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**MARSHALL SPACE FLIGHT CENTER
THE UNIVERSITY OF ALABAMA**

PLANNING AN EFFECTIVE SPEAKERS OUTREACH PROGRAM

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The National Aeronautics and Space Administration (NASA) and, in particular, the Marshall Space Flight Center (MSFC) have played pivotal roles in the advancement of space exploration and space-related science and discovery since the early 1960's. Many of the extraordinary accomplishments and advancements of NASA and MSFC have gone largely unheralded to the general public, though they often border on the miraculous. This lack of suitable and deserved announcement of these "miracles" seems to have occurred because NASA engineers and scientists are inclined to regard extraordinary accomplishment as a normal course of events.

The goal in this project has been to determine an effective structure and mechanism for communicating to the general public the extent to which our investment in our US civilian space program, NASA, is, in fact, a very wise investment. The project has involved discerning important messages of truth which beg to be conveyed to the public. It also sought to identify MSFC personnel who are particularly effective as messengers or communicators. A third aspect of the project was to identify particular target audiences who would appreciate knowing the facts about their NASA investment. The intent is to incorporate the results into the formation of an effective, proactive MSFC speakers bureau.

A corollary accomplishment for the summer was participation in the formation of an educational outreach program known as Nasa Ambassadors. Nasa Ambassadors are chosen from the participants in the various MSFC summer programs including: Summer Faculty Fellowship Program (SFFP), Science Teacher Enrichment Program (STEP), Community College Enrichment Program (CCEP), Joint Venture (JOVE) program, and the NASA Academy program. NASA Ambassadors agree to make pre-packaged NASA-related presentations to non-academic audiences in their home communities. The packaged presentations were created by a small cadre of participants from the 1996 MSFC summer programs, volunteering their time beyond their normal NASA summer research commitment. A total of eight presentations were created and made available for use by NASA Ambassadors.

A major segment of the research effort during the summer has been devoted to verifying and documenting certain "spinoff" contributions of NASA technology and in determining their relevance and impact to our society and our nation's economy. The purpose behind the verification/documentation research has been to shed light on the question of whether or not our NASA investment is a wise investment. It has revealed that NASA is a wise investment.

INTRODUCTION

In any organization, accomplishment deserves to be recognized and saluted. This is especially true when the accomplishments are of extraordinary value, such as might have led to major improvements in our national economy or the public's standard of living. Since the creation of our U.S. civilian aerospace agency (NASA) in 1958 NASA scientists and engineers have been engaged in wide-ranging scientific research, exploration of new places and new ideas, and the discovery and development of new technologies. Many of these accomplishments and their ultimate applications have gone unheralded to the general public.

The project discussed in this report represents an attempt by the author, a college professor and a member of the larger general public, to discover or utilize mechanisms suitable for transmitting information about our civilian aerospace program to that largely ill-informed or misinformed general public.

One thesis of this report is that the public deserves to hear certain large messages about the civilian aerospace program. Those large messages include the following three: (1) **NASA**, our U.S. civilian aerospace program (hereafter simply referred to as our space program) is **OUR PROGRAM**. It is something in which each of the citizens of this country invests and in which each of us has reason to be interested in the results of that investment, (2) our space program is a **FIRST-RATE BARGAIN**, and it deserves to be recognized as such. American citizens deserve to know, in fact, how much they are investing in this program and weigh that against how much they are receiving back in return, and (3) in terms of the kind of scientific research and technological development for which our space program is noted, our space program is **GOOD FOR US**, and we **NEED MORE OF IT, NOT LESS**.

This project sought from the outset to identify messages, such as those outlined in the preceding paragraph, which need to be passed along to the public. Further, it sought to identify at the Marshall Space Flight Center those persons who could most effectively relate to the public those pertinent messages, and, finally, it proposed to identify examples of public audiences which could appreciate hearing the important messages. The final result is to lead to the creation of an effective speakers outreach program, utilizing Marshall personnel to execute the agency's charter responsibility of informing and educating the public.

