Scientific Results Published	Mission Successes
	Congressional Interaction	Technologies Developed, Infused, Transferred	Stable funding to support research
		Advocacy	Clarity of Decision-Making
American Taxpayer	Influences Congressional Support	Awareness	Economic Benefits Realized
		Endorsement	Inspire Youth to Study Math and Sciences
			National Pride in NASA's Successes
Congress	Budget	Budget Stability	Satisfied Congressional Constituency
(Taxpayer's Representative)	Legislation	Endorsement	Mission Success within Cost and Schedule
SENIOR MANAGEMENT			
President	Policy	Inspiration and Advocacy	Economic Benefits Realized
(White House, OSTP, OMB)	Budget	Policy and Budget	World Leadership in Maths and Sciences
			Productive Partnerships with Industry
NASA Administrator	Policy	Leadership	Mission Success within Cost and Schedule
	Budget	Policy and Budget	Responsiveness to direction given
		Advocacy	Positive Response from Other Stakeholders
		Timely Conflict Resolution	
IMPLEMENTORS			
Office of Advanced Concepts and Technology	Provides Advanced Technologies	Responsiveness to OSS Requirements	Coherence and Stability of Technology Requirements
(and other technology providers)	Cofunds Technology Developments and Testbeds	Innovative technologies and approaches	Funding commitments to Advanced Technology Development
	Provides infrastructure for interacting with private sector	Technologies Developed, Infused, Transferred	Infusion of Developed Technologies in OSS Programs
	Provides Opportunities for OSS to Leverage ATD funds	Facilitate Leveraging of OSS ATD Funds	
Space Industry	Identifies Alternate Approaches to Implement Missions	Missions within Cost, Scope and Schedule	Development Opportunities Provided
	Mission Cost, Scope and Schedule	Innovative Ideas and Processes	Clearly Defined Requirements
	Lobbies Congress	Technologies Developed, Infused, Transferred	Funding consistent with scope and schedule
		Productive Partnerships	
		Advocacy	
Non-Space Industry	Lobbies Congress	Innovative Ideas and Processes	Commercially Relevant Technologies Transferred
	Productizes OSS-Sponsored Technology	Technologies Developed, Infused, and Transferred	
		Visible Technology Transfer Successes	
		Advocacy	
NASA Field Centers and JPL	Performance Reflects on OSS	Responsiveness to Direction	Clear requirements, direction and guidance
	Mission Cost, Scope and Schedule	Missions within Cost, Scope and Schedule	Adequate, stable funding
		Advocacy	Stable management
		Innovative Ideas	
Other Government Agencies	Competing missions	Advanced Technologies	Mission Successes
	Technology Suppliers	Productive Partnerships	Perception of public, national pride
	Partner in Joint Missions	Advocacy of OSS Missions	

Table 1: Stakeholders

OSS can point to any of its missions and readily identify the many benefits realized as a result of successful advanced technology utilization. Because early attention is paid to technology development and validation, the risk of utilizing new technologies in space science missions is maintained within acceptable limits.

The science community is profiting from NASA's technology successes. New technologies have enabled bolder scientific investigations and have significantly enhanced the data return from all OSS missions. Scientific breakthroughs are being achieved as a direct result of OSS's successful commitment to foster new technologies. These technologies have reduced mission costs, making more research opportunities available to the space science community.

Early and continued OSS support for the development and transfer of commercially relevant space technologies to the private sector have resulted in frequent public recognition of NASA's technology transfer successes. As a result, the non-space industry routinely seeks and engages in productive, synergistic enterprises with NASA and its university and space industry partners.

The Agency has reaped the benefits of OSS's successes. Public, administration and congressional support is strong. NASA has become a widely recognized leader in fueling the technological engine that is vital to the nation's economy.

5.0 Integrated Technology Goals

Consistent with its vision of a successful Integrated Technology Strategy, the Office of Space Science has established four strategic goals.

Goal 1: OSS will identify and support the development of promising new technologies which will enable or enhance space science objectives and reduce mission life cycle costs.

Goal 2: OSS will infuse new technologies into space science programs in a manner that is cost effective with acceptable risk.

Goal 3: OSS will establish technology transfer as an inherent element of the space science project life cycle.

Goal 4: OSS will support the development of strong and lasting implementing partnerships among industry, academia, and government to assure the nation reaps maximum scientific and economic benefit from its Space Science Program.

6.0 Analysis of Present OSS Environment

Addressing the goals listed above requires understanding the external and internal situations/environments, followed by an evaluation of strengths and weaknesses in relation to the opportunities and challenges faced.

6.1 External Environment: The Administration's Position

Since World War II, the federal government's technology policy has consisted of support for basic science and mission-oriented research and development, with a reliance on defense and space investments "trickling down" to civilian industry. In their February 22, 1993 statement, "Technology for America's Growth, A New Direction to Build Economic Strength," President Clinton and Vice President Gore indicate that the traditional federal role in technology development which was appropriate for a previous generation is no longer applicable to today's challenges.

The Administration calls for a move in a new direction which reaffirms a commitment to basic science, the "foundation on which all technical progress is ultimately built," while at the same time forging closer working partnerships among industry, government and universities. Clinton and Gore emphasize that the new approaches need not jeopardize agency missions. Rather, they contend that many missions coincide with commercial interests, or can be accomplished better through close cooperation with industry.

The Administration is moving to accelerate the development of civilian technologies with three primary goals in mind: long-term economic growth, a government more productive and responsive to citizens' needs, and world leadership in science, math and engineering.

The Office of Science and Technology Policy (OSTP) has been charged to lead in the development of science and technology policy and coordinate the R&D programs of the federal agencies. The way in which federal agencies do business will be modified to encourage cooperative work with industry in areas of mutual interest. All laboratories managed by the Department of Energy, NASA and the Department of Defense that can make a productive contribution to the civilian economy will be reviewed with the aim of devoting at least 10-20 percent of their budgets to R&D partnerships with industry. Every federal technology program will be regularly evaluated against pre-established criteria to determine if it should remain a part of the national program.

6.2 Internal Environment

6.2.1 National Research Council

In 1990, the National Research Council's (NRC) Aeronautics and Space Engineering Board and its Space Studies Board chartered a Joint Committee on Technology for Space Science and Applications. In late 1991, NASA asked the Joint Committee to review NASA's technology plans with an eye towards identifying means of optimizing the future development of technologies for space science and applications. The NRC joint committee convened a Committee on Space Science Technology Planning, a workshop was held in 1992, and the committee released a report in 1993 entitled "Improving NASA's Technology for Space Science."

In reviewing NASA's programs, the committee found that better mechanisms were needed to ensure infusion of OAST (now the Office of Advanced Concepts and Technology) developed technologies to the Office of Space Science and Applications (now the Offices of Space Science, Mission to Planet Earth, and Life and Microgravity Sciences and Applications) missions. They urged the offices, during the earliest phases of each project, to agree how and at what stage of development technology infusion will occur.

The committee recommended that the Office of Space Science and Applications (OSSA) develop an overarching technology development strategy and that each science division within OSSA formalize its technology planning activities. It suggested that the divisions consider empowering existing advisory groups to identify technology needs and to examine division-wide consolidated needs. It indicated a need to document the criteria used to determine which technology development efforts would be funded with OSSA funds versus OAST funds. And finally, the committee believed that the overall fraction of OSSA resources devoted to promoting technology development was too small to enhance capabilities, reduce risk and make new technological advances available for future space science initiatives.

