National Aeronautics and
Space Administration

Communicating NASA's Knowledge

A Report of the Communicate Knowledge Process Team

NP-1998-08-240-HQ

Communicating NASA's Knowledge

A Report of the

Communicate Knowledge Process Team

National Aeronautics and
Space Administration

August 1998

Contents

Executive Summary

NASA has a unique charter in the Space Act of 1958 to "provide for the widest practicable and appropriate dissemination of information concerning its activities and the results thereof." As NASA approaches the new millennium, Government legislation and regulations, budgetary reductions that have necessitated downsizing the workforce, an emphasis on measurable results from Government agencies, and technological communications breakthroughs have provided the impetus for NASA to reexamine the way it communicates the knowledge that it generates. NASA has been challenged to manage knowledge as a resource that we owe to the American people.

Throughout its 40-year history, NASA has enjoyed exemplary success in communicating its knowledge to its customer groups using a variety of media. In many cases, these successes were achieved as a result of the individual initiatives of scientists who received funding for a scientific project, began producing results, and knew whom to contact within NASA's employee hierarchy, or were themselves contacted by appropriate professionals, enabling the scientists to reach various audiences in a timely manner. Achieving this success required the combined expertise of numerous offices in a traditional Government organizational chart—the science project office, the technology project office, the operations office, the public affairs office, the education office, the history office, the scientific and technical information office, the information technology and communications office, libraries, and record depositories.

In 1997, NASA Administrator Daniel S. Goldin assigned General Spence M. Armstrong, who was then NASA Associate Administrator for Human Resources and Education, the responsibility for documenting NASA's "Communicate Knowledge" (CK) Process. Armstrong assembled a Communicate Knowledge Process Team, which conducted 274 research and technical interviews at 27 locations throughout the country within and outside of NASA. The analysis of these interviews led to the recommendations for the process made in this report.

This report proposes that a Headquarters Communicate Knowledge Board of Directors, chaired by the Headquarters CK Process Owner, be created, consisting of Associate Administrators or Deputy Associate Administrators reporting periodically to NASA's Capital Investment Council. A Headquarters Communicate Knowledge Working Group would be formed to assist the Process Owner in applying metrics, implementing policy, monitoring progress, and integrating Center Communications Plans from an Agencywide perspective.

In addition, a full-time CK Process Owner would be appointed by and directly report to each of NASA's 10 Center Directors. Each Center Director, with the Center Process Owner, would also designate, on a part-time basis, subject matter experts in such areas as public affairs, education, history, and scientific and technical information. The CK Process Owner would coordinate the work of these subject matter experts with the Center's data base administrator, librarian, and records manager to form the Center Integrated Communication Team (ICT). For each new project or new phase of an ongoing project, this team would meet and work with the project manager and the scientists, technologists, and engineers. Subsequently, the project at each NASA Center would develop a CK plan to ensure that each manager, scientist, technologist, and engineer has a system to use that could maximize dissemination of the scientific and technological results. The Center CK Process Owner would be responsible for helping develop the metrics, collecting them periodically, and forwarding them to record at Headquarters to fulfill the requirements of the Government Performance and Results Act of 1993.

Introduction

During the past four decades, the results (knowledge) of NASA's scientific activities and discoveries have proven to be extremely important to the American people and to the world. Concurrently, the means to communicate them to the world have grown exponentially. The writers of the NASA Space Act of 1958 mandate to "provide for the widest practicable and appropriate dissemination of information concerning its activities and the results thereof" showed great foresight as authors of the first of many mandates that would enable NASA to garner support for its activities and discoveries at the national level in its future.

. . . when I talk about (the fact that) it's necessary for scientists and engineers to reach out to Americans who are their customers, I really do mean it. I think it's a fundamental responsibility that we have to the future of this country.

Daniel S. Goldin
NASA Administrator
Worlds Apart

Policy and Regulatory Communications Initiatives

As the primary guiding force in NASA's communication of knowledge, the Space Act of 1958 is relatively unique in its direction and scope among Agency charters in setting the course for NASA's communications efforts. Over the years, other laws and executive directives have directed NASA to provide for the broadest application of its discoveries and results. Various directives provided by Congress and the Clinton Administration have called for Agencies to communicate their findings to the American public and to conduct science transfer and technology transfer to justify their research and development activities. Executive Orders 12591 and 12618 (1987) called for facilitating access to science and technology. The Stevenson-Wydler Technology Innovation Act of 1980 (Public Law 96–480) promoted the transfer of technology from NASA. Subsequent laws to foster technology transfer included the Federal Technology Transfer Act of 1986 (Public Law 99–502), the National Competitiveness Technology Transfer Act of 1989 (Public Law 101–189), the National Technology Transfer and Advancement Act of 1995 (Public Law 104–113), and the United States Innovative Partnership (USIP) program (1996 White House/Governors' Agreement).

In the 1990's, the Clinton Administration gave policy guidance to NASA through such documents as *Science in the National Interest, National Space Policy,* and *Goals for a National Partnership in Aeronautics Research and Technology,* all of which placed great emphasis on the necessity for NASA to communicate knowledge (CK) to the public.[1]

Budgetary CK Incentives

With national budget balancing considerations taking precedence in Congress, the way NASA communicates its knowledge to the world will be examined and impact NASA's support in the future. The Government Performance and Results Act of 1993 required that each Agency develop a strategic plan and an annual performance plan, both of which correlate to the justification of NASA's budget requests. The Government Performance and Results Act called for an annual report on the results of various program efforts, thereby demanding program progress accountability from Government Agencies.

As the Government moved toward reaching the goal of a balanced budget, it constrained the amount of funding available to Agencies such as NASA, whose funding amounts are discretionary rather than mandatory. Agencies have been clearly challenged to demonstrate the relevance of their efforts and are being held accountable for the use of their monetary resources. NASA's budget in future years will depend, in part, on NASA's ability to communicate its knowledge and successes.

1 These three guides were produced by the Executive Office of the President, Office of Science and Technology Policy, National Science and Technology Council, Washington, DC.

Technological CK Impetus

As early as 1976, the National Science Foundation's Office of Science Information Service foresaw the technological role that data bases would assume in the following decade. The foundation enlisted the services of Dr. Russell Ackoff, a pioneer in system design, to develop the National Scientific Communication and Technology System, with hope that it would provide organizational guidance to the information revolution foreseen and be adopted nationally. The plan, though never adopted, foresaw the role that computers would play in assuring "that scientific and technological information, knowledge, and understanding should be as publicly available as possible, minimally restricted only for reasons of personal privacy, national security, and preservation of security rights."[2]

As foreseen in Ackoff's book, during the following decade, data bases grew exponentially as scientific management tools. Videos communicated knowledge in most households. Science fiction came to life as movies and television programming portrayed NASA historical exploration, fictional exploration, and projected exploration. CD–ROM's stored complex color documents. Today, the best of conventional media—newspapers, magazines, television, personal appearances, fairs, workshops, conferences, tours, and publishers—have been combined with computer and Internet technology to create a powerful new interactive medium.

NASA is a recognized leader in Government for its innovative and comprehensive communications abilities. The Agency is frequently cited as having the best web site in Government, receiving praise from the Administration and Internet critics. The explosion in the number of communications vehicles available to every scientist, engineer, and technologist necessitates the need to translate information for the general public. With NASA's budgetary and personnel downsizing constraints on communications processes, it is important for NASA to take a systems-oriented, high-leverage approach to impact public understanding of NASA's science and technology activities at the national level.

The Strategic Plan and NASA's Communication Roles

The NASA Strategic Plan, first published in 1994, has been updated periodically. The 1998 revised plan identifies four collections of programs, called Enterprises: Space Science, Earth Science, Human Exploration and Development of Space, and Aeronautics and Space Transportation Technology. Cutting across these four core Enterprises are four Crosscutting Processes: (1) Manage Strategically, (2) Provide Aerospace Products and Capabilities, (3) Generate Knowledge, and (4) Communicate Knowledge. Their interrelationships are shown in Figure 1 (page 9).

CK Defined

In 1997, Spence M. Armstrong, then NASA Associate Administrator for Human Resources and Education, was assigned the ownership of the CK Process by the NASA Administrator, which gave him the responsibility for documenting the process and leading an improvement/reengineering effort on how knowledge is communicated by NASA. The Headquarters Process Owner was not to become responsible for carrying out the process—that responsibility was to remain with each echelon of management. The rec-

2 Russell L. Ackoff, *Designing a National Scientific and Technological Communication System*, University of Pennsylvania Press, 1976, p. 20.

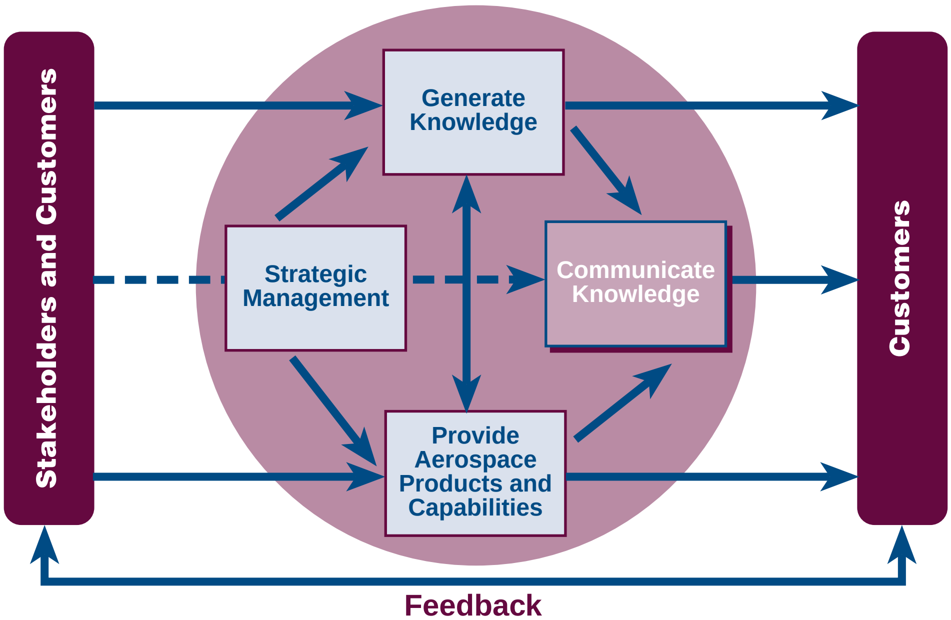

Figure 1. Interrelationships of NASA's Crosscutting Processes[3]

ommended process was to consider metrics that could be used to measure process effectiveness over time.

For purposes of this process documentation and improvement, "knowledge" was defined as a resulting product of a NASA-conducted or NASA-funded research, development, or operational effort. "Knowledge" could be delivered in a number of formats: raw data, data base, reports, imagery, software, technology, or materials. The Communicate Knowledge Process Team differentiated between "disseminating knowledge," defined as a NASA function in the Space Act and "communicating knowledge," which implies a two-way exchange of information between NASA and its customers.

"Communication" was defined as the distribution of knowledge via various means and the collection of feedback information to complete a communications loop. The communication was to be shown over a time continuum at various stages of the scientific product's evolution.

The communication of knowledge within NASA is not included intentionally as a part of the CK Process for purposes of simplification. In the 1990's, corporations instituted the position of chief knowledge officer to facilitate the distribution of institutional knowledge within an organization. This worthwhile endeavor is addressed within the NASA organization as a subprocess under NASA's strategic management process. As Jerry Junkins, the late chairman of Texas Instruments, said, "We have world-class operations side by side with others who just don't get it."

3 *NASA Strategic Management Handbook*, NASA, Office of Policy and Plans, Washington, DC, October 1996, Page 31.

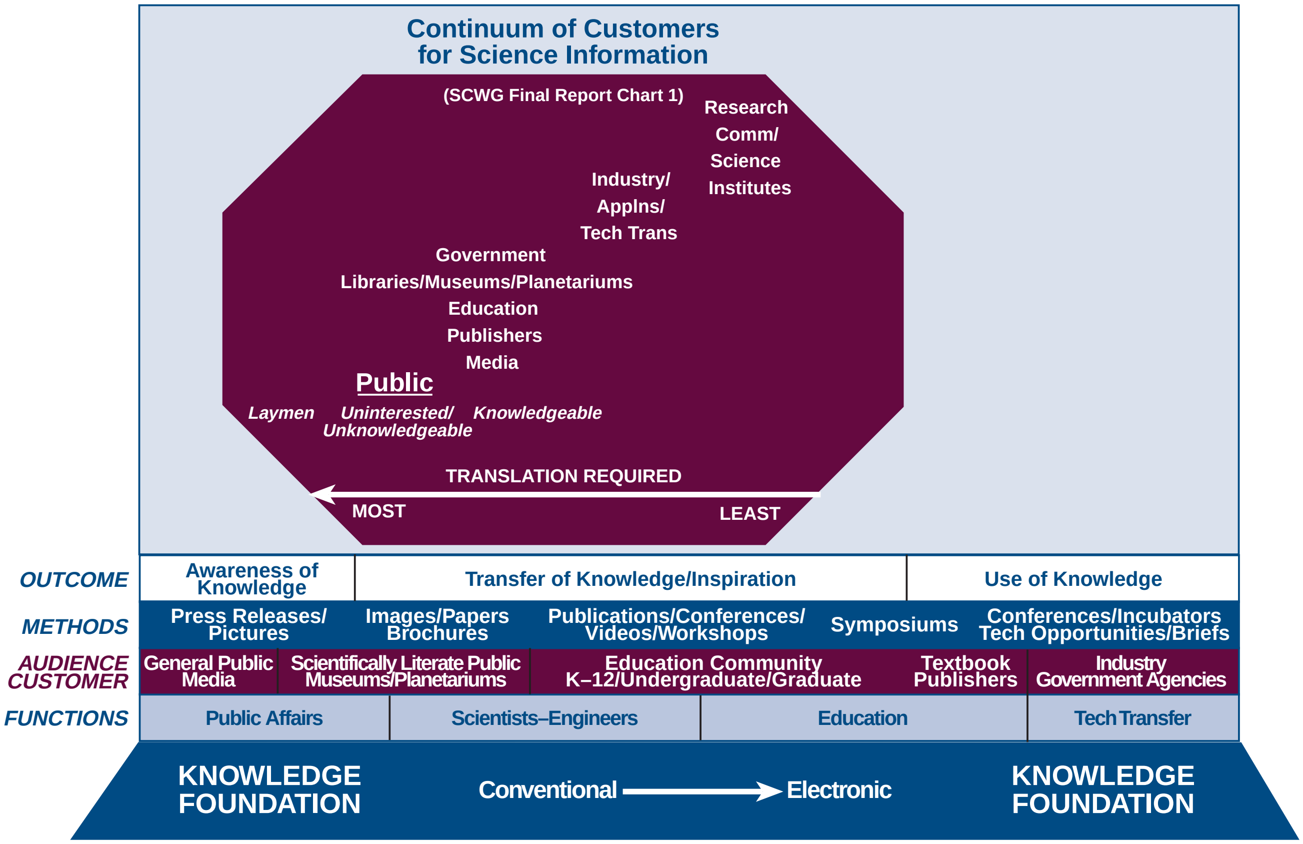

Figure 2. The scope of NASA's Communicate Knowledge Process

The value proposition is: "We can reduce cycle time and costs, increase the number of proposals we win, and more effectively bring the knowledge of the organization to bear on customer needs if we effectively find and transfer knowledge and best practices. . . ."[4]

The scope of NASA's CK Process is shown in a simplified model in Figure 2. This model rests on the foundation of NASA knowledge. Scientists, researchers, technologists, and operators generate knowledge. They are assisted in delivering the knowledge by facilitators or subject matter experts in areas such as public affairs, scientific community interaction, education, outreach, history, and technology transfer.