While the project, as outlined above, progresses, though not yet nearly to the point of fulfillment, another parallel project, **NASA AMBASSADORS**, has been launched. NASA AMBASSADORS are volunteers selected from among the participants in the various MSFC summer programs, including: the Summer Faculty Fellowship Program (SFFP), the Community College Enrichment Program (CCEP), the Science Teachers Enrichment Program (STEP), the Joint Venture (JOVE) program, and the NASA Academy student program. NASA AMBASSADORS agree to deliver pre-packaged presentations to public audiences at locations near their home institutions. The talks, amply supported with visual slides, were created by volunteers from among the summer program participants. The NASA AMBASSADORS program will be coordinated by the MSFC Office of Public Affairs.

Much of the effort for this summer has been directed to performing interviews with NASA scientists, engineers, and contractors and to conducting research into printed materials and internet resources to ascertain links between NASA-developed technologies and products and services in use in our society. Special interest has been paid to documenting those "spin-offs" from NASA technology which are having largest measurable economic impact to American citizens.

What follows, in order, is a discussion of the large messages relevant to our space program, a discussion of the NASA AMBASSADOR program, and a discussion of the research results gathered during the documenting of the transfer of NASA technologies into the public sector.

MESSAGES

The first message which needs to be emphasized to the public is the reminder that **the U.S. civilian aerospace program is our program**. It belongs to all U.S. citizens. They have a vested interest and many citizens have a desire to be included in the planning and dreaming that set the course for our space endeavors. Many U.S. citizens desire to be kept apprised of the progress and successes of our space program. They want to have a sense of ownership, inclusion, and participation. NASA personnel need to be conscious of this desire felt by many citizens and be eager to accommodate. NASA personnel need to actively combat any “us versus them” interpretation of the relationship between NASA and the general public.

The second message that needs to be communicated effectively to the public is that **our NASA investment is a bargain**. Much of the public is poorly informed of the cost of NASA or the relative size of the NASA budget. Many find it difficult to relate to amounts expressed in millions, billions, or trillions of dollars - they are all just huge numbers. They also have a blurry misinterpretation of the costs of our civilian space program *vis a vis* our military space ventures. The majority of the public lacks a good grasp of the relative portion of the federal budget that is the NASA budget. They deserve to be informed that the 13.8 billion dollar NASA budget is about eight-tenths of one percent of the 1.6 trillion dollar federal budget. Stated another way, each U.S. citizen is investing approximately **fourteen cents per day to operate our civilian space program**, out of the \$16.84 per day for all our government programs. More alarmingly, each U.S. citizen paid out \$3.43 per day in interest payment on the national debt in fiscal year 1995. (or the equivalent of 24 NASA budgets, as some would express it, shoveled down the proverbial rat hole!). The total interest payment was 332 billion dollars (nearly a thousand million dollars per day!). That number must be weighed against the 13.8 billion dollars spent on NASA this year.

The other side of the ledger sheet for consideration of the “cost” of NASA is the dollar value of the “spin-offs” and space technology derivative products and techniques which have brought direct benefit to our national economy and to the health and safety of our population. Examples of space program “spin-offs” will be presented later in this report.

The third message that begs to be related is that the **scientific research and technology** development in which NASA has been engaged and has supported for years **is good for us** and our national economy. **We need more of it, not less!** Independent econometric studies by groups such as the Midwest Research Institute and the Chase Econometric Associates reveal that, over time, **each dollar** invested in scientific research and technology, such as that conducted by NASA, **injects seven dollars** back into the national economy. The federal taxes alone on the seven dollars more than pay back the original dollar invested!

More and more modern economists are tuning in to the realization that the development of new technologies and new ideas spawned by those new technologies sets the pattern for long-range growth in a nation’s economy. For example, Paul Romer, economics professor at Berkeley, Visiting Fellow of the Hoover Institution, and the Royal Bank Fellow of the Canadian Institute for Advanced Research is regarded by many as an economist who is “turning economics upside down” and is on a certain road to a Nobel Prize in economics as a leading spokesman for the “**New Growth Theory**” of economics.

Romer’s New Growth Theory asserts that economic growth depends largely upon technology, in addition to the traditionally accepted components of capital and labor. He regards technology as being endogenous, or an internal part, in an economic system. This contrasts with traditional economists’ views that technology is external, outside of the economic system, something that happens so randomly as to be considered merely serendipitous. Romer asserts in compelling

fashion that long-term economic growth is driven by new ideas. The new ideas derive from investments in scientific research, discovery, and technology. Thus the declaration relating to the science and technology of our space program, we need more of it, not less!