6.2.2 NASA Technology Teams

While the NRC was developing its report on improving NASA's technology for space science, NASA Administrator Daniel Goldin initiated team efforts within NASA to review and provide recommendations on both the integration of state-of-the-art technology into NASA space programs and the transfer of technology from NASA to formal or informal organizations outside of NASA.

6.2.2.1 Technology Integration Team

NASA's Technology Integration Team, headed by Dr. J. Wayne Littles of the Marshall Space Flight Center, presented its findings and recommendations to Mr. Goldin in December 1992. The team found that NASA does not function as an integrated system in identifying, developing and inserting technologies into its space programs. NASA emphasizes low initial program costs as opposed to life cycle costs, and its phased project development process, as practiced, does not properly include technology definition and development. Similar to the NRC report, the Technology Integration Team recommended that each program office collaborate with "the Research and Technology organization" (OACT) to develop specific technology insertion plans. They recommended that each of the NASA offices implement advanced technology development programs to complement the OACT programs and to enable the smooth transition of technologies into new projects, in accord with the technology insertion plans.

6.2.2.2 Technology Transfer Team

The Technology Transfer Team, headed by Dr. Jeremiah Creedon of the Langley Research Center, also presented findings and recommendations to Administrator Goldin in December 1992. This team reaffirmed the fact that NASA has been directed to transfer its technology, and that NASA can expect to be held accountable for its technology transfer performance.

The team found that the activities associated with transferring primary NASA mission technology to its target customers are not supported by many of the formal processes in NASA's infrastructure. With the exception of people directly involved in NASA's Technology Utilization (TU) programs,awareness of NASA's technology transfer activities is almost non-existent. The burden of technology transfer rests largely with the TU officers, with little commitment from the research organizations. Researchers perceive little direct connection between technology transfer and rewards, and most NASA employees, contractors, and grantees don't feel technology transfer is part of their job. Distinct, non-integrated technology transfer activities and processes are being pursued within the agency, but there have been relatively few successes. Statistics and metrics to accurately measure success have not been routinely kept and used for managing technology transfer activities.

The team concluded that significant, continuing improvement must be made in NASA's technology transfer performance for NASA to best serve the country. However, success in technology transfer requires deliberate, dedicated effort. It occurs mainly in the context of appropriate person-to-person relationships between providers and recipients.

6.2.2.3 Office of Space Science Strategic Planning to Date

Prior to its reorganization into three separate science organizations, the Office of Space Science and Applications had initiated efforts to respond to an increasingly constrained budget environment and to address the NRC and NASA Technology Integration and Transfer Team recommendations. A strategy had begun to emerge that focused on lowering mission costs by reducing size and complexity through new technology. The new strategy had two components. The first component addressed the flight plan. Several flight programs were restructured to be simpler, leaner and more focused. Each of the discipline science divisions was charged to develop a flexible, low-cost set of missions to carry out science objectives quicker and cheaper. The second component emphasized developing new technologies to achieve science objectives.

The newly formed Office of Space Science (OSS) maintains the momentum generated to respond to the constrained budget environment. OSS strategic thrusts emphasize reducing the cost of current mission development and operations, developing more small missions, renewing emphasis on selected intermediate missions, and developing fewer large missions. Its plans call for reestablishing the vitality of the Research and Analysis base and continuing investment in technologies for future missions.

OSS recognizes and accepts its responsibility to team within the Agency in responding to the Administration's national technology thrust. It is committed to forming strategic alliances with the Office of Advanced Concepts and Technology, the Office of Space Communications and other organizations to address technologies of importance to the space science research community, and to transfer commercially viable technologies to the private sector. OSS has established a Technology and Information Systems Office to provide a focal point for OSS technology activities, and it has formed an Integrated Technology Strategy Process Action Team to propose an implementing organizational framework, with the attendant policies and processes. This document is the product of the Process Action Team.

6.3 Strengths, Weaknesses, Opportunities, and Challenges

The environmental analysis provided above highlights several strengths, weaknesses, opportunities, and challenges. These are summarized below in more detail:

6.3.1 Strengths

OSS has aggressively responded to the changing environment. It has:

- moved to a strategy of smaller, less expensive, more frequent missions

- emphasized new technology development and utilization in its missions
- established a Technology and Information Systems Office
- taken action to develop an Integrated Technology Strategy

OSS is committed to establishing a strong strategic alliance with the Office of Advanced Concepts and Technology (OACT), its primary technology provider.

OACT is restructuring its programs to be more responsive to OSS requirements by addressing broad-based but mission-focused technology developments.

Some OSS divisions have developed division-level technology plans.

Customer teams have been formed at the division level between OSS and the OACT to communicate technology requirements and priorities.

Positive initial results are being realized with focused technology development efforts in support of a limited number of OSS missions.

OSS has the ability to reward technology successes.

6.3.2 Weaknesses

NASA isn't functioning yet as an integrated system in identifying, developing and inserting technologies in its programs.

Insufficient attention is paid to life cycle costs, and the fact that they highlight the current and future mission benefits of implementing technology development, infusion, and transfer.

OSS doesn't have an overarching technology development strategy.

To date, neither OSS nor OACT has allocated enough resources to meet space science technology development needs.

No formal criteria exist within OSS, or between OSS and OACT, for technology selection, funding or transition planning.

Until very recently, use of new technologies in OSS flight projects was discouraged because of the cost, schedule and risk implications.

NASA's traditional phased project development process doesn't properly include technology definition and development.

There is a lack of awareness of technology transfer responsibilities, and little support for technology transfer within established processes.

There are no prescribed metrics for effectively evaluating technology transfer success.

The roles and responsibilities for the Technology and Information Systems Office have not been finalized and made available to the stakeholders.

6.3.3 Opportunities

There exists very strong Administration and Agency support for technology development and for transfer of technologies to the private sector.

The several organizational changes within NASA provide an opportunity to implement changes in the ways we do business and interact with others.

The reduced budget environment provides strong motivation for utilizing new technologies to reduce cost.

A strong strategic alliance with OACT, given OACT's strengthened customer focus, can profoundly impact the development of technology critical to future space science missions.

6.3.4 Challenges

Changing the "way of doing business," the culture, that has evolved over decades is difficult; it can't be done without strong, committed and continuous leadership.

Because of insufficient funds and lack of early attention to technology development, project managers view new technology infusion as a threat; they see it as increasing project risk and cost.

The science community sees the emphasis on spacecraft technology investment as a threat to the OSS primary mission of scientific research; it anticipates that it will take R&D dollars away from that research or the development of new instruments.

Failure to utilize new technologies to reduce mission costs will result in loss of space science research opportunities.

Underutilization of advanced technologies makes the U.S. Space Science Program less competitive internationally.

Lack of success in transferring technology to the private sector will impact NASA negatively, and will likely result in reduced funding for Space Science.

7.0 Strategic Objectives

Given its mission, strengths and weaknesses, opportunities and challenges, the Office of Space Science outlines the following strategic objectives to be addressed in achieving the four Integrated Technology Strategy goals identified in Section 5:

Goal 1: OSS will identify and support the development of promising new technologies which will enable or enhance space science objectives and reduce mission life cycle costs.