The audience for NASA ranges from the general public to industry. The outlet methods for communicating knowledge to various public audiences take many forms, ranging from press releases and pictures to professional papers, brochures, publications, conferences, videos, symposia, incubators, web sites, technical opportunities, or briefs. The desired outcome from the audience ranges from making people aware of NASA's knowledge, to transferring this knowledge, to facilitating the use of this knowledge outside of NASA.

In 1995, the NASA Chief Scientist initiated a Science Communication Working Group in response to suggestions from a forum chaired by NASA Administrator Goldin and Dr. Carl Sagan, in which several participants raised concerns that NASA's scientific knowledge was difficult to obtain. The work of this group was a useful starting point for this CK Process Team. The chart from that report is superimposed on Figure 2 as the octagon to both acknowledge the work of the group and to demonstrate where their work fits in the scope of this CK effort.

4 C. Jackson Grayson, Jr., and Carla O'Dell, "Mining your Hidden Resources," *Across the Board*, April 1998.

Team Methodology

When the NASA Administrator assigned the four Crosscutting Processes—Manage Strategically, Provide Aerospace Products and Capabilities, Generate Knowledge, and CK—to NASA senior officials, each owner was empowered to choose an approach to examine the process and to choose metrics for the future measurement of process success.

CK Process Owner Spence M. Armstrong described his planned benchmarking approach in a senior management meeting in February and again on March 31, 1997, in a memo to NASA Officials-in-Charge and Directors of NASA Centers (Appendix A). The memo requested volunteers from each Installation to serve on a CK Process Team. Team members (Appendix B) were enlisted from every Center and many of the Headquarters offices. The first meeting of the team was convened at Headquarters in May 1997.

Sampling

In their sampling of CK processes across NASA, the team agreed to: (1) visit each of NASA's 10 Installations to conduct interviews with employees who generate knowledge and communicate it; (2) visit other Government Agencies engaged in research and development to conduct interviews, and (3) examine communication initiatives at Headquarters. During the process, members of the NASA CK Process Team sampled the customer community, including professional associations, State and local government entities, and institutes, to assess how well the knowledge was communicated from their perspective.

The process of making the visits, by itself, heightened employee awareness to the necessity of CK planning. The Centers prepared for the visits as they would for a formal NASA Review. The team asked each host facility to identify a cross section of its activities (not necessarily the best) and supply a cross section of personnel for the team to interview in a conference room environment during a day-long visit. Ten questions were developed, which each Installation host previewed with the prospective interviewees for standard sampling purposes (Appendix C).

Each host facility presented those activities that were thought to be of interest to the whole team in a plenary session. These were usually education, public affairs, and technology transfer activities. At every session, the Agency CK Process Owner proposed the following paradigm: "If you are fortunate enough to receive tax payers' dollars to do research, development, or operations for them, then you have a responsibility to assure that the resulting products are communicated as widely and effectively as practicable." The responses by project personnel were invariably positive in acceptance of this premise.

CK teams were formed, each consisting of two to four members. The host provided projects whose members the teams interviewed, generally for about an hour. Each project leader described the project's objectives and discussed what it was doing to communicate knowledge in reference to the 10 standard questions. The CK team members took notes, which were shared with the entire team and which formed the basis for the development of a list of best practices (Appendix D; Sample Report, Appendix E).

Sites Visited

A total of 274 projects throughout the country were included in the interview process at the 10 NASA Centers, five additional organizations in other parts of the Federal

Government, and other entities listed below. The analysis of the answers to the 10 standard questions led to the findings and recommendations for formalizing the process made in this report.

June 3, 1997	Goddard Space Flight Center
June 30, 1997	Civil Engineering Research Foundation*
June 11, 1997	Georgia Center for Advanced Telecommunications Technology*
July 16, 1997	Lewis Research Center
July 17, 1997	Langley Research Center
July 23, 1997	American Association of Engineering Societies*
August 13, 1997	U.S. Army Medical Research Institute of Infectious Diseases*
August 19, 1997	John C. Stennis Space Center
August 19, 1997	Naval Research Laboratory at Stennis Space Center
August 19, 1997	Naval Meteorology and Oceanography Command at Stennis Space Center
August 21, 1997	George C. Marshall Space Flight Center
August 26, 1997	John F. Kennedy Space Center
September 9, 1997	Ames Research Center
September 10, 1997	Jet Propulsion Laboratory
September 11, 1997	Dryden Flight Research Center
September 25, 1997	American Association for the Advancement of Science*
September 25, 1997	Biotechnology Industry Organization*
October 29, 1997	Lyndon B. Johnson Space Center
November 7, 1997	Naval Research Laboratory
November 19, 1997	Sandia National Laboratories
November 20, 1997	Air Force Research Laboratory
January 22, 1998	Space Telescope Science Institute*
February 11, 1998	Mid-Atlantic Tech Transfer Center*
February 12, 1998	National Tech Transfer Center*
February 12, 1998	Classroom of the Future*
March 5, 1998	Maryland Education Coalition*
March 17–18, 1998	NASA Headquarters

* Small team visits

The organizations, projects, and officials interviewed are listed in Appendix F.

NASA Organization and the Communication of Knowledge

Most of NASA's knowledge is officially disseminated to various segments of the American population via informal and structured processes used by the public affairs, scientific and technical information, education, and history offices working with the Enterprise offices at Headquarters and the 10 NASA Centers. NASA information dissemination is enhanced and can be preserved for future generations through these offices, working in cooperation with the data base administrators, librarians, and records managers across NASA. Knowledge is also imparted through official and unofficial partnerships with other Agencies and organizations, interaction with Congress, and NASA's technology transfer initiatives.

The only irreplaceable capital an organization possesses is the knowledge and ability of its people. The productivity of that capital depends on how effectively people share their competence with those who can use it.

Andrew Carnegie
1835–1919

Functional Office CK Activities

Public Affairs Office CK Functions

Public affairs has a variety of services and products designed to present and distribute NASA information to the American public. Headquarters provides policy guidance, advice, and consultation to program offices and management, and it directs Agencywide programs and activities to coordinate, target, and direct resources (for example, NASA Television, exhibits, speakers bureau, astronaut appearances, audiovisual products, news operations, and web sites) to the news media and the American public. Public affairs also monitors trends in public opinion and technology developments in the news, entertainment, and electronic and Internet industries and consequently modifies its programs to communicate effectively with the public.

The Media Services Division at Headquarters issues press releases, organizes press conferences, and schedules editorial boards across the Nation, clips the news wires, monitors local and national television news programs, and targets specialized-audience press. The division provides daily satellite video to television stations across the country to use in news story development and arranges interviews with the press and "live shots" for scientists on national and local television news programs.

NASA public affairs officials oversee the current collection of 371,000 World Wide Web pages, all independently authored by NASA personnel throughout the Agency. They work with television producers or motion picture industry personnel who are writing or filming space productions, advertising agencies using NASA in promotions, publishers verifying NASA facts, and toy and game manufacturers producing facsimilies of NASA products. They work with video and photo organizations to disseminate aerospace footage, satellite imagery, and aerial views of Earth.

The dramatic visual component of the space program is also captured and shared with the American public through a touring collection of commissioned paintings by prominent artists depicting aeronautics and space travel, IMAX movies that chronicle various NASA missions, and exhibits at museums, fairs, and conventions. In addition, public affairs coordinates the preservation and display of space artifacts with the Smithsonian Institution.

The personal "NASA message" is also conveyed. The NASA Administrator and speakers from all NASA professions address audiences across the Nation throughout the year. In 1997, astronauts participated in 4,500 appearances. Thousands of visitors tour NASA's 10 Centers every day, learning about and experiencing the excitement of aerospace. During 1997, nearly 170,000 guests viewed Space Shuttle launches at Kennedy Space Center. Stamp, coin, and medal commemoratives are created, plane and spacecraft modelers are guided in their portrayal and development of NASA products, and contractors disseminating NASA memorabilia start their ideas for merchandising ventures through the auspices of Public Affairs.

Of these responsibilities, a typical Center public affairs office performs the following:

- Writes press releases, fact sheets, status reports, and significant events reports
- Provides video on Center news releases (where appropriate) to Headquarters to post via satellite to television networks for news broadcasts
- Maintains a home page that informs the public of the activities of that Center
- Develops, schedules, and staffs exhibits, national conferences, technical symposia, and community events
- Holds public lectures and coordinates a speakers bureau
- Maintains a visitor center
- Conducts tours and briefings for specific interest groups
- Answers public affairs inquiries
- Hosts open houses
- Publishes a newsletter for employees and community leaders

Education Office CK Functions

The NASA Education Program supports the achievement of educational excellence in science, mathematics, technology, engineering, and geography. NASA Headquarters provides direction and policy guidance to its counterparts in the Enterprises and Center offices in the implementation of the NASA Education Program. Educators participate in NASA research and development activities, apply methods for integrating NASA resources, science, and technology into their instruction, and are informed about available NASA resources, such as the Educator Resource Centers, daily NASA television educational programming, and the Internet.

The program also develops, uses, and disseminates instructional materials to support higher education curricula. A comprehensive dissemination system ensures access to materials through a distribution point in each State, electronic networking resources, the integration of instructional products into teacher workshops, and partnerships with organizations involved in systemic educational reform. Videoconferences and comprehensive Internet educational materials on NASA Spacelink supplement instructional products, as well as education and public outreach forums. The Education Program establishes partnerships, convening NASA principal investigators, NASA-trained teachers, and commercial contractors with the State's education leadership to determine how NASA assets may best be utilized within each State.

Precollege students are provided information and research opportunities. Graduate students and faculty are provided support opportunities through the National Space Grant College and Fellowship Program, the Experimental Program to Stimulate Competitive Research, and Graduate and Faculty Fellowships. Through these avenues, the NASA Education Program contributes to the NASA Communicate Knowledge Process.

A typical center education office:

- Provides precollege education programs, products, and services to a specific geographic region

- Provides support to the university community through research grants, graduate student and faculty fellowships, and programs such as the Space Grant College and Fellowship Program and the Summer Faculty Fellowship Program

- Conducts teacher/faculty enhancement programs, such as NASA educational workshops, NASA Opportunities for Visionary Academics (Project NOVA), the Aerospace Education Services Program, and the Summer Faculty Fellowship Program

- Facilitates the development of curriculum support products in partnership with NASA scientists, engineers, technicians, and professional education organizations

- Disseminates educational products through Educator Resource Centers, professional education conferences, and electronic systems

- Provides student programs, such as the Summer High School Apprentice Research Program (SHARP), the NASA Student Involvement Program (NSIP), and the Graduate Student Researchers Program (GSRP)

- Supports systemic education through partnerships with State education leadership

- Provides online resources for educators through educational technologies such as the Learning Technology Program and NASA Spacelink

History Office CK Functions

The NASA History Program provides the public and the technical community with the resources to gain a comprehensive understanding of the Agency's institutional, cultural, social, political, economic, technological, and scientific development of aeronautics and space. The public has access to Agency documents, taped oral history interviews, biographical files, news clippings, press releases from public affairs, correspondence, annual reports to Congress, numerous serial publications, monographs, and special publications created periodically. In addition, it sponsors special symposia on current topics of historic significance. These offer forums for discussion by prominent scientists, which are often covered by the press.

The categories of publications include reference works, management histories, project histories, NASA Center histories, and general histories. Historical reports and monographs that focus on public policy formulation and administration issues are also available.

The program has extensive information for the public on the Internet. Its research and development programs contract with historians at universities and industry to produce publishable manuscripts, research reports, documentary collections, finding aids, or a combination of these, which benefit the entire scholarly community. The program periodically invites scholars to submit proposals for research, writing, and documentation projects on subjects of current historical interest to the Agency, and it offers (with other history organizations) a fellowship competition for predoctoral or postdoctoral research in any area of NASA-related aerospace history.

All of the NASA Centers have historical monitors who supervise resources and assist researchers with specialized topics. A typical history office at a Center:

- Contracts monograph or oral history work
- Answers historical inquiries
- Archives Center information
- Researches data bases and develops activities

Scientific and Technical Information Office CK Functions

The NASA Scientific and Technical Information Program acquires, processes, archives, announces, and disseminates information for the scientific community. The information records basic and applied research results from the work of scientists, technologists, engineers, and other technical management personnel. It is available on paper, film, microfiche, multimedia, and electronic media.