NASA AMBASSADORS

An idea, which is now being referred to as "NASA AMBASSADORS", grew out of a voluntary effort put forth by several persons who participated in the MSFC summer educational programs. NASA Ambassadors will be persons selected from the various summer educational programs who will accept responsibility for making public presentations of pre-packaged talks, fully supported by visual materials, to audiences near their home institutions. The pre-packaged talks have been prepared by the group of volunteers during the summer of 1996. It is planned that more talks will be contributed during successive summers by other volunteers. The talks range in subject matter from general discussions of NASA contributions to society to specific areas of research being conducted in the laboratories at MSFC. A total of eight presentations were developed during the summer of 1996, with the author responsible for two.

In the NASA AMBASSADOR agreement, NASA agrees to provide the presentation package, including both photographic slides and written explanatory material to accompany the slides. NASA undertakes to keep the talks updated and to notify the users of each package when new material to support the presentation is available. NASA also assures that a knowledgeable NASA scientist or engineer can be contacted if the NASA AMBASSADOR has any questions about the material in the packages. NASA will offer some type of appropriate recognition for outstanding performance by NASA AMBASSADORS.

NASA AMBASSADORS agree to give at least two presentations per year of each presentation package received. They also coordinate with the Office of Public Affairs at MSFC to report information regarding presentations, audiences, responses, *etc.*

The presentations developed during the summer of 1996 include the following topics:

1. "**Rocket Ships**" - The history of propulsion and NASA's planned new propulsion systems.
2. "**Spacecraft Charging**" - A discussion of the phenomenon of electrostatic charging of orbiting spacecraft, spurious results caused by the charging, and attempts to solve the problem.
3. "**Mars in Fact and Fiction**" - A treatment of the science fiction and the science related to our neighboring planet.
4. "**NASA - The Place Where Miracles Happen**" - A discussion of the spin-off benefits that have evolved from our space program.
5. "**To Lead, or Not to Lead, That is the Question!**" - A validation of the scientific research and technological development engaged in by NASA and its value to our nation.
6. "**Extending Our Senses Beyond Our Reach**" - A discussion of the great Orbiting Space Observatories, with emphasis on the development and utilization of the Hubble Space Telescope.
7. "**Protein Crystal Growth**" - A talk illustrating the marvelous science that is being done on the near-perfect protein crystals grown in the microgravity environment of the orbiting shuttle and its value to mankind.
8. "**The Blue Planet**" - A talk on NASA's initiative of directing its satellite and communications technology expertise toward the study the resources, environment, and weather patterns of our own planet.

TECHNOLOGY TRANSFER RESEARCH RESULTS

Some of the most interesting time spent during the summer was devoted to verifying or corroborating information about various space program developments and spin-offs which seemed to have varying degrees of documentation supporting them. It was especially gratifying to discover links to products and services that have become integrated into our society's usage to the extent that we often are not even aware of the relationship of its development from space technology. A couple of particularly striking examples will be presented. Another exciting discovery was an example of the present-day development of a valuable technology now in the process of emerging because of a collaboration between a far-sighted MSFC scientist and a private contractor.

A link that was definitely corroborated by this research is the contribution of NASA technology to the compact disk industry. It began when NASA anticipated sending its space probes out into the solar system to photograph and send the photographic images back to earth. A NASA scientist at the Jet Propulsion Laboratory (JPL), G. Solomon, and professor I.S. Reed collaborated to develop a method for digitally encoding the image information for telemetering to earth where it was then decoded to produce the photographs. Their invention came to be known as "Reed-Solomon Coding". The code has the distinction of a clever error-correction capability. In 1982, some twenty-two years after its invention, the Reed-Solomon technique became the industry standard for the encoding of audio information on compact disks, thus launching the ubiquitous compact disk revolution throughout the world which continues today. Thus does a multi-billion dollar industry owe its flourishing existence largely to the contributions made by our space program.