To achieve this goal, analysis indicates the need to strengthen and better integrate the processes by which technologies are identified and developed, to increase the resources applied to these efforts, and to establish a way for decision-makers to recognize the resulting benefits of supporting the technology development effort. Associated strategic objectives are:

- To implement life cycle cost analysis (and analysis of cost implications to future missions) as a standard project review requirement to determine, early in the mission design process, the benefits associated with developing and infusing advanced technologies in space science missions.

- To establish a process for identifying, prioritizing and communicating OSS technology requirements to technology providers.

- To establish and maintain a viable OSS advanced technology development program.

- To exploit opportunities to leverage OSS advanced technology development funds.

Goal 2: OSS will infuse these technologies into space science programs in a manner that is cost effective with acceptable risk.

OSS managers and the technology providers must agree, at the earliest phase of each study, how and at what stage of development technologies can best be incorporated into the project. This process needs to be appropriately incorporated into the project

development plan so as to keep costs of technology infusion reasonable and the risks of using these technologies manageable. Associated strategic objectives are:

- To advance technologies for spacecraft, science instruments or ground systems by incorporating these technologies into space science missions.

- To establish a project management structure and phased project development planning process which facilitates and rewards successful technology infusion into OSS projects.

- To establish mechanisms to retire risk early, including use of technology testbeds and/or flight opportunities to validate technologies prior to inserting them in project critical paths, and the identification of alternative approaches to satisfy mission objectives in the event of slower than anticipated technology maturation.

Goal 3: OSS will establish technology transfer as an inherent element of the space science project life cycle.

The Administration's emphasis on accelerating development of civilian technologies in support of long-term economic growth reaffirms the fact that the Office of Space Science is responsible for transferring to the private (and especially the non-space) sector the technologies developed in support of its missions. Successful technology transfer requires deliberate, dedicated effort and funding, and occurs mainly in the context of appropriate person-to-person relationships between providers and recipients. Associated strategic objectives are:

- To implement modifications to Announcements of Opportunity (AOs), NASA Research Announcements (NRAs), Research and Technology Operating Plans (RTOPs), Requests for Proposals (RFPs), grants and contracts to establish dual use technology development and transfer as an integral part of OSS projects.

- To reinforce program and project level employees' awareness of technology transfer responsibilities through training, performance evaluation and award structure, and through encouragement of appropriate person-to-person interfaces.

- To routinely utilize NASA's established technology transfer infrastructure.

- To explore the feasibility and potential benefits of issuing separate AOs or RFPs for participation in science missions strictly for the purpose of transferring technology to the private sector.

Goal 4: OSS will support the development of strong and lasting implementing partnerships among industry, academia and government to assure the nation reaps maximum scientific and economic benefit from its Space Science Program.

Productive partnerships between industry (space and non-space), academia and government provide an environment which facilitates concurrent technology development and transfer. The federal agencies have been directed by the Administration to develop these partnerships with industry. Associated strategic objectives, therefore, are:

- To establish a space science partnerships initiative which will synergistically address both OSS and private sector technology needs and contribute to the achievement of the national goal for DoE, NASA, and DoD of devoting at least 10-20 percent of the budget to R&D partnerships with industry.

    1. To encourage use of partnership arrangements with the private sector in conducting R&D grants.

    2. To require establishment of partnership arrangements with the private sector in selected award fee contracts.

8.0 Office of Space Science Technology Policy

OSS is committed to advancing technology. It will aggressively seek new techniques and new approaches for its missions, it will accept a proportionately greater mission risk, and it will actively promote continuing interactions among space scientists, technologists and the private sector.

In contributing to the advancement of technology, OSS pursues four goals:

Goal 1: OSS will identify and support the development of promising new technologies which will enable or enhance space science objectives and reduce mission life cycle costs.

Goal 2: OSS will infuse these technologies into space science programs in a manner that is cost effective, with acceptable risk.

Goal 3: OSS will establish technology transfer as an inherent element of the space science project life cycle.

Goal 4: OSS will support the development of strong and lasting implementing partnerships among industry, academia and government to assure the nation reaps maximum scientific and economic benefit from its Space Science Program.

To achieve these goals, OSS establishes the following policies:

1. **Each OSS mission will contribute to the advancement of space flight technologies, science instrument technologies or ground systems technologies to ensure that new technologies continue to become available for use on future missions.**

2. **OSS will participate in strategic alliances with the Office of Advanced Concepts and Technology and the Office of Space Communications.** These alliances will strive to ensure that:

   a. OSS technology requirements and priorities are effectively communicated;

   b. Specific plans are developed and agreed to for timely development and infusion of new technologies into OSS flight and ground systems;

   c. Ground-based technology testbeds and flight opportunities to validate technologies are appropriately utilized to understand and control the risks of using new technologies in OSS missions;

   d. Technology transfer to the private sector (space and non-space) is successfully accomplished;

   e. Funding approaches to accomplish the above are agreed upon; and

   f. Conflicts are rapidly resolved.

3. **OSS and OACT will jointly charter a Technology Advisory Panel.** This panel will consult with and advise NASA with respect to strategies, plans and progress for development and infusion of new technologies into OSS programs and missions, and for maximizing the subsequent transfer of technologies developed under NASA auspices to the private sector for broader commercial application as appropriate so as to stimulate the economy and contribute to increased international competitiveness. The Technology Advisory Panel will report to both the Space Science Advisory Committee and the Technology and Commercialization Advisory Committee. Appendix A provides details on the charter, membership and relationships of this panel.

4. **OSS divisions and offices will:**

   a. Develop division technology plans, documenting the technology requirements needed to satisfy tactical and strategic science objectives. Plans are to be coordinated and reviewed on an annual basis with relevant advisory bodies.

   b. Identify, on an annual basis, proposed technology requirements to be transmitted to the Office of Advanced Concepts and Technology and other technology providers, and negotiate approaches for meeting these requirements.

   c. Address life cycle costs throughout the phased study and project development process and in the yearly budget process, to clearly quantify the impacts (positive and negative) of infusing new technologies in current and subsequent Space Science missions.

   d. Identify, through the yearly budget process, the level of division and office funds devoted to mission concept studies and to promoting technology advancement, what the funds address, and the extent to which funds are leveraged through cooperative activities internal or external to the Agency. Funding shortfalls are to be highlighted, along with plans and/or recommendations to resolve identified deficiencies.

   e. Require that project technologist functions be supported within OSS flight projects no later than the start of Phase A activities. These functions will be addressed earlier in the flight project's life cycle as required to maximize opportunities to identify, develop and infuse new technologies into space science missions.

   f. Provide and protect resource allocations (power, mass, etc.) on selected science missions specifically for the purpose of technology demonstration/validation.

   g. Require that technology identification, development, infusion and transfer progress be measured in the regular project reporting process.

   h. Provide, at selected points in the phased project development process, independent review of technology identification, development, infusion and transfer plans and status.

   i. Encourage and fiscally support project-level participation in conferences promoting technology transfer.

5. **Criteria for OSS's selection of technologies** to be addressed by technology providers in support of OSS projects and/or missions shall be, in order of priority:

   a. The technology has a specific application on a firm or expected OSS mission.

   b. The benefits of using the technology, in terms of cost, mission risk and/or science return have been quantified.

   c. The degree to which the proposed technology applies to multiple missions or projects.

   d. The technology or the processes used to develop the technology are of value to the private (especially non-space) sector, and a plan to transfer that technology to the private sector has been identified; or, in the event that the value of the technology to the private sector is not well understood, a plan exists for assessing this.