The program collects information from the NASA Centers, acquires information from more than 50 countries worldwide, maintains the largest collection of aerospace information in the world, and provides worldwide access to advance the frontiers of knowledge rapidly. The knowledge contained in more than 3 million bibliographic records is a critical component in the worldwide activity of scientific and technical aerospace research and development.

The group, headquartered at Langley with managers at each Center, produces technical reports, conference reports, technical memoranda, contractor reports, technical translations, and special publications. The program produces eight periodic bibliographies, which range from technical, medical, and aeronautical subjects to NASA space flight video and NASA patents. It also provides yearly publications on NASA technological spinoffs and produces a *NASA Thesaurus*, as well as a university program report.

The search and distribution vehicle used for the information retrieval is housed at the Center for Aerospace Information in Hanover, Maryland. Much of the report data base is available on the Internet in text or abstract format.

A typical scientific and technical information office at a Center:

- Oversees the graphics, photography, print, video, and library operations for the Center

- Helps the scientist conduct research for refereed journals

- Coordinates graphic, editorial, and print services for technical reports, conference reports, technical memoranda, contractor reports, technical translations, and special publications

- Answers technical inquiries

Legislative Affairs Office CK Functions

NASA's Office of Legislative Affairs informs congressional members of all NASA's scientific accomplishments throughout the year, and it provides responses to congressional public inquiries regarding NASA's programs. It provides the Administration with NASA's position on legislation and advises NASA officials regarding congressional testimony. In addition, the office informs congressional members of NASA activities in their districts and States, including procurement awards, astronaut selections, and expenditures going to their districts and States. This prepares congressional members to be conversant on NASA issues in speeches and outreach activities to constituents.

In response to constituent requests, NASA makes arrangements for various NASA officials, as well as astronauts to visit various districts and States and give presentations on NASA programs. The congressional members are continually advised on NASA launches and landings, and arrangements are made for them to attend, enabling the members of Congress to experience, firsthand, the excitement and discoveries of the space program. The members also visit the various NASA Centers to observe the work in progress of the NASA Enterprises.

Enterprise Office CK Responsibilities

Human Exploration and Development of Space

In July 1996, the Human Exploration and Development of Space (HEDS) Enterprise identified the need to strengthen and improve communications not only within the Enterprise but also with its stakeholders, customers, and partners. Given the Enterprise's diminishing resources and the desire to strengthen communications, the Office of Space Flight and the Office of Life and Microgravity Sciences and Applications chartered an Enterprisewide Integrated Communications Team (ICT) for Outreach. The ICT was formed to create an infrastructure to coordinate communications activities; develop, unify, and better communicate HEDS themes, messages, and rationale; collaborate and focus diminishing resources; reach target audiences; cultivate and engage customers; and eliminate duplicative efforts. It is composed of a multidisciplinary group from the program, technical, legislative affairs, public affairs, and education offices appointed by the Center Directors.

One of the first actions taken by the ICT was to conduct a comprehensive review of current and planned HEDS outreach activities. Next, the ICT identified eight customer segments for HEDS outreach: the Administration and Congress, other Government agencies, industry, media, research and scientific communities, international agencies, educational communities, and the general public. The ICT continues to hold regular collaborative meetings to share information and to identify, prioritize, and fund high-impact outreach opportunities to reach its customer segments.

Space Science

The Office of Space Science has appointed an Assistant Associate Administrator of Education and Outreach and has developed strategic and implementation plans for education and outreach in support of the NASA Education Program. Their objectives are to:

- Have a substantial education and outreach program associated with every space science flight mission and research program
- Increase the fraction of the space science community directly involved in education at the precollege level and in contributing to the broad public understanding of science
- Develop a presence in every State in the United States to serve as a focal point for encouraging and assisting scientists and educators to develop partnerships and, in so doing, contribute in a meaningful way to space science education and outreach
- Organize a comprehensive, national approach for providing information on and access to the results from space science education and outreach programs
- Continue and refine or enhance, where appropriate, programs dedicated to the development and support of future scientists and engineers
- Provide new opportunities for minority universities in particular and for underserved/underutilized groups in general to compete for and participate in space science missions and research programs
- Develop the tools to evaluate the quality, effectiveness, and impact of space science education and outreach programs

The Space Science Enterprise is developing the use of a broker/facilitator network that will encompass every region of the United States and search for high-leveraging opportunities for education/outreach across the country. The Enterprise is planning to establish four major centers for space science education aligned with the four principal scientific themes—Structure and Evolution of the Universe, Astronomical Search for Origins and Planetary Systems, Solar System Exploration, and the Sun-Earth Connection.

Two exhibits are being developed. The Space Science Institute has been awarded funds from the Informal Science Education Program of the National Science Foundation's Education and Human Resources Directorate in support of an innovative 5,000-square-foot, hands-on traveling exhibition called "MarsQuest." The science exhibition will feature the opportunity for exploration of the Red Planet via electronic links to NASA Mars missions. Approximately 2 to 3 million people will visit the exhibit during its 3-year tour of nine American science centers. Electric space exhibits are also being developed to intrigue the video generation and offer a variety of hands-on displays with eye-catching graphics and "sounds" of space.

Earth Science

The Office of Earth Science is planning to reach four major audiences: the public through weather broadcasters, science journalists, and environmental journalists; the educational community through the National Science Teachers Association and curriculum developers; other Government Agencies, such as the National Oceanic and Atmospheric Administration (NOAA) and the U.S. Geological Survey, as well as urban planners and regional water authorities; and industry through Earth Science contractors, flight and ground system providers, and data firms.

The office is in the process of drafting an outreach strategy and is planning to develop 16 regional global-change-impact workshops across the country. In 1997, the office sent representatives and information to 14 conferences, reaching a variety of audiences in the insurance industry, agricultural community, agronomy community, and land satellite information industry, as well as influential professionals, such as environmental journalists and science teachers.

Five projects under consideration for funding are the development of: (1) the Urban Heat Island Characteristics of U.S. Cities; (2) an Earth Science Writers Summer Workshop for Professional Journalists; (3) an Earth Science elder hostel; (4) the Challenger Center's Window on the Universe; and (5) a partnership to produce/disseminate Earth Science information products.

Aeronautics and Space Transportation Technology

At NASA Headquarters, the Office of Aeronautics and Space Transportation Technology has formed the Alliance Development Office (ADO) to develop, integrate, and coordinate communications internal and external to NASA. The broad external groups considered include Congress, the Administration, other Government agencies, industry, advisory committees, the education community, international partners, and the general public.

The ADO has worked closely with industry partners in creating the Enterprise's strategic goals and developed a document to communicate these goals to each of the external groups. ADO members each have key responsibilities in working with the various external groups, facilitating the mechanisms, and developing the "tools" necessary to communicate the work of the Enterprise and its value to the Nation. The group has been active in reaching out to citizens in both traditional and nontraditional forums and in seeking feedback on its programs and performance.

The ADO team is currently developing a long-term communications strategy to focus the Enterprise's efforts. The charter is to create a solid foundation for clearly and succinctly presenting and describing this complex Enterprise in a manner meaningful to its key customers and stakeholders, as well as the public at large.

Technology Transfer CK Functions

NASA's Commercial Technology Program is based on the NASA Commercial Technology mission, which requires that each NASA program be conducted in a way that proactively involves the private sector from the onset to ensure that the technology developed will have maximum commercial potential. To facilitate this mission, NASA's Commercial Technology program established the NASA Commercial Technology Management Team

(NCTMT). The NCTMT is an internal mechanism (consisting of the commercial technology manager at each Center and a representative from each of the NASA Strategic Enterprises) responsible for overseeing NASA's technology transfer and commercialization process.

The NASA commercial technology transfer CK function supports the Provide Aerospace Products and Capabilities Process and is focused to encourage, facilitate, and manage the transfer and use of NASA-developed technologies in aerospace and nonaerospace industries. This focus provides opportunities for the application of NASA-developed technologies through programs that ultimately contribute to growth in American commercial products and services and strengthen the national economy.

The NASA Commercial Technology Transfer Program communicates with the public largely through its technology transfer network mechanisms (Regional Technology Transfer Centers (RTTC), National Technology Transfer Center (NTTC), and Internet-based information systems. These entities are considered agents that seek out opportunities for partnerships between NASA and industry by matching industry needs with NASA technology deemed potentially ready for commercialization.

Technology Transfer Center Offices provide the public with information about their technologies through *Tech Briefs* and Technical Support Packages (via controlled access). Presentations, conferences, trade shows, and industry workshops are other media by which the program communicates technologies with commercial potential. Technology transfer opportunities are relayed to interested parties through conferences, seminars, publications, web sites, and the NASA TechTracs data base. Publications and brochures (*Spinoff, Aerospace Technology Innovation,* and *Small Business Innovation Research*) are developed and distributed to provide information about the results of NASA technologies that have been commercialized into new and improved products and services. A data base of success stories is also a primary means of relaying accrued benefits to the public.

Technology partnerships can be achieved in many ways, including a host of agreements (both funded and nonfunded), partnership arrangements tailored to industry needs, and leveraging of mutual interests among parties. The licensing of NASA technology depends on intellectual property rights. Technology transfer and commercialization are a central element of the CK plan in that they relate the value of NASA (beyond its aeronautical and space research) to the public by emphasizing how the commercial successes derived from NASA technologies contribute to enhancing the quality of life.

A typical technology transfer office:

- Identifies existing technologies and innovations with commercial potential
- Conducts industry outreach activities (conferences, workshops, and open houses)
- Develops technology opportunity sheets (for outreach distribution)
- Provides technical assistance (to industry, Government, and academia research and development efforts)
- Develops outreach material/media for specific target audiences

- Utilizes the technology transfer network (RTTC's, NTTC, Computer Software Management and Information Center (COSMIC), and incubators) to communicate technologies available for commercialization
- Prepares/provides technical support packages
- Prepares/provides technical briefs for publication
- Guides the new technology reporting process
- Develops success stories
- Provides technology information input to the NASA TechTracs data base
- Facilitates the patent and licensing process
- Seeks out partnerships (via cooperative projects) with industry, Government, academia
- Tracks partnerships
- Periodically measures technology transfers and commercialization results/performance
- Sponsors program specific training
- Facilitates/supports small business development

Collaborative Possibilities for the Future

The CK function at NASA has been conducted most effectively when professionals from each of NASA's CK functional offices consulted with the scientist/engineer on a collaborative level at the beginning of the project process. If this were done consistently rather than on the current informal or ad hoc basis, the Centers could ensure that projects across NASA had similar support systems, and a Communications Plan for the life of the project could be created for the scientist's or engineer's benefit as well as the Enterprise's benefit. There would be a capability for collecting metrics on project activities for the Enterprises and for the NASA Performance Plan, which would provide information necessary to meet the requirements of the Government Performance and Results Act of 1993.

Findings

The conversations with individuals during visits to NASA Centers and Headquarters by the CK Process Team validated that NASA employees truly believe in NASA's vision statement: "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." They also validated that most employees understand that an effective CK Process is essential to attaining that vision.

Each one has the right to share in the knowledge and understanding which society provides.

Albert Einstein 1936

1. The primary finding was that there are some exemplary CK activities already taking place within NASA and some of the other Agencies visited. The team members discerned a technical workforce comprehension of the need to show the relevance of their scientific endeavors to the American public. These exemplary CK activities are driven by professional incentives, contractual obligations, official policies, or personal commitments that are frequently carried out on personal time. NASA's Space Act charter, specifying that it disseminate its information to the public, provided an impetus to communicate knowledge unavailable to other Government Agencies.

2. Although much work is currently being done to communicate knowledge, the potential is for NASA to do significantly better in providing a process, monitoring the output, examining the outcome, and widely publicizing the results.

3. NASA's CK efforts follow numerous and mostly ad hoc processes. There are perceived and real impediments, including inadequate funding and travel budget, as well as a lack of management support, guidance, time, or incentive for accomplishment. A formal process is needed, which can then be improved.

4. The Agency needs to set policy and provide guidance detailing knowledge-communicating techniques in the form of a NASA Policy Directive (NPD) and a NASA Policy Guide (NPG).

5. Although the team did not find a consistent CK Process across the NASA Centers or at Headquarters, the other Government or Government-sponsored entities sampled had formal pieces of what the team defined as the CK Process. For example, the Naval Research Laboratory, the Sandia National Laboratories, and the RTTC's and NTTC have a very well-defined and implemented technology transfer process. The Space Science Telescope Institute has a very thorough formal process for educational outreach.

6. Within NASA, data bases were inconsistently assigned, maintained, and archived, such that many could not be located without the knowledge of the scientist or technologist.

7. There are many excellent technical publications published at Headquarters and the Centers. If a publication presented "knowledge" and provided a way for the reader to contact someone who could answer questions, it was considered a CK instrument. Center Director Discretionary Fund Reports are examples of this classification of publication.

8. Not surprisingly, the CK Process worked best when it included (a) a formal Communications Plan, (b) resources directed for implementing the Communications Plan, and (c) top management commitment.

9. Exemplary CK practices were observed at every site visited. These were practices that showed innovation or extra effort applied to the typical Center functions for the offices mentioned earlier. The CK Process Team was initially reluctant to list these host

practices as best without further analysis. Because one of the prime reasons for the CK Process Team effort in this report was to provide assistance to those engaged in the CK Process, it was agreed to list best practices in Appendix D and subsequently in a data base. In a central data base created at NASA Headquarters, each Center CK Process Owner will become the manager of all best practices performed at that Center.