One more example of an exciting development from our space program which represents a major boon to the maintenance of our nation's health is a new, advanced breast biopsy imaging system. It owes its availability to the technology created for one of NASA's more notable "failures". The reference here is to the Hubble Space Telescope (HST), initially greeted with some levels of scorn and derision after its launch, as it was learned that it suffered a little from a "vision" problem - a vision problem which was soon corrected on a subsequent mission. Admittedly, the American public invested quite a large sum of money (more than two billion dollars) into the planning and creation of this truly remarkable instrument. This is proving to be one of the wisest investments ever made into a reputed "failure". Oh, that all our failures could be of this magnitude.

A special device, known as a Charge-Coupled Device, or CCD for short, was designed to capture in a digital manner the images viewed by the HST. This was an especially high resolution imaging system that permitted the HST to send back the examples of breath-taking images of our Universe which we would never have had the opportunity to view otherwise. The CCD imaging system has "spun off" into the development, by the Lorad Corporation, of the Advanced Breast Imaging Biopsy System.

The new system permits the imaging and precise locating of very tiny tumors which can be immediately subjected to a biopsy examination by the insertion of a needle. The new technique, still in its infancy of application, allows the procedure to be conducted in a physician's office with the patient under local anesthesia. It requires little time, causes little scarring, pain, and trauma, and the healing from the biopsy is almost immediate. The procedure costs about \$850. That is to be contrasted with the traditional biopsy procedure which requires days of hospitalization, an invasive surgical removal of the biopsy sample with the concomitant pain, trauma, and healing time requirement, and a typical cost in the \$4000 range.

Different estimates found by this author of the number of breast biopsy procedures conducted in this country range from 500,000 to 800,000 per year, with some ninety percent of them candidates for the new, advanced HST-technology-derived system. A simple mathematical calculation with

the preceding data quickly reveals that the potential **savings** for our nation's **health costs** from the full implementation of this single spin-off is approximately **1.5 billion dollars per year!** That means, therefore, that the entire amount our nation has invested in the Hubble Space Telescope "failure" can be **recouped in less than two years** from this one space program spin-off. It is evidence such the two preceding examples which serve to convince that our space program investment is a wise investment and should be continued, even accelerated.

The example of the emerging technology happening currently is resulting from a "marriage" between the valuable protein crystal research being conducted by Dr. Dan Carter in his MSFC laboratory and a new x-ray focusing device created by a NASA contractor, Dr. Walter Gibson. The new x-ray focusing technology reduces the time required for establishing the molecular structure of important protein crystals, brought back to the laboratory after being grown in a microgravity environment aboard the shuttle, by approximately two orders of magnitude **from a nominal two weeks to a mere two hours!** The immediate and obvious benefit is that it speeds up Dr. Carter's research into determining the causes and possible cures of one of the world's deadliest killer diseases, schistosomiasis. The other huge benefit to society will come because the applications of the x-ray focusing technique will find immediate application in every corner of this nation's medical community where x-ray machines are operated for diagnostic and therapeutic purposes. The author predicts that this technology is destined to provide a major advancement in the usefulness and application of x-rays in the medical arts.

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This has been a truly invigorating, challenging, and inspiring summer of research at the Marshall Space Flight Center. It has been made so by the hospitality and genteel graciousness of many people. I begin by thanking my NASA colleague, Mr. Ed Medal, and Director of the Public Affairs Office, Mr. John Taylor, for the privilege I have enjoyed of working with them and so many other persons in the MSFC Public Affairs Office. They have been the most gracious of hosts and supporters of the work I have attempted. My special thanks go to Ms. Jerry Ann Ise, Ms. Lynne Lowery, and Ms. Judi Hollingsworth for helping me get "set up" at the beginning of the summer and acclimated to working with the many wonderful people I have come to appreciate in the Public Affairs Office. I was given total freedom to roam, to explore, to discuss ideas, and to reap all the benefits of being present at a NASA center with its nearly unlimited possibilities for learning. I owe sincere thanks to Ms. Angela Storey who rescued me on more than one occasion by submitting rush requests on my behalf for photographic services needed to support presentations I was preparing. To Ms. Icle Blankenship, we need to get a patent on your smile and your pleasant and helpful disposition.

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