6. **Technology development funding** shall typically be phased between the primary developer (OACT or other organizations, including other OSS divisions and offices), and the OSS user organization. Phasing shall be identified with respect to the NASA Civil Space Technology Readiness Levels (defined in Appendix G):

   a. The primary developer will fund the development of technology readiness levels 1 through 4. (The principal contribution of OSS at these levels is to identify/track requirements.)

   b. The primary developer, OSS Advanced Programs and/or an intermediary (if identified) will co-fund levels 5 through 7. OSS investment percentage will typically increase as the technology readiness level increases.

   c. OSS Flight Programs will fund levels 8 and beyond.

   These funding criteria represent a baseline funding position. Specific funding arrangements between provider and user will be negotiated and documented. Funding arrangements will be reviewed on an annual basis by the Associate Administrators. Modifications to agreed upon arrangements will require the approval of the Associate Administrators.

   It is recognized that, in some cases, the user will also be the primary developer.

7. **Announcements of Opportunity (AOs), NASA Research Announcements (NRAs) and Research and Technology Operating Plans (RTOPs) will be structured** to make it clearly understood that in addition to mission research objectives, NASA maintains a programmatic objective to develop and transfer promising technologies to the non-space private sector.

   In addition to addressing scientific rationale, selected AO and NRA background sections will state that it is the objective of the Administration and NASA to transfer to the private sector dual-use technologies developed in support of scientific missions. Proposers will be required to address, as a criterion for selection, the extent to which scientific and programmatic objectives can be met synergistically.

   OSS will encourage partnership arrangements with the commercial sector in conducting the R&D objectives depicted in its RTOPs. RTOP reports to Headquarters will highlight, along with research progress, established partnership arrangements, and identification of commercial applications of the resulting R&D to create new products, processes or services.

8. **Office of Space Science divisions and offices will support timely transfer of commercially promising dual-use technologies to the private sector.** Technology transfer may be implemented through any of several mechanisms. These include, but are not limited to:

   a. Partnership arrangements between the government and industry to jointly develop dual-use technologies pertinent to space science objectives.

   b. Inclusion of development of dual-use technologies pertinent to space science objectives in OSS funded contracts.

   c. Supplements to existing research grants to facilitate technology transfer.

   d. Interface with Office of Advanced Concepts and Technology (OACT) supported technology utilization offices and technology transfer centers.

   OSS divisions and offices will take full advantage of Agency level initiatives designed to promote the transfer of technologies to the private sector.

   Division and Office of Space Science monthly reviews will provide status on technology transfer progress.

Technology transfer potential and successes will be factored into Office of Space Science fiscal decision-making processes.

9. **The Office of Space Science will participate with the Office of Advanced Concepts and Technology on technology missions** by selecting science experiments to fly on the technology missions. The primary purposes of this participation will be to validate new technologies in advance of future space science missions and to facilitate technology transfer between the technology providers and the science users of these technologies.

9.0 Measuring Strategy Success

Table 2 highlights the metrics established to evaluate progress and successful achievement of each of the strategic goals.

Goals	Progress towards goal	Achievement of goal
Identify and develop new technologies	• Use of life cycle costing; subsequent accuracy validation • Level of leveraging of OSS funds • Numbers of new mission concepts inspired by technology advances • Number and dollar value of joint technology • Size and growth trend of OSS ATD program • Positive Advisory Committee reviews • Consistency and stability of requirements and requirements definition process	• OSS technology requirements addressed by technology providers
Infuse technologies into space science programs	• Mission technology plans in place • Successful testbed demonstrations • Flight validated technologies available	• New technologies on space science missions • Number of awards to implementers of technology infusion
Establish technology transfer as an inherent element of space science projects	• Recognized ownership of technology transfer responsibilities by OSS projects • Development arrangements allow technology transfer while technology is being developed • Technology transfer conference attendance • Number of requests for technology information • Number of OSS AA/senior management interactions with non-space firms	• Number of acknowledged uses • Royalties received • Commercial product sales by non-space firms
Develop partnerships	• % of OSS funds to non-space firms • % of non-space matching funds • Numbers of partnerships with non-space industry	• Quality of partnerships with non-space industry

Table 2: Metrics

Appendix A: Technology Advisory Panel

Charter:

The Technology Advisory Panel reports to the Space Science Advisory Committee and the Technology and Commercialization Advisory Committee, both of which are standing committees of the NASA Advisory Council. The function of the panel is to consult with and advise NASA with respect to strategies, plans, and progress for development and infusion of new technologies into OSS programs and missions, and for maximizing the subsequent transfer of technologies developed under NASA auspices to the private sector for broader commercial application as appropriate so as to stimulate the economy and contribute to increased international competitiveness. In this capacity, the panel will review and advise on:

1. Strategies, objectives, and implementing policies and procedures for funding technology investments spanning OSS, OACT, and the Office of Space Communications (OSC).

2. Proposed technologies to be developed, and the priorities across OSS divisions and offices and OSS for developing those technologies.

3. The degree to which OSS technology investment program is effective in achieving its objectives and contributing to overall agency objectives.

4. The coordination of NASA's interests within space science, technology and private sector communities and institutions.

Membership:

The panel will have multidisciplinary representation from a broad cross-section of communities involved in the program. Members will be chosen on the basis of their comprehensive knowledge and leadership and their ability to integrate their more specialized skills across a breadth of the activities. Expertise and communities represented include: scientific research, space system and related technologies, systems and operations analysis, economics/policy expertise, university and federal laboratories, and private industry.

Relationships:

The panel will formally submit its positions and recommendations to the SSAC and the TCAC. The Directors of OSS's Technology and Information Systems Office and

OACT's Spacecraft and Remote Sensing Division will alternate in providing executive secretarial support.

The panel will coordinate its activities with similar efforts established in other NASA science program offices (Office of Mission To Planet Earth, Office of Life and Microgravity Science and Applications), and coordinate its efforts with related panels and working groups within the various space science discipline divisions.

The panel will also conduct special studies and reviews, some of which could be more detailed in nature or involve more specialized assessment of program content and/or progress. It is expected that it may be necessary to augment the study teams with additional expertise from the external community. One example of such an activity would be consultation, advice, and coordination for establishing a collection of independent review teams to assess the progress of NASA technology insertion and transfer on a periodic basis.

Appendix B: Procedure for Identifying, Prioritizing, Communicating Technology Requirements

The Office of Advanced Concepts and Technology (OACT) has developed a "NASA Space Technology Strategy Process" as part of its strategic planning process. This process is depicted in the chart on the following page. The Office of Space Science (OSS) participates in the NASA Space Technology Strategy as a customer to OACT.

In addition to Headquarters division-level customer strategic planning teams depicted in the NASA Space Technology Strategy Process, intercenter technical discipline teams sponsored jointly by OACT and OSS will exist at the field centers. These teams provide a forum for project technologists to interact with technology organizations at the field centers to determine the best approaches for satisfying customer requirements.