Recommendations from the Communicate Knowledge Process Team

A notable realization from the CK Process Team visits was that knowledge was communicated most effectively when NASA's CK functional office professionals collaborated with the scientist or technologist at the beginning of a science or technology project. If collaborations were done unilaterally on every project, NASA Headquarters could ensure a communications support system and a Communications Plan for every project. This would enable project metrics to be collected for the Enterprises on a yearly basis for the NASA Performance Plan, in fulfillment of the requirements of the Government Performance and Results Act of 1993. To create a system to manage this support function, the following organizational recommendations are made:

1. A Headquarters CK Board of Directors reporting directly to the Administrator, chaired by the CK Process Owner, will be formed and consist of Enterprise Associate Administrators or their Deputies and key functional Associate Administrators. The board will assist the Agency Process Owner in policy coordination and oversight of the Agency's CK Process.

2. A Headquarters CK Working Group will be formed to assist the Process Owner. The group will periodically convene meetings to apply metrics, implement policy, monitor policy, and integrate Communications Plans and will be composed of representation from:

    - NASA CK Process Owner
    - Enterprises
    - Legislative affairs
    - Public affairs
    - Education
    - History/policy and plans
    - Scientific and technical information
    - Technology transfer
    - Data base administration
    - Library
    - Records management

3. The Agency Process Owner will provide a web-based data base for "best practices" to be subsequently updated by the Center Process Owners.

4. Every Center Director will appoint a full-time Center CK Process Owner to lead an Integrated Process Team. This person will be responsible for developing, implementing, and overseeing a Center CK Process, accumulating results of CK activities for Headquarters and directly reporting to the Center Director. He or she will also be the gatekeeper for adding communications practices from that Center to an Agency data base, including the best practices data base.

5. In consultation with the Center Process Owner, every Center Director will appoint a number of "subject matter experts" as part of an Integrated Communications Team to meet with and advise the scientist or technologist on how to communicate effectively

with various audiences at various stages of the project activity. Representation from the following offices is suggested:

- Project office (project director/knowledge generator)
- Public affairs
- Education
- History
- Scientific and technical information
- Technology transfer
- Data base administration
- Library
- Records management

6. Every research, development, or operational effort conducted within NASA or primarily funded by NASA will have a Communications Plan unless the Center Director waives the effort. The plan will indicate expected CK products from each team member on a time continuum, designating the dollar and personnel resources needed to complete each.

7. The components of a plan should encompass: (a) the assessment of the task (What may be discovered? Which audiences could benefit from this information? What is the desired outcome?); (b) the identification of various forms of communication (In what formats should the information be made available?); (c) the development of the products; (d) the communications initiatives; and, ultimately, (e) the metrics of the effectiveness.

8. The Agency Process Owner will create a NASA Policy Directive (NPD) and a NASA Policy Guide (NPG) to document the CK Process recommendations made above.

9. The current CK Process Team will be suspended pending periodic review of the CK Process, as required by assessing customer feedback at the Headquarters level. Figure 3 (page 27) is a simplified representation of how CK fits into the other Crosscutting Processes.

10. NASA Headquarters policy and oversight is required to provide guidance and best practices for the use of archives, data bases, and electronic web pages, because information accessibility and usability directly affect NASA's image to the technical community, industry, and the public.

11. NASA should develop an information process for communicating knowledge to the public that is, at a minimum, accessible to public information and technical information specialists. Information on products and events to be developed for each science project and each technology project should be extracted from all Communications Plans and placed online on a data base, to be arranged by the Headquarters Working Group. Any NASA employee or member of the public searching for knowledge on a particular NASA program, science topic, or technology product should be able to locate all relevant technical and nontechnical publications, articles, and brochures; educational materials and events; public speeches; public events; newspaper/magazine articles; press conference details, and museum/fair/conference exhibits.

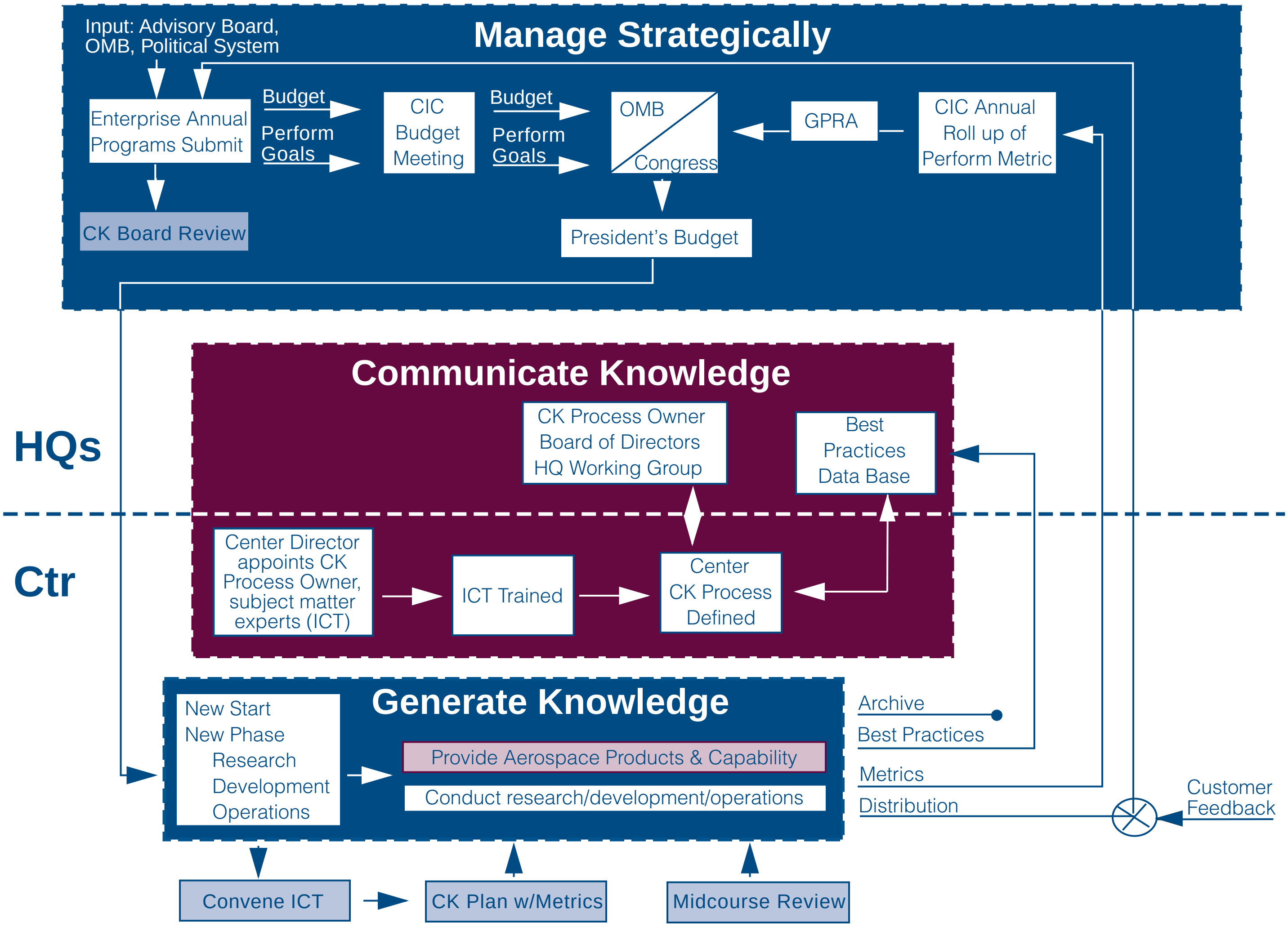

Figure 3. The Communicate Knowledge Process relationship to the Strategic Management Process

Note: The CK Process Team was asked on many occasions how its process related to the other three Crosscutting Processes depicted in Figure 1. At the time the *Strategic Management Handbook* was written, these processes had not been developed sufficiently to provide a description of their relationship beyond that indicated in Figure 1. Therefore, after the visits had been made and the report was being drafted, the CK Process Owner developed Figure 3 to suggest a relationship among the processes. This diagram is admittedly simplistic and views the world from a CK perspective.

Appendix A

Process Owner Memo to Officials-in-Charge and Center Directors

March 31, 1997

TO: Officials-in-Charge of Headquarters Offices
Directors, NASA Field Installations
Director, Jet Propulsion Laboratory

FROM: F/Associate Administrator for
Human Resources and Education

SUBJECT: The Communicate Knowledge Process

Recently I was named the process owner for the Communicate Knowledge (CK) crosscutting process, relieving Alan Ladwig who has been assigned as the process owner for the Strategic Management Process. At the March 11, 1997, NASA Senior Management Strategic Planning Retreat, I presented my approach to fulfilling this new role. We clearly need to capitalize on the previous efforts in CK headed first by France Cordova and Alan in which many NASA employees participated, including myself. During my presentation at the retreat, my role was further clarified by the group that I was the **owner** of the effort to improve the various processes by which we communicate knowledge and **steward** of the CK process itself. The former role is what I am launching with this letter. In the latter role, I will continually monitor the CK process across the Agency, disseminating new and better ideas as they come to light. I will also initiate follow-on improvement efforts as appropriate. The "foot stomper" is that I am not responsible for communicating knowledge per se nor do I serve in a controlling position over those managers who are responsible for program execution.

It was also clarified at this meeting that Alan was retaining part of the responsibility previously under the CK heading. He will retain that part which I am calling the **message**. This is the common set of themes, goals, projects, examples, etc. which will be available to every NASA employee for communicating with internal as well as external entities. The current thought is that the **message** will be available from the NASA home page with hyper-text links to other official home pages for more detail as desired. The Office of Public Affairs would be assigned the responsibility to keep the **message** current; comparable to a Speakers Bureau task. Therefore, the knowledge that I will be referencing henceforth is that **knowledge** that is obtained through a NASA research effort. This effort could be an internal laboratory experiment, results from a grant, an aircraft flight program, a space flight program, etc. The knowledge could be in the form of a report, raw data, imagery, formulae, material, technology, etc. In other words, whatever form our customer base of Government, education, industry, science, public, etc. entities find most accessible and useful. The above definitions are a starting point. We may very well discover that they are too broad to handle productively. For example, technology transfer may or may not be an applicable category of knowledge communication.

Starting next month, I intend to launch the process improvement with the formation of a team of about 15–25 NASA employees. I want this to be a diverse team. I am expanding the accepted definition of diverse to include broad Center representation, all applicable disciplines and a grade spread. I would like each addressee to consider nominating individuals for this team. After I make the selection, I will convene a planning meeting here at Headquarters to establish the rules of engagement and schedule. We will also establish a set of metrics for the conduct of the process improvement task. My current thought is that the team would develop a list of questions to ask NASA project/program managers concerning the way they currently determine their communicate knowledge requirements and delivery methods. I would ask the Strategic Enterprises to recommend a cross section of research efforts for the team to survey. The survey results would not specifically identify any of the research efforts surveyed, be they exemplary or otherwise. What would be produced is a handbook of best practices and some templates for NASA managers to use as a reference when developing a new research effort. With this handbook would be a preliminary set of metrics for the CK process. I estimate that this process improvement effort will take six months of near full-time participation of 15 team members but could be done on more of a part-time basis if I get a larger number of nominations. There is likely to be some travel required to go to the Centers to conduct the surveys. In some cases, travel may be to the customer community to ascertain their satisfaction.

As you can see, my plans are rather tentative at this point. I do intend to get started very soon and produce a product that will be of use to NASA managers. I request that each addressee consider nominating one or more individuals to participate on my team. The experience should be useful to the individuals and they would undoubtedly be ideal candidates for the Integrated Communications Teams (ICT) that will be formed in the future to serve as on-call support to program managers. Request you send/call in your nominees by April 8, 1997. Thank you.

Spence M. Armstrong

Appendix B

The Communicate Knowledge Process Team Members

Spence M. Armstrong, Lt. Gen. USAF (ret.), Process Owner/Team Leader

Headquarters Representation
Myra Bambacus
Annette Frederick
Terri M. Hudkins
Ali S. Montasser
Pamela L. Mountjoy
Nora Normandy
Helen Rothman
Alotta Taylor
Donald D. Teague
Mike A. Torres
Ann Marie Trotta
Janelle B. Turner

Field Center Representation
Irving Abel
Pamelia P. Caswell
Ernestine K. Cothran
Eugene 'Lee' Duke
Angela Ewell-Madison
John Horack, Ph.D.
Samuel Massenberg, Ph.D.
Blanche Meeson
Unmeel Mehta, Ph.D.
Steve Nesbitt
Mark Pine
Oscar Toledo
Myron L. Webb

Appendix C

Communicate Knowledge Process Team Questions for Site Visits

1. What was the objective of your research effort (could also be an operational effort from which some knowledge was derivable)?

2. How would you classify your research?
   Basic research—to seek knowledge for the sake of knowledge
   Fundamental research—to seek useful knowledge
   Exploratory research—to identify perceived useful knowledge
   Applied research—to pursue practical objectives
   Programmatic research—to seek and provide knowledge for a mission
   Industrial research—to achieve economic benefits and meet demand

3. Who were your customers? (Customers are very widely defined as any entity/individual who could use the knowledge communicated.)

4. Did you involve your customers in the upfront planning?

5. What kinds of communication did you use (the form of the knowledge and the medium in which it was distributed)?

6. Who assisted you in this process?

7. Was there a source of funds dedicated to help you in this process?

8. How has this knowledge been archived?

9. What was your incentive to carry out this process?

10. What mechanisms did you use to gather feedback from the customers on the quality, timeliness, accuracy, etc., of this knowledge?

Appendix D

Best Communicate Knowledge Practices

Best practices from each site that the team visited are listed in this appendix. Those listed are not all of the best practices observed, nor are they necessarily the very best practices of those at each Center. They were selected as a virtual mosaic of the range of best practices. This list also introduces some of the categories that can be used in presenting data bases on the CK Process in the future: Management, Partnerships, Technology Transfer, Science Transfer, Education, Public Affairs, Archives/Data Bases, and Communications.