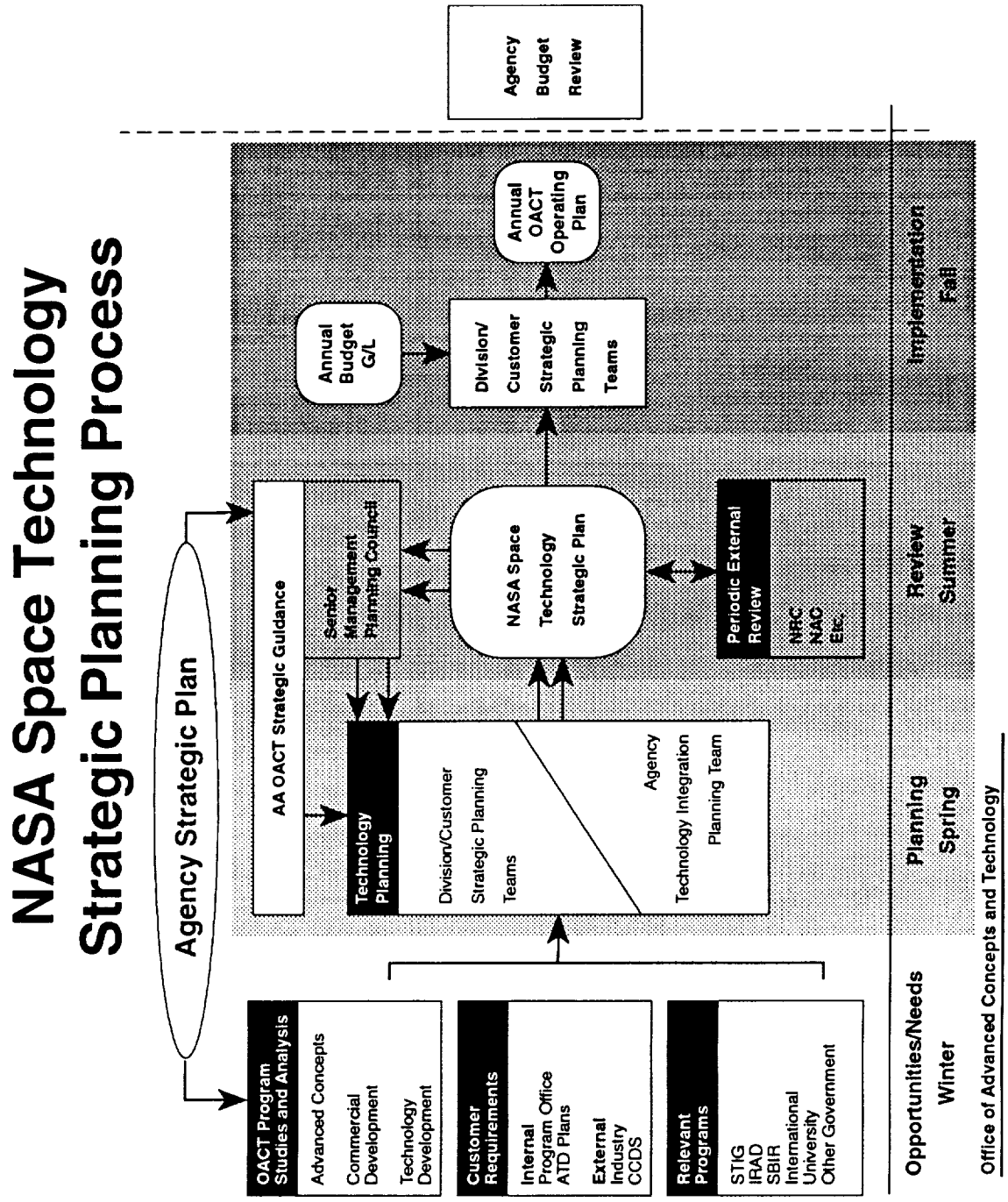
OSS develops and communicates its technology requirements and priorities and establishes proposed funding arrangements with its technology providers through the following general process:

Fiscal Year First Quarter:

1. Using the technology selection criteria outlined in Section 8 of this document as a guideline, each OSS division and office works with its respective science and/or industrial communities to identify technology requirements through two basic mechanisms:

    a. Near-term (3-5 year) and mid-term (5-10 year) mission-focused requirements are recommended to the appropriate OSS division and office via the mission technology plans developed by the project technologists. These plans reflect the results of field-center technology customer team discussions and address the consolidated sets of mission technology requirements of individual principal investigators, science discipline teams and/or science working groups. The plans are based on a set of budgetary assumptions mutually agreed to by OACT and OSS.

    b. Longer term prioritized requirements are identified to the appropriate OSS offices/divisions and to the technology development organizations (i.e. OACT, OSC) by each field center's technology and advanced concepts organizations. Longer term requirements may be established through any of several forums, including workshops with the science and/or industrial community, candidate mission evaluations, collaborative discussions, etc.


NASA Space Technology
Strategic Planning Process
Agency Strategic Plan
OACT Program Studies and Analysis
Advanced Concepts
Commercial Development
Technology Development
Customer Requirements
Internal
Program Office
ATD Plans
External
Industry
CCDS
Relevant Programs
STIG
IRAD
SBIR
International
University
Other Government
AA OACT Strategic Guidance
Senior Management Planning Council
Technology Planning
Division/Customer Strategic Planning Teams
Agency Technology Integration Planning Team
NASA Space Technology Strategic Plan
Periodic External Review
NRC
NAC
Etc.
Annual Budget G/L
Division/ Customer Strategic Planning Teams
Annual OACT Operating Plan
Agency Budget Review
Opportunities/Needs
Winter
Planning
Spring
Review
Summer
Implementation
Fall
Office of Advanced Concepts and Technology

For both a and b, proposed funding scenarios are to be provided along with the technology requirements. Funding scenarios are to be consistent with the funding criteria outlined in Section 8 of this document.

2. Technology requirements are then consolidated and prioritized at the division and office level in accordance with the divisions' technology plan. Each division and office reviews its plan (with the individual technology requirements and proposed funding scenarios) with the appropriate Space Science Advisory Committee subcommittee or panel, as well as with other advisory bodies if it elects to do so. Modifications are made, if necessary, based on advisory committee recommendations.

3. Division-level OSS/OACT customer teams meet to discuss the plans, to evaluate proposed alternatives for meeting the needs, and to refine funding scenarios. Based on the results of these meetings, each division and office prepares a final technology requirements/funding scenario package, which is provided to the OSS Technology and Information Systems Office.

Fiscal Year Second Quarter:

4. The Technology and Information Systems Office works with representatives from each of the OSS science divisions and offices (and with the customer teams, if necessary) to identify and resolve overlap of requirements and to produce a proposed consolidated, prioritized plan of technology requirements/funding scenarios for OSS.

5. The Technology and Information Systems Office reviews the proposed plan with the Technology Advisory Panel. The Technology and Information Systems Office works with the affected parties (divisions, offices, customer teams, etc.) to incorporate panel recommendations, as required.

6. The Technology and Information Systems Office presents the plan to the OSS for review and approval.

7. The Associate Administrator, OSS, formally transmits the plan, with the technology requirements and proposed funding scenarios to be addressed in the coming budget cycle, to the OACT Associate Administrator and, if necessary, to other identified technology providers.

8. OSS anticipates formal reply from the Associate Administrator, OACT (and other technology providers) confirming receipt of the requirements, and identifying, if necessary, the need to work issues with the proposed funding scenarios. The Technology and Information Systems Office will act as OSS's agent for any required conflict resolution.

Fiscal Year Third Quarter:

9. OSS issues its budget guidelines, reflecting the technology funding scenarios agreed upon between OSS and its technology providers.

10. Field centers prepare budget responses to the guidelines, with field center technology customer teams providing the initial forum for coordination of responses back to the respective Headquarters offices. Field center mission, technology and advanced concepts organizations are expected to coordinate their formal budget submissions to Headquarters.

11. OSS division and offices will utilize the Headquarters division-level customer teams as a forum for coordinating the budgets to address individual technology requirements. The Technology and Information Systems Office will monitor progress, and will act as mediator, as necessary, to resolve conflicts.

Fiscal Year Fourth Quarter:

12. The divisions and offices will present budget recommendations to OSS reflecting the agreements reached with OACT, OSC, and other organizations, as appropriate. Division and office presentations will identify the level of division and office funds devoted to promoting technology advancement, what the funds address, and the extent to which funds are leveraged through cooperative activities internal and/or external to the Agency. Funding shortfalls will be highlighted, along with plans and/or recommendations to resolve identified deficiencies.

13. The Technology and Information Systems Office will present a consolidated technology budget package to OSS which reflects the summary of proposed OSS activities promoting advanced technology development.

14. OSS will make final budget decisions, and will reflect these decisions to the divisions and offices, to the OACT and other technology providing organizations, and to the SSAC.

15. Joint funding commitments between OSS and OACT or other organizations will be documented and signed at the Associate Administrator level. The Technology and Information Systems Office will act as OSS's agent to assure that outstanding issues are resolved in a timely fashion.

Appendix C: Roles and Responsibilities

C.1 Office of Space Science

Office of Space Science roles and responsibilities in implementing the OSS Integrated Technology Strategy include:

1. Establishing and promulgating OSS technology policy:

    - Cultivating ongoing strategic alliances with the OACT, OSC and other technology providers to support and sustain effective communication and implementation of OSS technology requirements.

    - Assuring appropriate levels of OSS fiscal and physical resources are allocated to promote advanced technology identification, development, infusion and transfer in support of space science programs.

    - Annually approving and transmitting the OSS integrated technology plan, with technology requirements and proposed funding scenarios, to the OACT and/or other technology providers.

    - Reaching formal agreement with OACT for joint funding of selected technology testbed activities, for OSS participation in selected OACT technology missions, and for OACT participation in selected OSS missions.

2. Providing strong, committed OSS leadership throughout Integrated Technology Strategy implementation:

    - Communicating OSS technology strategy and requirements in appropriate forums (i.e. advisory meetings, conferences, symposia, meetings with industry associations, Congress, etc.).

    - Promoting partnerships between the space science community and the private sector.

    - Rewarding technology identification, development, infusion or transfer successes.

3. Staffing and empowering the OSS Technology and Information Systems Office.

C.2 Office of Advanced Concepts and Technology

OSS requires OACT's support to implement its Integrated Technology Strategy, and to assure that these activities are coordinated within the overall context of NASA's technology strategy. OSS looks to OACT to:

1. Participate in an ongoing strategic alliance with OSS to support and sustain communication and implementation of OSS technology requirements:

   - Provide strong, committed OACT leadership which is supportive of OSS technology goals and objectives.

   - Annually respond to OSS's transmittal of its integrated technology plan.

   - Advocate OSS technology strategy and requirements in appropriate forums (i.e. advisory meetings, conferences, symposia, meetings with representatives from industry associations, etc.).

2. Provide the resources—funds, technical management, facilities—for meeting OSS technology needs with competitive, innovative advanced technology concepts:

   - Assure appropriate levels of OACT funds are allocated to supporting development and infusion of OSS required technologies.

   - Reach agreement with OSS for joint funding of selected technology testbed activities, for OSS participation in selected OACT technology missions and for OACT participation in selected OSS missions.

3. Provide the resources—organizational structures, funds and technical management —to support transfer of technologies developed for OSS programs:

   - Recognize private sector technology needs and identify commonality with space science technology needs, and facilitate communication between technology and private sector interests and the space science community.

   - Fund selected efforts to transfer OSS sponsored technology to the private sector.

4. Reward technology identification, development, infusion or transfer successes.

C.3 OSS Divisions and Offices

Office of Space Science discipline divisions and Launch Vehicles Office roles and responsibilities with respect to implementing the OSS Integrated Technology Strategy include:

1. Implementing the OSS Integrated Technology Strategy:

    - Developing technology plans which document tactical and strategic technology plans, with associated requirements.

    - Staffing customer teams to determine approaches for satisfying technology plans.

    - Working with the OSS Technology and Information Systems Office to integrate plans within OSS and conduct negotiations with technology providers in preparation for annual transmittal of an OSS technology plan to OACT and other technology providers.

    - Evaluating life cycle costs throughout the phased study and project development processes and yearly budget process to quantify the impacts of infusing technologies in proposed missions.

    - Annually evaluating the level of funds devoted to mission concept studies and to promoting technology advancement and identifying plans and/or recommendations to resolve identified deficiencies.

    - Assuring that project technologist functions are supported within flight projects in a timely manner.

    - Providing and protecting resource allocations (power, mass, etc.) on selected science missions specifically for the purpose of technology demonstration/ validation.

    - Assuring that AOs, NRAs, RTOPs, RFPs, contracts and grants reflect, as required, programmatic objectives to develop and transfer promising technologies to the non-space private sector.

2. Monitoring and reporting implementation progress:

    - Providing independent review of technology identification, development, infusion and transfer plans.

- Providing OSS regular technology advancement progress reports.

3. Creating an environment conducive to success:

   - Emphasizing at the Headquarters and field center levels, and within the science community, the strategic importance of implementing the Integrated Technology Strategy.

   - Encouraging and supporting increased program and project level awareness and acceptance of technology responsibilities.

   - Rewarding technology identification, development, infusion or transfer successes.

C.4 OSS Technology and Information Systems Office

The Office of Space Science's Technology and Information Systems Office has a Chief Technologist responsibility for OSS. It will be the focal point for OSS technology activities, serving as liaison to the Office of Advanced Concepts and Technology, to industry and other government agencies.

This office will have the responsibility for developing strategy and recommending programs for incorporating technology in ground and flight systems and instruments, including management of selected ground and flight technology testbeds. It will manage data systems and information management technology for OSS.

Responsibilities of the Technology and Information Systems Office with respect to the OSS Integrated Technology Strategy include:

1. Formulating policies and plans that lead to the infusion/insertion of new technologies in missions and the identification and transfer of dual-use technologies to the private sector.

2. Formulating the prioritized technology needs of OSS into a coherent strategy that leads to the development, demonstration, and infusion of the technology into the Office's ground, aircraft, and space flight programs, and to the timely transfer of commercially relevant technologies to the private sector.

3. Formulating an annual tactical plan for OSS which outlines recently demonstrated technologies, near-term technology demonstrations, Phase A and B studies to be implemented in fulfillment of the OSS Strategic Plan, and communicating this plan to the centers, industry, universities, and other government agencies.

4. Coordinating OSS's technology needs with the other Science Offices to determine common technology needs/requirements, technology development priorities, and strategies for development of common technology needs.