Best Management CK Practices

Within NASA, the best management practices for the CK Process are: (1) the inclusion of the CK function in position descriptions; (2) the inclusion of specific elements in the outreach activity knowledge generator's performance plan; (3) the provision of an award incentive for conducting the process; (4) the inclusion of outreach as a requirement in grant solicitations and proposals; (5) the development of dedicated outreach specialists; (6) the assignment of an outreach coordinator for each project; (7) teamwork among scientists, technologists, engineers, and public affairs personnel; (8) the availability of written internal processes for the CK Process; (9) advance planning for goals and messages for target audiences; (10) regular contact with the public affairs office for communication with the general public; (11) funding allocations for the CK Process in programs; (12) the development of metrics for outreach activities; and (13) assistance to external organizations.

At the Marshall Space Flight Center, a process resulting from the recommendations of the NASA Headquarters Science Communication Working Group has evolved. Its success is attributed to strong management support and to having a process owner. Funding is provided by Center project offices/managers. The public affairs and technology transfer offices are engaged as appropriate when CK messages are identified that lend themselves to such vehicles as press releases. Customers are defined in advance. An external science writer is hired to clarify scientific translation as needed. All web communications are done at the 8th-grade level. Web home pages on each subject are linked to share information effectively.

The Office of Public Outreach at the Space Telescope Science Institute is composed of such professionals as educators, scientists, public affairs specialists, and information service experts. They collaborate with the user community as an idealized integrated product team. The outreach process and the scientific process are conducted concurrently. There is dedicated funding and great support from NASA Headquarters and the Goddard Space Flight Center, the sponsoring Center.

At the Naval Research Laboratory, the Deputy Director, Dr. Timothy Coffey, chairs a board that decides which research initiatives will be approved. He routinely asks the proposer: "If you are successful beyond your wildest dreams, who will use it?" The answer to this question is instrumental in evaluating the technical merit of the proposal.

At the Lewis Research Center, a flywheel research program is creating a next-generation energy storage device that is more efficient than batteries. Lewis has awarded several small research contracts to flywheel companies through Boeing, to ensure that the International Space Station prime contractor is cognizant of the progress. The flywheel companies are interested in applying the technology to use in automobiles to satisfy stringent clean air standards, which provides an added incentive to the contractors to communicate the outcome of research.

Best Partnership CK Practices

Partnerships and consortia are used by organizations to pool resources for research, development, and operations. Communicating capabilities are compounded through partnerships by budget integration. Partnerships show promise for the future in an environment of limited resources. The CK Process Team found many examples of excellent partnerships, of which the following are representative.

The National Rotorcraft Technology Center at the Ames Research Center is a Government-industry-university partnership to maintain American preeminence in rotorcraft technology. The partnership plans to expand the world rotorcraft market, expand the U.S. industry market share, and ensure continued superiority in American military rotorcraft through the partnership. This new method of doing business is characterized by: (1) joint program management and execution; (2) a single industry focal point; (3) coordination with academia; (4) strategic guidance from senior executives of Government, industry, and academia; (5) identification of customer needs; (6) Government-industry cost sharing; (7) Government-university cost sharing; (8) joint use of facilities, expertise, research results, and intellectual property rights; and (9) rapid technology transition.

VERS (Virtual Environment for Reconstructive Surgery) is a collaborative project between Ames and the Department of Reconstructive Surgery at Stanford University. The partnership helps surgeons organize facial reconstruction procedures on patients through the use of a computer, creating a virtual environment for surgeons to simulate and plan an operation. Their customers are the National Institutes of Health, the medical community, and NASA's Earth Science Enterprise.

Ecological research and environmental impact studies are also conducted through intergovernmental collaboration. A joint effort of the Kennedy Space Center, the U.S. Fish and Wildlife Service, and Sea World of Florida has generated survey data for trends of habitat use and preference manatee in the Banana River.

The Global Hydrology and Climate Center (GHCC) at the Marshall Space Flight Center shares a partnership with NASA, the universities in Alabama, and the Universities Space Research Association (USRA). Climate variation in the Southeast of the United States is assessed to generate information and knowledge for farmers, urban planners, and organizations responsible for forestry. GHCC also has successful education partnerships, such as the Regional Earth System Science Outreach and International Earth System Science Partnerships.

CK is greatly facilitated by creating educational partnerships to address NASA missions and to share NASA's research, technology, and expertise with students. To do this, NASA personnel at the Commercial Remote Sensing Program at the Stennis Space Center are working with students at Thomas Jefferson High School, Alexandria, Virginia; W. P. Daniel High School, New Albany, Mississippi; Wheat Ridge High School, Colorado; and Glenbrook Middle School, California.

Sandia National Laboratories employees believe that "only through strategic partnerships can Sandia be successful in providing exceptional service in the national interest." Sandia uses market research to determine partnership needs at the beginning of a project rather than making presentations subsequent to project development. For partnerships, Sandia uses such mechanisms as licenses, leave-of-absences, publications and conferences, personnel exchanges, user facilities, commercial work for others, Cooperative Research and

Development Agreements (CRADA), consortia, memoranda of agreement, and technical assistance. Sandia uses business development processes for science and technology partnerships. The principles guiding their technology transfer are the following: (1) to provide for fairness of opportunity, (2) to contribute to U.S. competitiveness, (3) to contribute to the Department of Energy mission impact, (4) to manage conflict of interest, (5) to protect national security, and (6) to avoid competition with the private sector.

Advanced General Aviation Technology Experiments (AGATE) is another example of a best practice in partnership with industry. A strategic alliance, AGATE is a cooperative arrangement that engages both Government and the private sector in a shared research objective to revitalize the general aviation industry. The AGATE membership includes approximately 70 separate related entities. The joint pursuit of technology advances and standards is strengthening the general aviation industry and its operations today. NASA, with respect to general aviation, is not only communicating its technological knowledge, but also leveraging capabilities, by drawing strength from its members to frame the industry for tomorrow.

Houston, Texas, and Washington, D.C., are benefiting from NASA's communication of knowledge on global positioning systems (GPS). The Johnson Space Center is providing technical assistance to a consultant perfecting the GPS used to guide ships into the Port of Houston channel. Johnson volunteered its engineering employees and laboratory resources to improve the contractor technology that supplies compass direction and positioning information for the ships. NASA is also engaged in a GPS space navigation project with Mayflower, an engineering firm based in Washington, D.C., under NASA's Small Business Innovation Research (SBIR) program. This project uses GPS technology to provide the relative position for two spacecraft coming together at centimeter-level accuracy.

Best Technology Transfer CK Practices

The technology transfer function on the CK spectrum probably exhibited the most developed integrated communications capability at NASA and the other Federal laboratories. Technology transfer accomplishments cannot always be widely communicated if there are special intellectual property rights established at the onset of the program. In the SBIR, Incubator, and Commercial Space programs, Congress gives Government knowledge specifically to small businesses. The NTTC and the RTTC are used to find the appropriate technology transfer CK mechanisms. Their role is not as a broker entitled to a commission, but as a facilitator supporting small business development through institutional funding.

The Lewis Research Center organizes business and industry summits to showcase NASA's best minds, technologies, capabilities, and facilities to customers, stakeholders, and decision makers. They communicate NASA's expertise through numerous displays, tours, technical publications, and discussions with staff. World-class facilities with testing capabilities, innovative technologies, and the efforts of prestigious scientists and technologists increase stakeholder value and maximize technology transfer.

At the Marshall Space Flight Center, a Productivity Enhancement Complex places appropriate disciplines, skills, and contractors where technological opportunities can be quickly evaluated. The organization's Technology Opportunity Fliers are attractive and concise, enabling entrepreneurs to gauge technological possibilities easily.

The Jet Propulsion Laboratory (JPL) has developed three forums to accomplish technology transfer: (1) a Commercialization and Licensing Workshop featuring a history of JPL and commercialization, the latest results from JPL's current spacecraft missions, and presentations by several JPL partners on the successful production and marketing of space-themed products; (2) a JPL Industry Day featuring comprehensive briefings on future plans and networking, creating a forum for the exchange of information as well as opportunities to learn the major technological innovations in hardware and software development; and (3) a conference targeting women entrepreneurs, presenting speakers as well as panels and workshops investigating state-of-the-art technologies, entrepreneurial success strategies, business site selection strategies, financing, marketing trends, management, and related topics of interest to business owners.

One effective way of transferring technology is to transfer equipment so that the receiver can get immediate use. The Dryden Flight Research Center provided surplus Convair-990 equipment to Goodyear Aviation, giving the company an opportunity to incorporate new technology into its products and services immediately.

The Naval Research Laboratory (NRL) regards technology transfer as a statutory requirement, leveraging opportunity, and problem-solving opportunity for industry. A project champion is assigned for commercialization of all developed technology. NRL utilizes licensing of patented intellectual properties, CRADA's, the Research and Technology Application Program, and a visiting scientist and engineering program to accomplish the transfer. NRL identifies technology ready for transition, develops a strategy, and finds a partner. SIC codes from Dun and Bradstreet are used for targeting companies. To NRL, a successful partnership is one in which the commercialization pathway is defined and understood, partners respect each other's contribution, there is a shared commitment, decision makers are involved, and negotiations proceed promptly.

The NTTC has developed a series of training modules as CK mechanisms that are available to NASA and other Federal laboratories. NTTC programs employ nationally recognized experts in technology transfer throughout the design and development phases of its modules. Courses are written in-house by experienced designers working with experts from Federal laboratories, universities, industry, and professionals associations. Training objectives and activities are designed to support adult learning based on current successful practices in the field. Case studies used in NTTC courses are taken from actual situations, provided and validated by expert practitioners from industry, universities, and successful Federal laboratories, and reviewed continually. Courses are facilitated only by expert practitioners with extensive hands-on experience.

The Mid-Atlantic RTTC assisted the Langley Research Center in marketing and developing the licensing strategy for Thunder technology. The RTTC identified potential market areas and organized an in-house workshop at Langley to inform prospective companies about the product and its potential in commercial markets. As a result, Langley has formed both a nonexclusive and exclusive license with Face International Corporation of Norfolk, Virginia, and has granted Virginia Power of Richmond an exclusive license for several NASA-owned technologies, including rights to pending patent applications for molded magnetic articles, loudspeakers, valves, pumps, and refrigerators.

At the Lewis Research Center, the HiTemp program tests temperature resistance in materials and structures for manufacturers, industry, and advanced materials programs. Lewis technology transfer representatives convene an annual conference of potential customers, where they distribute extensive documentation of the year's work. This effort has promoted understanding, ensuring effective and cost-effective CK distribution to industry.

Lewis uses two types of technology transfer outreach. The first is the operation of the Great Lakes Industrial Technology Center, which informs potential customers on the availability of science and technology to provide technical assistance through reimbursable contracts. A second type of outreach at Lewis is business incubators. In a business incubator on a NASA site, a business interested in developing a technology is provided with working space and access to technical expertise, reimbursing NASA for consumables, but not for civil service salaries.

The Kennedy Space Center and the State of Florida jointly sponsor a network of high-technology small business incubators near the Center. The incubator network assists NASA with technology transfer by encouraging clients to license and develop NASA technologies, while State resources are made available to assist them with market and business systems development. Kennedy works closely with the incubator network to provide ready access to NASA technology and research information, which facilitates NASA's technology communications goals.

The Langley Research Center has a Technology Applications Group (TAG). The TAG looks for patented technology that can be licensed. To do this effectively, the TAG sends representatives to numerous trade conferences, sets up booths to display the patents, and talks with prospective licensees about applications. The TAG's are extremely successful at Langley, which has granted about half of all of the licenses given by NASA in recent years. Langley's incentive awards reinforce support for the initiative.

Best Science Transfer CK Practices

Scientists at the Centers who go beyond the traditional communications practices of preparing peer-reviewed journal articles and presentations at professional conferences: (1) provide easy access to a variety of CK products to various segments of the public; (2) create web sites for various audiences, including chat rooms for scientists and "Just for Kids" web sites; (3) create science advisor programs to communicate the latest scientific findings to students by conducting teacher workshops, mentoring teachers, and assisting the development of lesson plans.

The fatigue countermeasures program at the Ames Research Center has developed a presentation that has been given to 240 audiences in 16 countries to market its findings aggressively. Air crew safety will be positively impacted by this effort.

At the Goddard Space Flight Center, the Distributed Active Archive Center found Earth Science data customers by marketing their potential at conventions and conferences. Customers were found at the Public Health Service, which needs data to forecast epidemics and disasters and assist offshore fish farmers.

Best Education CK Practices

JPL developed an education outreach template for the life cycle of projects. This *Education Outreach Resource and Development Guide* describes events that need to transpire at each phase of a project. It includes information on education pedagogy, science standards, assessment, developers, product options, NASA policies, dissemination, and other items to enhance the understanding of outreach managers with current trends in education. The Deep Space Network used this guide to develop science and technology curricula with the Apple Valley School District and to create a program that uses a decommissioned

Goldstone antenna (made available by the Stevenson-Wydler Act) to allow 8th-grade students in Detroit to conduct astronomical experiments.

Sandia National Laboratories involve technical professionals in K–12 science education by providing scientists information on working effectively with students and teachers, conducting a student tour of work sites, and providing hands-on student activities. Sandia technical professionals support and collaborate with teachers, employ sound learning principles, develop age-appropriate activities, create activities that engage numerous senses of students, balance science process and content, hypothesize and test by experiment, demonstrate concern for safety and environment, build relationships, and solicit feedback.

The Earth Observing Commercial Applications Program at the Stennis Space Center, which expands the acceptance and use of remote-sensing technology in the marketplace, encourages its partner companies to publish articles on educational activities. These companies are also encouraged to publish in trade journals to educate the marketplace about their products.

The Classroom of the Future in Wheeling, West Virginia, has developed two educational, computer-based programs in which students can react in a virtual environment. This project also created a classroom where teachers can learn to use multimedia education techniques and developed a web-based environmental course for wide dissemination.

The Marshall Space Flight Center's Microgravity Research Office has developed user-friendly instructional materials on its microgravity programs to involve talented and interested students in the field. The student/teacher materials contain tutorial topics and hands-on activities illustrating scientific principles used in microgravity research and tied to the National Standards for K–12 science and mathematics.