5. Negotiating and coordinating OSS technology needs and requirements with the Office of Advanced Concepts and Technology (OACT) in order to establish an agreement on which new mission focused technologies OACT will be responsible for developing and demonstrating.

6. Negotiating and coordinating, as appropriate, communications and data systems technology needs and requirements with the Office of Space Communications (OSC) in order to establish an agreement on what OSC will be responsible for developing and demonstrating.

7. Formulating strategies to leverage OSS ATD dollars, including coordinating regular communication of OSS technology needs to Small Business and Innovative Research (SBIR) participants, to the space and non-space industrial community, to Historically Black Colleges or Universities (HBCU), and other potential technology development sources; stimulating IR&D investments; prompting OSS participation in the multi-agency Technology Reinvestment Project; etc.

8. Serving as the OSS member, or assigning appropriate individuals for OACT technology development planning, integration, and implementation teams.

To support these duties the Technology and Information Systems Office shall:

1. Represent OSS at meetings with OACT, with other government agencies, and industry to determine what technologies are available and under development to meet OSS needs, to determine the extent to which OSS technology needs complement or support industry technology needs, and to pursue specific joint technology development efforts where appropriate.

2. Coordinate and participate in the review of technology development proposals submitted to OSS.

3. Coordinate with the OSS divisions and offices participation in domestic and foreign technology conferences, workshops, and symposia to present results of the work being accomplished.

4. Maintain personal contacts with individuals in the advanced technology community in order to be cognizant of technology development activities that are relevant to OSS needs.

5. Assure, through coordination with OACT and the OSS divisions and offices, that OSS managers and scientists at Headquarters and the field centers are educated about their technology transfer responsibilities and about the available technology transfer infrastructure.

6. Formulate broad agency announcements regarding technology development for OSS, as well as establishing proposal review and/or funding support from OACT.

7. Provide executive secretarial support to the Technology Advisory Panel.

C.5 Project Technologist

The life cycle of each project or mission must include the identification, development and infusion of new technologies and the timely transfer of project-developed commercially promising dual-use technologies to the private sector. Responsibility for these activities will typically be delegated to the project technologist, who is a member of the project staff, reports directly to the project or study manager and is involved in the design and structure of the mission. The Project Technologist is appointed by the Project Manager after review by the Headquarters Program Managers in OSS and OACT. It is recognized that a full time position for a project technologist may not be warranted for a given project. It is critical, however, that every project address the functions that a project technologist is responsible for accomplishing.

Project Technologist roles and responsibilities are:

1. To identify technology developments that will be of direct benefit to the mission (or subsequent missions) and/or reduce project life cycle costs.

2. To survey promising new technologies, both within NASA and other government agencies and in the private sector, for their applicability and relevance to the mission.

3. To develop a mission technology plan for technology developments, infusion of the technologies into flight or ground systems, and transfer of dual-use technologies to the private sector. The plan will show,for each technology item, the early technology development tasks that are appropriate for funding and management by the technology provider. It will also identify those more mature technologies – suitable for joint sponsorship by both a technology provider and the project–to be managed by the project technologist. The plan will also indicate the point at which the decision must be made by the project manager to baseline the validated

technology into the project, and the process for technology transfer. The plan should include technical performance measures, schedules and milestones, funding profiles, deliverables, etc. The plan is to be developed as early as possible in the study phase, but no later than during the Phase A study and must be approved by the Project Manager and by the funding sources.

4. To manage the development of approved technology items, complete milestones established in the technology plan, and deliver items in time to meet project need dates. The Project Technologist is also accountable to the organizations sponsoring the development of the approved technology items.

5. To disseminate widely technology development results by interacting with field center Technology Utilization offices and Regional Technology Transfer Centers, briefing technology communities and industry, disseminating databases, participating in and/or organizing technology conferences, and publishing technology papers and briefs. The Project Technologist is a champion for the technology, who works to complete the development for space science needs and transfer the technology for private sector needs.

After the technologies have been developed and baselined, the project may elect to retain the Project Technologist to support the development of the affected flight or ground-based mission hardware through to mission use, and to participate in the assessment of the on-orbit or during-mission performance of the technology.

Appendix D: Space Science Partnerships Initiative

OSS will support the development of partnerships among space, non-space firms, educational, other non-profit organizations, and government entities to facilitate technology development and transfer. It is expected that this process will foster the conception and development of new commercial products and result in the creation of new market demand and new U.S. jobs. The space science partnerships initiative addresses synergistically the needs of both OSS and the private sector.

Distinguishing characteristics of space science partnerships are the requirements that the members—including government organizations, if they are members—actively participate in the conduct of the tasks and that they contribute resources either in cash or in kind.

Space science partnerships can be implemented by means of a variety of teaming arrangements: from informal agreements to legally chartered partnerships including consortia, joint ventures, non-profit research corporations, and limited partnerships. To assure its viability, the arrangement must:

- be documented in writing,
- describe the commitments of the parties, and
- be signed by officers qualified to represent the parties.

A partnership supported by OSS will contain members from two or more of the following categories:

- Space firms
- Non-space firms
- Educational entities or other non-profit organizations

Other government organizations, for example a federal laboratory, may be a funding agent, a member, or both.

There are no restrictions to the selection of funding instruments for space science partnerships. Currently available instruments include: contracts, cooperative agreements, grants, and space act agreements.

OSS may also use interagency agreements with other government organizations to help in achieving the goals of space science partnerships.

Appendix E: Integrated Technology Strategy Process Action Team Membership

Mary Kicza, Team Leader
Solar System Exploration Division, Office of Space Science

Steven Hartman
Office of Advanced Concepts and Technology

Dwight Holmes
Office of Space Communications

George Anikis
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Giulio Varsi
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Appendix F: Bibliography

1. NMI 1102.1I: Roles and Responsibilities - Associate Administrator for Space Science, June 28, 1993.

2. Technology for America's Economic Growth, A New Direction to Build Economic Strength. President William J. Clinton, Vice-President Albert Gore, Jr. February 22, 1993.

3. NASA Strategic Planning: June 1993 Report by Dr. Charles J. Pellerin to the Space Science and Applications Advisory Committee, June 1993.

4. Technology Infusion Process Action Team: Final Report and Recommendations to the OSSA Program Management Process Improvement Council. June 24, 1993.

5. NASA Technology Transfer: December 1992 Report of the Technology Transfer Team (Jeremiah Creedon)

6. NASA Technology Integration: December 1992 Report of the Technology Integration Team (J. Wayne Littles)

7. Proposed NMI for Management of NASA Technology and Advanced Development. (Transmitted June 4, 1993 from MSFC/DD01/J. Wayne Littles to HQ/AF/ Gen. Dailey)

8. Improving NASA's Technology for Space Science: 1993 Report of Committee of Space Science Technology Planning, National Research Council.

9. Science, Technology and the Federal Government: National goals for a New Era. 1993 Report of Committee on Science, Engineering and Public Policy, National Academy of Science, National Academy of Engineering, Institute of Medicine.

10. Astrotech 21: Technology Development Program Plan for the U.S. Space Astrophysics Program by the Astrophysics-Technology Team (OSS Astrophysics Division/OACT). March 1993.

11. Space Physics Division Technology Development Plan. NASA Space Physics Division, OSS. April 1993.

12. Solar System Exploration Division Strategic Plan. Volume VI Technology Program. July 1991.

13. NASA Technology Strategic Planning. Briefing by Dr. Robert Norwood at OACT Space Technology Program Strategy Meeting. June 3, 1993.