At the Dryden Flight Research Center, the Environment Research Aircraft and Sensor Technology (ERAST) program worked with the Dryden Education Office, the Dryden Educator Resource Center, and the Aerospace Education Services program to develop a series of educator workshops and student programs in conjunction with the deployment of the Pathfinder aircraft to Kauai. Working in close collaboration with the Hawaii State Science Supervisor and local district officials on the islands of Maui, Oahu, and Kauai, more than 220 teachers were trained on the use of aeronautics and Earth systems science to support mathematics, science, and technology classroom activities. These teachers were then invited to bring their students to the Pacific Missile Range Facility at Barking Sands, Kauai, to view the aircraft and science instruments (Airborne Real Time Imaging System and Digital Array Scanned Interferometer), and to interact with Pathfinder scientists and engineers and Pacific Missile Range Facility personnel.

The Stennis Space Center pioneered the Tri-State Education Initiative, which has received five "Hammer" awards. The initiative uses teacher workshops, student activities, technology, and curriculum supplements, as well as Federal, public, State, and private partnerships to reach America's educational systems. The initiative has been replicated in 14 States.

Best Public Affairs CK Practices

Exemplary public affairs practices performed throughout NASA include: (1) participating in fairs and conventions; (2) arranging unique opportunities, such as Galileo Family and Friends Night and Center open houses; (3) creating interactive Internet events, such as

“On-Line from Jupiter,” web chats, and award-winning web sites; (4) coordinating the daily release of print, video, photographic, and web site information and arranging interviews and press conferences; (5) developing and maintaining exhibits that almost continuously are displayed throughout the country; (6) proactively seeking and successfully reaching dozens of nonaerospace, specialized audiences each year for displays, speaking platforms, partnerships, and publication in journals; (7) providing media training for those presenting and talking to the public; (8) providing digital images on web sites for the public; (9) providing the opportunity for the public to visit and tour Centers; (10) supporting museums and planetariums; and (11) arranging 700 “live shots” in 1997, with the expectation of conducting 1,000 during 1998, providing NASA information to between 35 and 100 million viewers.

The Goddard Space Flight Center’s Microwave Anistrophy Probe project worked with the New York Planetarium to provide an exhibit and video. The planetarium’s request for information products was fulfilled efficiently and inexpensively using equipment that was a byproduct of the project to produce the CK products needed.

Media plans for the Pathfinder event on Mars began preparation 6 months before the landing date. The plan included developing logistics including staffing, developing web mirror sites, arranging for press housing, creating “sandboxes” for television backdrops, and making arrangements for NASA Television coverage. Public and press web sites, 50 mirror sites, corporate support, and the accommodation of 1,000 press personnel contributed to the event’s success. Press staffing was drawn from public information officers from JPL as well as other Centers, volunteers, teachers, and students.

The Johnson Space Center takes advantage of local visitor attractions to place exhibits before large public audiences. On an ongoing basis, Johnson provides space hardware and artifacts to Space Center Houston for display to the public. This includes historic spacecraft, spacesuits, and new technology under development. Johnson has also provided special exhibits to the new Discovery Center at Moody Gardens, a tourist attraction in Galveston. The exhibits highlight space program achievements and current activities. Both arrangements benefit the public by sharing knowledge of historical and new NASA projects. They benefit the receiving organizations by attracting additional visitors.

Best Data Base CK Practices

The Air Force Research Laboratory’s Strategic Information Management provides communication on Air Force-industry research and development. In cooperation with the Defense Technical Information Center, the laboratory developed a secure controlled-access Air Force Science and Technology World Wide Web site providing both Government and industry with Air Force requirements, planning documents, and points of contact. The web site includes public access, export-controlled, and sensitive unclassified information. Unclassified summaries and points of contact direct the web user to offline sources of classified information.

The Air Force Research Laboratory’s Science and Technology Bulletin Board web site includes science and technology documents and reference materials, news and announcements, organizational information, points of contact, process improvement programs, related sites, and utility web sites. The TechConnect web site helps Government, industry, and academia contact Air Force technology experts, learn about potential technology transfer opportunities, accelerate the transition of technology, find information regarding a particular Air Force technology, and search for helpful Air Force technologies to solve specific problems.

The Ames Research Center researches information on how materials respond to atmospheric heating at very high speeds. Much of the research in aerothermodynamics, computational chemistry, arc jet testing, and materials science and technology is published in aerospace technology journals. An online data base is continually updated to provide the most extensive information source in the world on thermal protection materials.

The Kennedy Space Center's Life Sciences Data Archive contains data from space flight experiments and related ground-control studies. This searchable data base contains top-level information and pictures related to all NASA missions involving space life sciences. The information is written for the general public with an online glossary for scientific terms and with a digital image library, including photographs of Space Shuttle launches, Spacelab, and astronauts, as well as artist concepts. A "Just for Kids" section includes games and activities designed to teach children about space and space life sciences.

One of the best web sites is the Research Triangle Institute web site established by the Kennedy Space Center. Every report produced is available to the general public. The Fast Retrieval of Electronic Data system answers queries through the use of key terms. A data base firewall prevents restricted material from being accessed by the general public. A log-in system allows customers to track the progress of the research being conducted for them at the laboratory via the Internet.

The Dryden Flight Research Center provides an exemplary practice of archiving software technology in data bases at the NASA Software Technology Transfer Center (COSMIC). The Goddard Space Flight Center has an exemplary data processing site, the Distributed Active Archive Center, where raw data is translated to data sets and archived. Goddard also converts extensive data from web sites to CD–ROM's.

Sandia National Laboratories preserves unique knowledge. Before an experienced employee leaves Sandia, he is interviewed to capture his knowledge electronically. Experiences, information, and wisdom are preserved and indexed for electronic recall. Aspects of a major design review are also video recorded and archived for future use.

Best Communications CK Practices

Best practices in communication throughout NASA include: (1) forming working groups among Government, industry, and academia to create dialogue and issue resolution; (2) detailing individuals to other sites, such as Centers, space-related industries, and universities; (3) involving customers throughout the project, even co-locating personnel as needed; (4) developing representatives to establish and maintain constant communication with the customer; (5) conducting formal customer surveys before and after service; (6) establishing media training for communicators; (7) developing internal points of contact for systematic knowledge collection and distribution; and (8) holding internal, monthly mandatory meetings, alternating speakers to share information on work being done.

Sandia National Laboratories developed the concept of scientific "landscaping" for mapping and navigating knowledge. Scientific trends are represented as ripples, flows, peaks, and gorges on a three-dimensional map. The landscape can provide past trends and a understanding of unfolding trends. Who is doing what? Where is the leading edge? How might we improve science and technology investment strategies? The landscapes indicate to decision makers what is happening and not happening, by linking the context rather than the content of knowledge.

The Los Alamos National Laboratory publishes an electronic newspaper every day. It also makes internal memoranda for 400 managers available electronically to more than 10,000 employees.

Appendix E

Communicate Knowledge Sample Project Report

Communicate Knowledge Process Team
Site Visit to Sandia National Laboratories
19 November 1997

Fact Finding Report
by
Team 3

1. CK Process Team Members: Angela Ewell-Madison and Unmeel Mehta

2. Technical Activities and Communicators:

• Micro Devices	Dr. Robert Blewer Manager, Microelectronics Industry/University Partnerships Department	(505) 844-6125
• Education Outreach	Dr. Kenneth H. Eckelmeyer Education Outreach Program	(505) 845-8680
• Technology Partnerships	Kevin A. McMahon & Commercialization Licenses & Agreements	(505) 843-4168

3. Micro Devices

i) What was the objective of your research/operational effort?
- To develop the necessary expertise and capabilities to support the Microelectronics and Photonics Center (a staff of 400) Mission
- To support the objective of the Defense Microelectronics Technology Program (DMTP)

ii) How would you classify your research? How do you accomplish research?
- Programmatic research to provide knowledge for a mission
- Industrial research to achieve economic benefits
- Industrial partnerships save capital, time, and manpower in achieving Sandia's mission
- The DMTP relies on existing relationships and industry production
- Win-win partnerships model
- Commercial partnerships are vital to Microelectromechanical Systems (MEMS) technology development

iii) Who were your customers?
- Primary: DOE, IC (Integrated Circuit) industry manufacturers, IC equipment manufacturers, and consortia of these
- Secondary: Other Federal Agencies, universities, non-semiconductor based industries
- Ultimate Customer: U.S. taxpayer
- Example: Semiconductor Manufacturing Technology (SEMATECH)/ Sandia Partnership
  - Started as a work-for-others contract in 1989; extended with two one-year CRADA's in 1992; extended with a five-year CRADA in 1993; negotiating extension for the sixth year
  - Total CRADA funding $105,950,000 (50% from DOE and 50% from SEMATECH (fund-in and in-kind))

- 241 total personnel working on program (zero full time), involving 70 departments, 23 centers, and 9 divisions
- Project Management Approach: The Sandia/SEMATECH CRADA is operated under formal project management principles and techniques to ensure successful projects and satisfied partners and projects are selected from the list of mutually beneficial topics that appear on both partners' technology roadmaps.
- Through 1997, greater than 130 projects were completed

iv) Did you involve your customers in the up-front planning?
- DOE/Defense programs: Worked with DOE to assist the U.S. Congress in creating a contingency for radiation-hardened microelectronics
- SEMATECH: Worked with S&T Focus Advisory Boards to define research projects of greatest mutual interest/benefit
- Industry CRADA's: Established streamlined approach to defined R&D projects

v) What kind of communication did you use?
- Written: Proceedings, publications, preview reports, tech transfer reports, Gantt charts
- Oral: Presentations at quarterly and annual reviews, at conferences, at road shows at sponsor's site, and at trade shows
- Electronic: Web page, videos, e-mail, teleconferences, videoconferences

vi) Who assisted you in this process?
- Internal Infrastructure: Program participants, internal tech transfer, protocol, marketing groups, and onsite partner assignees
- External Partners: Consortia, CRADA partners, and universities
- Industry Trade Groups: Semiconductor Research Corporations, Semiconductor Industry Association, and Trade Journal Editors

vii) Was there a source of funds dedicated to help in this process?
- Costs of report preparation, of travel for presentations, etc., were included in the project plan.
- The infrastructure and resources of Consortia partners were leveraged to fan out results of joint projects.
- Internal infrastructure was used when possible.
- Spinoff of technology was encouraged through entrepreneurial leaves.
- Internal points of contact were appointed for systematic knowledge collection and distribution.

viii) How has this knowledge been archived?
- FTAB (Focus Technology Advisory Board) proceedings, publications, reports
- Newsnotes, minutes, quarterly reports, one pagers
- Patents, technical advance disclosures, lab notebooks
- Videotapes

ix) What was your incentive to carry out this process?
- Reduced costs
- Unforeseen dual-use applications
- Reduced time to application
- Future funding opportunities

x) What mechanisms did you use to gather feedback on quality, timeliness, accuracy, etc., of this knowledge?
- Support and satisfaction ratings on each project after every consortium review
- Real-time feedback/action requests during every meeting
- Meeting evaluation forms at the completion of every review with a customer/partner
- Monthly or quarterly reviews with customers/partners
- Upward/360 feedback exercises internally

4. Education Outreach

- Sandia's K–12 effort began with after-school activities (hands-on science and technology projects) for minority secondary students in 1980's led by minority Sandia staff. Several dozen students were involved in 1980's, and several hundred students took part in 1990's.
- The effort was expanded in 1989 in response to DOE's request to help enhance science education for America's mainstream students.
- The School Partnership Program was initiated to improve mainstream students' attitudes toward and understanding of science by teaming Sandia staff with schools (~1,000 students) to provide
  - In-class activities complementing curriculum topics
  - Teacher support & assistance
  - Out-of-class mentoring & tutoring
  - Special event (science fair, etc.) involvement
- The Science Advisors Program extended the Partnership program to target teachers in entire districts by providing assistance to teachers on request, by making available hands-on instructional resources to teachers, and by holding professional development workshops for teachers.
  - ~200 schools served by SCIADs (Science Advisors)
  - ~10,000 resource center loans per year
  - ~1000 teachers attend workshops
- Following several years of SCIAD involvement, 3rd and 5th graders scored higher in science than any other Iowa Test Basic Skills test area. Eighth graders did not.
- The strengthening quality in the schools program concentrated on improving education using Baldridge Quality Award Criteria and on implementation of quality principles, procedures, and tools.
- In 1995, Sandia began changing the way in which future teachers experience science at universities by also including them.
- Currently, an effort is being made to win commitment from school districts to implement hands-on minds-on science instruction in 1999.
- Strategies used for quality science education activities:
  - Support and collaborate with teachers
  - Recognize your need for planning and preparation
  - Employ sound learning principles
  - Do age-appropriate activities
  - Engage numerous senses and learning modalities
  - Balance science process and content
  - Demonstrate concern for safety and environment
  - Build relationships
  - Solicit feedback from teachers and students

5. Technology Partnerships and Commercialization

- Congress mandated the development of closer partnerships with industry by enacting the National Competitiveness Technology Transfer Act of 1989.
- Created new technology transfer mechanism: Cooperative Research and Development Agreement (CRADA)
  - 5-year protection of trade secrets (Freedom of Information Act exemption)
  - Broad authority to negotiate intellectual property rights
- Guiding principles of technology transfer
  - Provide for fairness of opportunity

  - Contribute to U.S. competitiveness
  - Contribute to DOE mission impact
  - Manage conflict of interest
  - Protect national security
  - Avoid competition with private sector
- Intellectual property management and licensing
  - Technological innovation and know-how are “owned,” have value, and can be managed to generate tangible and intangible benefits to the corporation
  - Rights of use can be conveyed to others by make, sell, or use and qualified by the term exclusive, limited exclusive, or nonexclusive
- “Every patent shall contain a grant to the patentee for the term of twenty years . . . of the right to exclude others from making, using, or selling the invention throughout the United States.”
- Mechanisms for technology partnering: licenses, leave-of-absence, publications and conferences, personnel exchange, user facilities, commercial work for others, CRADA’s, consortia, memoranda of agreement, and technical assistance
- Internal filters and external market research are used to identify technologies for transfer. Technology transfer project leads to either an R&D project or a know-how project.
- The modes of communication of tech transfer opportunities are conferences, seminars, publications, *Commerce Business Daily*, and external web sites.
- Market research to determine partner needs is the preferred approach rather than the “show and tell” approach for creating partnerships.
- At the end of fourth quarter of FY 1997, Sandia had
  - 602 CRADA’s in 37 States, with some CRADA’s having multiple industry partners
  - granted 186 plus 33 foreign commercial licenses
  - provided technical assistance numbering in 1,148 cases since October 1991

6. Summary

- Sandia presents the best example of the use of CRADA’s.
- Probably, Sandia does some things in Education Outreach that are unique and that may help NASA to enhance its Education Outreach.
- Education Outreach addressed to elementary school students has more impact than to junior high school students.
- Market research offers higher payoff than show and tell for setting up partnerships and for commercialization of technology.

Appendix F

Communicate Knowledge Process Team Visits

AFRL	Air Force Research Laboratory, Wright-Patterson AFB, Ohio
ARC	Ames Research Center, Moffett Field, California
Assoc	Lt. Gen. Armstrong Visits with Local Associations
Briefings	Presentations to Members of Communicate Knowledge Process Team
DFRC	Dryden Flight Research Center, Edwards, California
GSFC	Goddard Space Flight Center, Greenbelt, Maryland
HQ	NASA Headquarters
JPL	Jet Propulsion Laboratory, Pasadena, California
JSC	Lyndon B. Johnson Space Center, Houston, Texas
KSC	John F. Kennedy Space Center, Kennedy Space Center, Florida
LaRC	Langley Research Center, Hampton, Virginia
LeRC	Lewis Research Center, Cleveland, Ohio
MSFC	George C. Marshall Space Flight Center, Marshall Space Flight Center, Alabama
NRL	Naval Research Laboratory, Washington, D.C.
Sandia	Sandia National Laboratories, Albuquerque, New Mexico
SSC	John C. Stennis Space Center, Stennis Space Center, Mississippi
STScI	Space Telescope Science Institute, Baltimore, Maryland
STV	Small Team Visits

Site	Organization	Officials Interviewed
AFRL	Advanced Laser Eye Protection	Tim Strange, John Eric
AFRL	AF S&T Investment Strategy Process/ AFMC S&T Business Area Overview	Maj. Gen. Paul
AFRL	Aging Aircraft	Michael L. Zeigler
AFRL	Combat Identification	Maj. Jaime Gainey
AFRL	Composite Affordability Initiative	Roger Griswold, Dan Brewer
AFRL	Composite Bridge	John P. Mistretta
AFRL	Corporate Communications	Lt. Col Kosiba
AFRL	Developing Cooperative Research and Development Agreement Opportunities	Kristen Schario
AFRL	Education Outreach	John Sparks
AFRL	Helmet Mounted System Technology	Randy Brown
AFRL	Independent Research and Development	Maj. Louis Scacca
AFRL	Infrared Counter Measures (IRCM)	Bill Taylor, Dr. George Vogel

Appendix F

Site	Organization	Officials Interviewed
AFRL	Integrated High Performance Turbine Engine Technology	Lt. Col. Lance Chrisinger
AFRL	Next Generation Transparencies	Bob McCarty
AFRL	Small Business Innovation Research (SBIR)	Jill Dickman
AFRL	Technology Transfer	Lt. Col. Kosiba
AFRL	Welcome/Remarks	Lt. Col. Jay McDaniel, Maj. Gen. Paul
ARC	Agency Programs—Aviation Operations Systems and Rotorcraft Research Technology	Dr. Cynthia H. Null, John M. Davis
ARC	Agency Programs—Aviation Systems Capacity	David R. Picasso
ARC	Agency Programs—Gravitational Biology and Ecology	Dr. Gary Jans, Dr. Rosalind A. Grymes
ARC	Agency Programs—NASA's K–12 Internet Initiative	Karen Triacoff, Marc R. Siegel, Andrea L. McCurdy, Susan O. Lee
ARC	Aeronautics and Space Transportation Technology—Center-TRACON Automation System	Dr. Dallas G. Denery
ARC	Aeronautics and Space Transportation Technology—Human Factors	Dr. Kevin Corker
ARC	Aeronautics and Space Transportation Technology—Piloted Research Simulation	Arthur D. Jones
ARC	Aeronautics and Space Transportation Technology—Analysis and Design Tools	Reese L. Sorenson
ARC	Aeronautics and Space Transportation Technology—Fatigue Countermeasures	Dr. Mark R. Rosekind
ARC	Aeronautics and Space Transportation Technology—Thermal Protection Systems	Howard E. Goldstein
ARC	Aeronautics and Space Transportation Technology—Wind Tunnel Testing	Dr. Lawrence E. Olson
ARC	Communication Facilitators	Michael Marlaire, Dr. Bruce Webbon, Lisa Reid, Christine Gong

Site	Organization	Officials Interviewed
ARC	Communication of Mission Knowledge	Dr. Robert Rosen, Dr. David Morrison, Dr. Fredric H. Schmitz, Anthony R. Gross
ARC	Human Exploration and Development of Space—Biocomputation	Dr. Muriel D. Ross, Jeffery D. Smith, Duncan Atchison
ARC	Human Exploration and Development of Space—Biomedical Effects/ Countermeasures	Dr. Charles E. Wade, Dr. Paul X. Callahan, Bernadette Luna
ARC	Human Exploration and Development of Space—Human Support in Space	John W. Fisher, Dr. John E. Finn, Bernadette Luna, Dr. Mark H. Kliss
ARC	Human Exploration and Development of Space—Technology/Sensors 2000	John W. Hines, Michael G. Skidmore, J. Jane Cordell, Steven S. Wegener, Laura W. Doty
ARC	Earth Science—Atmospheric Research (Climate/Clouds/Ozone)	Warren J. Gore, Roderick S. Hipskind, Eric J. Jensen
ARC	Earth Science—Ecosystems (BADGER/ GRAPES/Urban growth/Breathing earth)	Edwin J. Sheffner, Lee F. Johnson
ARC	Earth Science—Health Monitoring (Disaster monitoring/ Fire/ Vector tracking) with OLMSA	Sheri W. Dister, Jeffrey S. Myers
ARC	Earth Science—Observatorium	Kathryn M. Kemp
ARC	Space Science—Airborne Astronomy (KAO/SOFIA/FOSTER)	Dr. David G. Koch, Edna K. DeVore, Christopher B. Wiltsee, Dr. Lawrence J. Caroff
ARC	Space Science—Life's Origins (Evolution/ Astrobiology/Academy)	Dr. Jack D. Farmer, Dr. David G. Koch, Dr. David F. Blake, Dr. David Morrison
ARC	Space Science—Mars Missions (CMEX/Pathfinder)	Dr. Robert M. Harberle, Virginia C. Gulick, Paul F. Wercinski
ARC	Space Science—Solar System Exploration (Pioneer/Rings/Asteroids/Comets/LP)	Dr. Yvonne J. Pendleton, Dr. Lawrence E. Lasher, Kenneth J. Bollinger, Jeffrey M. Moore

Site	Organization	Officials Interviewed
ARC	Space Science—Information Technology Outreach	Dr. Yvonne A. Clearwater
ARC	Welcome/Remarks	Dr. Henry McDonald, Dr. Unmeel Mehta
Assoc	American Association for the Advancement of Science (AAAS)	Joanne Carney, Stephen Nelson, Bob Bobala, Bob Rich
Assoc	American Association of Engineering Societies (AAES)	Tom Price
Assoc	Biotechnology Industry Organization (BIO)	Alan Goldhammer, Dave Schmickel
Assoc	Civil Engineering Research Foundation (CERF)	William Kirksey (Environmental Technology), John Meyer, Peter Kissinger
Briefings at HQ	Center for Commercial Space	Ed Gabris
Briefings at HQ	Education Outreach	Frank Owens, Mark Pine, Jenny Kishiyama
Briefings at HQ	Lunar Planetary Institute	Pam Thompson
Briefings at HQ	Minority University Research and Education (MURED) Programs	Bettie White
Briefings at HQ	Office of Aeronautics and Space Transportation	Dr. Robert Norwood
Briefings at HQ	Office of Earth Science	Greg Williams
Briefings at HQ	Office of Legislative Affairs	Helen Rothman
Briefings at HQ	Office of Public Affairs	Peggy Wilhide, Brian Welch
Briefings at HQ	Office of Space Science	Dr. Melvin Montemerlo
Briefings at HQ	Public Understanding of Science	Dr. Gerry Wheeler
Briefings at HQ	Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR)	Carl Ray

Site	Organization	Officials Interviewed
Briefings at HQ	Worlds Apart	Rick Chappell
DFRC	Environment Research Aircraft and Sensor Technology (ERAST)	Jenny Baer-Riedhart, John Del Frate
DFRC	F-18 High Alpha Research Vehicle (HARV)	Donald H. Gatlin, Albion H. Bowers
DFRC	Flush Air Data Sensing (FADS)	Tony Whitmore
DFRC	Flight Research (R&T Base)	Dwain A. Deets
DFRC	Linear Aerospike SR-71 Experiment (LASRE)	David P. Lux
DFRC	Mathematical Techniques	David R. Hedgley
DFRC	Multidiscipline Analysis	Kajal K. Gupta
DFRC	Parameter Estimation	Kenneth W. Iliff
DFRC	Propulsion Research	Bill Burcham, Gordon Fullerton, James F. Stewart
DFRC	Systems Research Aircraft	Joel R. Sitz
DFRC	Tu-144LL High Speed Experiments	M. Russ Barber
DFRC	Welcome/Remarks	Kenneth J. Szalai
DFRC	X-31	Rogers E. Smith, Gary A. Trippensee, Gary Thompson
DFRC	X-38/CV-990	Robert Baron, Christopher Nagy
GSFC	Climate—Long-Term	Dr. Rickey Rood, Dr. Max Suarez, Dr. Joann Simpson, Dr. James Hansen, Dr. William Rossow
GSFC	Climate—Short-Term	Dr. Troy Busalacchi, Dr. Chet Koblinsky
GSFC	Cosmic Background Explorer (COBE)	Dr. John Mather, team
GSFC	Compton Gamma Ray Observatory (CGRO)	Dr. Neil Gehrels, Dr. Jay Norris
GSFC	Distributed Active Archive Center (DAAC)	Dr. Blanche Meeson, Carla Evans, George Serafino, Paul Chan

Appendix F

Site	Organization	Officials Interviewed
GSFC	Earth Observing System (EOS)	Dr. Vincent Salomonson, Charlotte Griner, Dr. Claire Parkinson, Dr. Nahid Khazenie
GSFC	Geodosy	Dr. Herb Fry, Dr. Jin Garvin, Dr. Dave Smith
GSFC	Global Geospace Science (GGS)	Dr. Mario Acuna, Dr. Mauricio Peredo, Mike Carlowicz, Dr. Bob Hoffman
GSFC	High Energy Astrophysics Science Archival Research Center (HEASARC)	Dr. Nick White, team
GSFC	Hubble Space Telescope (HST)	Dr. Dave Leckrone, Leslye Boyce, Dr. Bruce Woodgate
GSFC	Polar Ice	Dr. Claire Parkinson, Dr. Josefino Comiso, Dr. Jay Zwally, Dr. Bob Bindschandler
GSFC	Land	Dr. Forrest Hall, Dr. Steven Ungar, Dr. Marc Imhoff, Dr. Jim Irons
GSFC	(Earth Observing System) Meteorological Satellites (METSATS)	Dr. Fritz Hasler, Dr. Dennis Chesters, Dr. Franco Einaudi
GSFC	Microwave Anisotrophy Probe (MAP)	Dr. Chuck Bennett, team
GSFC	Next Generation Space Telescope (NGST)	Bernie Seery, Dr. John Wood, Eric Smith
GSFC	Ozone	Dr. Paul Newman, Dr. Arlin Krueger, Ernie Hilsenrath, Dr. P.K. Bhartia, Dr. Anne Thompson
GSFC	Planetary X-ray Gamma Ray Spectroscopy	Dr. Jack Trombka
GSFC	Regional Verification Centers	Bill Campbell, Milt Halem
GSFC	Small Explorers Project (SMEX)	Eduardo Torres-Martinez
GSFC	Solar and Heliospheric Observatory (SOHO)	Dr. Art Poland, Steele Hill, Dr. Joe Gurman, Dr. Barbara Thompson, Terry Kucera

Site	Organization	Officials Interviewed
GSFC	Space Experiment Module (SEM)	Dr. Ruthan Lewis, Al Byers, Chris Dunker
GSFC	Spartan	Mark Steiner, team
GSFC	Technology Programs	Nona Minnifield, team
GSFC	Wallops Flight Facility (WFF)	Dr. Arnold Torres, team
GSFC	Welcome/Remarks	Joseph Rothenberg, Dr. Steven Maran, Dr. Louis Walter
HQ	Code ICB Inventions/ Contracts Board	Dr. Paul Curto
HQ	Code ID, NASA Export Control	Robert Tucker, Kristine Johnson
HQ	Code L, NASA Legislative Affairs	Karl Stehmer, Larry Spencer
JPL	Cassini	Ellis Miner, Terry Flynn
JPL	Commercialization	James Rooney
JPL	Deep Space Network (DSN)	Chad Edwards, Shirley Wolff, Sue LaVoie, Mike Klein
JPL	Earth Imaging Radar	Mona Jasnow, Ellen O'Leary, Annie Richardson
JPL	Education Affairs Office	Dr. Frederick Shair
JPL	Education Outreach Advisory Team	David Seidel
JPL	Earth Observing System (EOS/Inst.)	Marguerite Syvertson
JPL	Galileo	Leslie Lowes, N. Talbot Brady, Karen Buxbaum, Louis A. D'Amario, Claudia Alexander
JPL	Ice and Fire	Jackie Guiliano, Richard Shope, Rob Staehle
JPL	Mars ‘98	Steve Saunders
JPL	Microelectronics Devices Laboratory (MDL)	Dr. Carl Kukkonen
JPL	New Millennium Program	Lisa Wainio
JPL	NASA Scatterometer (NSCAT)	Gracie Hallowell, Tim Liu, James Huddleston
JPL	Overview	Mark Pine