14. Briefing on Small Business and Innovative Research by Mr. John Glaab, OACT. June 15, 1993.

15. Briefing on Industrial Research and Development by Mr. Stan Sadin, OACT. June 15, 1993.

16. Briefing on OACT National Network for Technology Transfer by Mr. Jonathon Root, OACT. June 15, 1993.

17. Approaching the New Reality. A.V. Diaz. Banquet Address AAS/GSFC International Symposium on Space Flight Dynamics. April 28, 1993.

18. Strategies in Transition. A.V. Diaz. Second International Symposium on Ground Data Systems and Space Mission Operations. November 17, 1993.

19. Space Science Strategic Plan Summary. W. T. Huntress. Draft for SSAAC Winter '92-93 meeting.

20. Office of Space Science and Applications Strategic Plan 1991.

21. 1991 Integrated Technology Plan for the Civil Space Program.

22. National Aeronautics and Space Act of 1958, As Amended. January 1, 1991.

23. Program Information Package for Defense Technology Conversion, Reinvestment, and Transition Assistance. ARPA, March 10, 1993.

24. Strategic Planning for Public and Nonprofit Organizations. John M. Bryson. Jossey-Bass Publishers. San Francisco, 1989.

25. Managing at the Speed of Change. Daryl R. Conner. Villard Books. New York, 1993.

26. Organizational Vision and Visionary Organizations. James C. Collins, Stanford University. Jerry I. Porras, Stanford University. California Management Review, Fall, 1991.

27. NMI 7120.4 (Draft). Management of Major Systems Programs and Projects.

28. Technology Innovation Legislation Highlights. Excerpt from Technology Transfer and the Management of Federal Research and Development. U.S. Office of Personnel Management, Western Management Development Center. Denver, Colorado. June 1-11, 1993.

29. Briefing on OACT Proposal for Advanced Concepts Studies by Mr. John Mankins, July 9, 1993.

30. New Technology Investments, National Aeronautics and Space Administration. July 9, 1993.

Appendix G: Glossary

When used in the context of this document, the terms listed below are defined as follows:

Advanced Technology Development: in the context of this document, encompasses surveys to determine technology state-of-the-art, technology development, technology infusion into OSS ground or flight programs, and technology transfer from NASA to the private sector, other government organizations, or academia.

Life Cycle Cost: (from draft NMI 7210.4) the sum total cost of the direct, indirect, recurring, non recurring, and other related costs incurred, or estimated to be incurred in the design, development, production, operation, maintenance, and support of a project over its anticipated life span. Life cycle costs are the costs incurred in Phases B through E, including development and facility construction costs and the project unique costs such as launch vehicles, tracking and data acquisition, and institutional support exclusive of civil service workforce costs. Also excluded are the undistributed costs of launch vehicles, tracking and data acquisition science, post-phase E (operations) data analysis, base research and technology (R&T), and focused technology, and the non-reimbursable costs of other agencies and governments.

NASA Civil Space Technology Readiness Levels: taken from NASA's 1991 Integrated Technology Plan; outlines the relative maturity of a given technology as follows:

Basic Technology Research:
- Level 1: Basic principles observed and reported

Research to Prove Feasibility:
- Level 2: Technology concept and/or application formulated
- Level 3: Analytical and experimental critical function and/or characteristic proof of concept

Technology Development:
- Level 4: Component and/or breadboard validation in laboratory environment

Technology Demonstration:
- Level 5: Component and/or breadboard validation in relevant environment
- Level 6: System/subsystem model or prototype demonstration in a relevant environment (ground or space)

System/Subsystem Development:
- Level 7: System prototype demonstration in a space environment

System Test, Launch and Operations:
- Level 8: Actual system completed and "flight qualified" through test and demonstration (ground or space)
- Level 9: Actual system "flight proven" through successful mission operations

Program/Project Life-Cycle: (from draft NMI 7120.4) includes:

Phase A	Preliminary Analysis. The analysis of a proposed agency technical objective or mission and alternative approaches and concepts for its accomplishment sufficient to establish need, validate feasibility, and prepare an RFP to initiate the acquisition process.
Phase B	Definition. The effort necessary to understand the full range and implications of implementing a proposed project and defining the technical and management implementation approaches sufficient to make an agency commitment to fully accomplish the project technical objective or mission on schedule and within budget.
Phase C	Design. The effort required to generate the system(s) critical design and test and verification plans.
Phase D	Development. The effort required to produce system(s) operational readiness.
Phase E	Operations. All activities commencing with acceptance of the system(s) by the ultimate operator that are necessary to accomplish the technical and scientific objectives of the project. These include post-launch development, maintenance, planned upgrades, and selected data analyses.

Private Sector: used in this document, refers to both space and non-space industry.

Project Technologist: not necessarily an individual, but a set of functions to be performed by an individual or set of individuals. The project technologist has an enduring role as product champion during the technology development, infusion and transfer processes.

Technology Infusion: the insertion of "new" technology in a space science flight mission. The technology may be "new" in the sense of:

- a novel invention which has just been tested in a ground laboratory or testbed, or
- a product or approach in existence for some time for ground applications or for commercial purposes, but never before used as a part of a flight mission, or
- a product or approach already in use in DOD classified applications, but never before flown in a civilian space science mission

Technology Transfer: the transition of scientific and engineering knowledge from one entity to another for a potentially useful purpose. In this document, emphasis is placed on technology transfer from NASA to the private sector, particularly the non-space

industry, for use in or as a commercial product or process. Transfer of OSS technology is deemed to have occurred when:

- OSS participated in the development by having:

  - contributed funds to the laboratory development, or
  - provided resources (financial or in kind) for flight tests, or
  - validated it on one of its science missions or science experiments; and

- One or more of the six measures identified in the December 21, 1992 Report of the Technology Transfer Team chaired by Dr. J. Creedon show positive indication. The measures are:

  - Requests for Technical Support Packages
  - Number of secondary targeted requests
  - Number of Tech Briefs & Technical Support Packages used
  - Number of acknowledged uses
  - Value of COSMIC sales
  - Royalties received

Appendix H: Acronyms

AA	Associate Administrator
AO	Announcement of Opportunity
ARPA	Advanced Research Projects Agency
ATD	Advanced Technology Development
CCDS	Centers for Commercial Development of Space
DoD	Department of Defense
DoE	Department of Energy
G/L	Guidelines
HBCU	Historically Black Colleges or Universities
IR&D	Independent Research and Development
NAC	NASA Advisory Council
NASA	National Aeronautics and Space Administration
NRA	NASA Research Announcement
NRC	National Research Council
OACT	Office of Advanced Concepts and Technology
OAST	Office of Aeronautics and Space Technologies
OMB	Office of Management and Budget
OSSA	Office of Space Science and Applications
OSC	Office of Space Communications
OSS	Office of Space Science
OSTP	Office of Science and Technology Policy
R&D	Research and Development
RFP	Request for Proposals
RTOP	Research and Technology Operating Plan
SBIR	Small Business and Innovative Research
SSAAC	Space Science and Applications Advisory Committee
SSAC	Space Science Advisory Committee
STIG	Space Technology Interdependency Group
TCAC	Technology and Commercialization Advisory Committee
TU	Technology Utilization