Site	Organization	Officials Interviewed
JPL	Pathfinder	Matt Golombek, John Wellman, Richard Cook
JPL	Planetary Data System (PDS)	Sue McMahon
JPL	Public Affairs Office	Betty Shultz
JPL	Space Infrared Telescope Facility (SIRTF)	Larry Simmons
JPL	Small Bodies	Gloria Jew
JPL	Technology Transfer	Alfred Pappano
JPL	TOPEX/Poseidon	Annette deCharon
JPL	Welcome/Remarks	Dr. Moustafa Chahine, George Alexander
JSC	Advanced Life Support	Don Henninger
JSC	Aeroscience and Flight Mechanics	Don Brown
JSC	Astronaut Appearances	Linda Godwin
JSC	Automation, Robotics, and Simulation	Jon Erickson
JSC	Biotechnology	Steven Gonda
JSC	Earth Observations Photography	Dr. Hkamlesh Lulla, David Ansbury
JSC	EVA Suits and Tools	Philip R. West
JSC	Exploration Office	Joyce Carpenter
JSC	Human Physiology	Deborah Harm
JSC	Public Affairs Office	Steve Nesbitt
JSC	Solar System Exploration Division—Orbital Debris and Mars Meteorite	Nicholas L. Johnson, David S. McKay
JSC	Tech Transfer and Commercialization	Dr. Kumar Krishen
JSC	Welcome/Remarks	Brian Duffy
JSC	X-38 Vehicle	John Muratore
KSC	Aeronautics Systems Analysis Division	Scott Murray, Dionne Jackson, Angela Balles

Site	Organization	Officials Interviewed
KSC	Automated and Intelligent Systems Division	William C. Jones, Thomas C. Lippitt, Roger D. Hall, Robert L. Morrison, Michael D. Hogue
KSC	Checkout and Launch Control System	Rick Hurt, Kirk Lougheed, Tom Flemming
KSC	Checkout, Control, and Data Systems Division	Wayne Prince, Larry Morgan
KSC	Ecological Research	Burt Summerfield, Ross Hinkle, Carlton Hall
KSC	Human Factors Team	Pat Simpkins, Mark Nappi, Timothy Barth, Lana Maier
KSC	Instrumentation Division	Bill Helms, David Collins, Bill Larson
KSC	International Space Station (ISS) Logistics	Bob Cunningham, Cindy Lodge
KSC	Life Sciences Research	John Sugar, Ray Wheeler, Jay Garland, Elise Blaise
KSC	Mechanical Design Division	Roger Hall, Joe Porta, Alan Littlefield
KSC	Payloads Launch Site Support Process Team	Julie Schneringer, Mark Ruether, Ronald Schlierf, Jeannie Ruiz, John Lekki
KSC	Payloads Outreach Process Branch	Linda Hannett
KSC	Process Industrial Engineering (IE)	Timothy Barth, Steve Robling, Lana Maier, Lawrence Ellis
KSC	Propellant Logistics	Chuck Davis, H.T. Everett
KSC	Public Affairs Office	David Dickinson, Lisa Malone, Bill Johnson
KSC	Shuttle Processing Team	Ruth Harrison, Mike Leinbach, John Guidi, team
KSC	Technology Programs and Commercialization	Karen Thompson, Danny Culbertson
KSC	Weather Support to Space Flight Operations	John Madura, Frank Merceret

Appendix F

Site	Organization	Officials Interviewed
KSC	Welcome/Remarks	Oscar Toledo, Roy Bridges, James Jennings, JoAnn Morgan, Loren Shriver, Hugh Harris
LaRC	Aeronautics Systems Analysis Division	Mark Gynn, Peter Coen, Gary Giles
LaRC	Airframe Systems Program Office	Bill Cazier, Joe Chambers, Luat Nguyen, Woodrow Whitlow, Long Yip
LaRC	Atmospheric Sciences Division	Curtis Rinsland, Chris Currey, Lin Chambers, Joel Levine, Jeff Considine, Arlene Levine
LaRC	Communicating Knowledge	Dennis Bushnell
LaRC	Education	Dr. Samuel Massenberg
LaRC	Experimental Testing Technology Division	Jag Singh, Billy Upchurch, Mike Chapman, John Hoppe, Mitch Thomas
LaRC	Fluid Mechanics and Acoustics Division	Michele Macaraeg, Feri Farassat, Jerry Hefner
LaRC	High Speed Research (HSR)	Allen Whitehead, Ginger Cordle, Wally Sawyer
LaRC	Internal Operations Group (IOG)	Bruce Conway, Frank Thames, Richard Campbell, Laurence Bement, Steve Syrett
LaRC	Materials Division Team	Mark Shuart, Tom Yost, Karen Taminger
LaRC	Public Affairs Office	Aubrey Price
LaRC	Research and Technology Group (RTG)	Doug Dwoyer, Jerry Housner
LaRC	Research Information Management	Mary McCaskill
LaRC	Scientific and Technical Information Program Office	George Roncaglia
LaRC	Space and Atmospheric Sciences Group	Darrell Branscome, Bill Smith, Wilson Lundy, Jerry Newsom, Roger Breckenridge
LaRC	Technology Applications Group (TAG)	Preston Carraway, Barry Gibbons, Cheryl Allen, Billy Upchurch
LaRC	Welcome/Remarks	Dr. Belinda Adams, Irving Abel

Site	Organization	Officials Interviewed
LaRC	Wind Tunnel Reengineering	Jerry Kegelman, Pete Jacobs, Thomas Noll
LeRC	Advanced Communications Technology Satellite (ACTS)	Jennifer Sibits, Michael Zernic
LeRC	Advanced Supersonic Technology (AST)	Anita Liang
LeRC	Aeronautics Outreach Team	Sandy App
LeRC	Education Outreach	Jo Ann Charleston
LeRC	Fast Guiet Engine Group	Joe Shaw
LeRC	Flywheel Team	Raymond Beach
LeRC	General Aviation Propulsion (GAP) Group	Robert Corrigan
LeRC	High Performance Computing and Communications (HPCC)	Greg Follen
LeRC	High Speed Research (HSR)	Robert Plencner
LeRC	High Temperature Integrated Electronics	J. Anthony Powell
LeRC	HITEMP—High Temperature Materials Program	Carol Ginty
LeRC	Icing Technology	Tom Bond
LeRC	Introduction for External Programs	Lynn Bondurant
LeRC	Launch Services and Space Transportation	Harry Cikanek
LeRC	Lewis Business Industry Summit	Susan Hennie
LeRC	Mobile Aeronautics Education Laboratory (MAEL) and Science, Engineering, Mathematics and Aerospace Academy (SEMAA)	Lynn Bondurant
LeRC	Microgravity Science (Combustion and Fluids)	Thomas Glasgow, Laura Maynard-Nelson
LeRC	Next Generation (Traveling Wave Tube Amplifier)	Vernon Heinen
LeRC	Power and On-Board Propulsion	Tom Labus, James Calogeras, John Dunning
LeRC	Research and Technology, Technology Transfer Team	Bruce Banks

Appendix F

Site	Organization	Officials Interviewed
LeRC	Scenario Study Team	Jeff Berton
LeRC	Speakers Bureau and WVIZ Intiative	Linda Dukes-Campbell
LeRC	Technical Publications	Sue Butts
LeRC	Welcome/Remarks	Irving Abel, Donald Campbell
Los Alamos	Plasma Physics Research	Michelle Thompson, John Gosling
Los Alamos	X-Ray Astronomy/High Energy Astrophysics	Jeff Bloch
MSFC	60k Engine Design	Karen Spanger
MSFC	A Commitment to Science Communications	Dr. Greg Wilson
MSFC	Advanced X-ray Astronomy Facility Project	Tom Rankin
MSFC	Aerogel	Ray Cronise
MSFC	Automated Rendezvous & Capture (AR&C)	Mike Martin
MSFC	Burst And Transient Source Experiment (BATSE)	Jerry Fishman
MSFC	Education	Jim Pruitt
MSFC	Flexure Test Technology	Mike Tinker, others
MSFC	Global Hydrology Climate Center (GHCC)	Ron Greenwood
MSFC	Lightning and Global Temperature	Hugh Christian
MSFC	Microgravity Program Research Office	Robin Neeley
MSFC	Mission Operations	Cathy Lapenta
MSFC	Optics	Helen Cole
MSFC	Plasma Physics/Solar Physics and Near-Earth Space Environment	Barbara Giles
MSFC	Productivity Enhancement Complex (PEC)	Wendell Colberg
MSFC	Propulsion	Charles Schafer
MSFC	Public Affairs Office	John Taylor
MSFC	Space Environmental Effects	Jim Zwiner
MSFC	Space Science Lab	Dr. John Horack
MSFC	Space Transportation	Dennis Smith

Site	Organization	Officials Interviewed
MSFC	Suppression of Transient Bursts Levitation Evaluation (STABLE)	Dean Alhorn
MSFC	Technology Transfer	Sally Little
MSFC	Urban Heat Island and Archeology from Space	Dale Quattrochi
MSFC	Welcome/Remarks	Ernestine Cothran, Carolyn Griner
NRL	Bio-Sensors	Dr. Frances S. Ligler, Dr. Catherine M. Cotell
NRL	Diamond Research	Dr. James Butler
NRL	Explosives Detection	Dr. Al Garroway
NRL	Liquid Crystals	Dr. Ranganathan Shashidhar
NRL	Magnetic Materials	Gary Prinz
NRL	Optical Fiber Radiation Detector	Dr. Alan Huston, Dr. Brian Justus
NRL	Sensor and Remediation Research	Dr. Jimmie McDonald
NRL	Space Systems	Ed Senasack
Sandia	Cooperative Monitoring Center	Dave Barber
Sandia	Education Outreach	Dr. Kenneth Eckelmeyer
Sandia	Energy and Environment/Technical Partnerships and Commercialization	Kevin McMahon
Sandia	Engineering Sciences	Paul Hommert
Sandia	Enterprise Solution to Information Management	Mike Eaton
Sandia	External Web	Manuel P. Ontiveros
Sandia	Information/Computer Technologies	Elaine Gorham
Sandia	Knowledge Preservation	Paul Page, Keith Johnstone
Sandia	Mapping and Navigating Science	Chuck Meyers
Sandia	Materials	Dr. Clifford L. Renschler
Sandia	Media Relations	Rod Geer
Sandia	Micro Devices	Dr. Robert Blewer

Appendix F

Site	Organization	Officials Interviewed
Sandia	National Security	Dave Larson
Sandia	Science and Technology	Cesar Lombana
Sandia	Stress Technology Partnerships and Commercialization	Virgil Dugan
Sandia	University Interactions	Mary Ann Zanner
Sandia	Welcome/Remarks	Bobbie Burpo, Virgil Dugan
SSC	Earth Observation Commercial Application Program (EOCAP)	Mark Mick
SSC	Earth System Science	Rick Miller, Marco Giardino, Greg Carter
SSC	Education	David Powe
SSC	Light-Synthetic Aperture Radar (Light-SAR)	Tom Stanley, William Graham
SSC	New Business Development (Engine Testing)	Rick Gilbrech
SSC	Operations	Mike Dawson
SSC	Project Offices	Robert Bruce
SSC	Propulsion Testing	Lon F. Miller, Mike A. Potts
SSC	Public Affairs	Linda Theobald, Cheri Miller
SSC	Small Spacecraft Technology Initiative (SSTI)	Vicki M. Zanoni, Donald E. Holland
SSC	Technology Transfer	Kirk Sharp, Kristen Riley, Bill Shepherd
SSC	Thoughts on the Context for Communication—A Human Exploration and Development of Space Perspective	Mark Craig
SSC	U.S. Navy—Mapping, Charting, and Geodesy	Dr. Dawn Levoie, Rich Sandy, Kevin Shaw, Brenda Smith
SSC	U.S. Navy—Ocean Modeling	Capt. Peter Ranelli, Dr. Mike Carron, Dr. Mike Stanley, Christopher Hall
SSC	U.S. Navy—Satellite Remote Sensing LCDR	Bill McQueary, Emil Petruncio, Doug May, Bob Arnone
SSC	Visiting Investigator Program	Hugh Carr, Cliff Holley

Site	Organization	Officials Interviewed
SSC	Welcome/Remarks	Myron Webb, Mark Craig, Capt. Peter Ranelli, Kern Witcher, Carol Christian, Ray Villard, Trish Pengra, Terry Teays
STScI	Office of Public Outreach	Carol Christian, Ray Villard, Trish Pengra, Terry Teays
STV	Advanced General Aviation Transports Experiments (AGATE)	Bruce Holmes
STV	Georgia Center for Advanced Telecommunication Technology (GCATT)	Dr. Michael Cummins, Dr. Wayne Clough, and others
STV	U.S. Army Medical Research Institute of Infectious Diseases (USAMRID)	Col. David Franz, Lt. Col. Gerald Jennings, Dr. Carol Linden
STV	Mid-Atlantic Technology Application Center	John M. Bacon, Jeanne Nicholls, Lani Hummel, Preston Carraway
STV	National Technology Transfer Center and Classroom of the Future	Father Acker, Joseph Allen, Melanie Griffith, Jerry Miller, Tracee Joltees, Bill Schick, Dr. Frank Withrow, Dr. Laurie Ruberg, Dr. Bob Myers, Dr. Steve Croft, Dr. Steve Purcell, Jeanne Gasiorowski, Dr. Steve McGee, Charles Winschel, Donald Watson, Nancy Sturm