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A COMPILATION OF TECHNOLOGY SPINOFFS FROM THE U.S. SPACE SHUTTLE PROGRAM

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Introduction

As the successful transfer of NASA-developed technology is a stated mission of NASA, the documentation of such transfer is vital in support of the program. The purpose of this report is to document technology transfer, *i.e.* "spinoffs", from the U.S Space Shuttle Program to the commercial sector. These spinoffs have their origin in the many scientific and engineering fields associated with the shuttle program and, as such, span many diverse commercial applications. These applications include, but are not limited to, consumer products, medicine, industrial productivity, manufacturing technology, public safety, resources management, materials processing, transportation, energy, computer technology, construction, and environmental applications.

To aide to the generation of this technology spinoff list, significant effort was made to establish numerous and complementary sources of information. The primary sources of information used in compiling this list include: the NASA "Spinoff" publication, NASA Tech Briefs, the Marshall Space Flight Center (MSFC) Technology Utilization (TU) Office, the NASA Center for Aerospace Information (CASI), the NASA COSMIC Software Center, and MSFC laboratory and contractor personnel. A complete listing of resources may be found in the bibliography of this report. Additionally, effort was made to insure that the obtained information was placed in electronic database form to insure future access, and subsequent updating, would be feasible with minimal effort.

Technology Transfer Information Resources

As stated, the spinoff compilations were obtained from several sources. A listing of these sources including the number of items from each is given in Table 1.

Information Source	Items
MSFC TU Office	15
NASA "Spinoff"	74
NASA Tech Briefs	235
COSMIC Software Center	146
Laboratory and Contractor Personnel	6

Table 1. Information Sources for Compilation of Technology Spinoffs

Although these resources are broad in their coverage of technology spinoffs, the author believes that this listing represents only a small fragment of the actual successful technology transfers that have taken place throughout the life of the shuttle program. The true number of spinoffs may be impossible to document due to initially insufficient recording during early years of the program and the natural tendency of the technology transfer process to dilute itself.

Each information resource contributes to the overall documentation of the technology transfers, however, the information obtained from the MSFC TU office and the NASA "Spinoff" publication represent those spinoffs which are most likely to enthuse the typical

citizen about the wealth of products and services whose origins lay in the shuttle program. The other information resources represent potential spinoffs, emerging spinoffs, or those spinoffs of a sufficiently technical nature as to indifferentiate the reader as to their origin. Data specific to each information source is described below.

The spinoff items documented from the MSFC TU office are diverse and among the best documented in the form of the office's Technology Transfer Reports and the TU Office Annual Report. However, in the interest of spinoff traceability, several improvements may be made to the form of these reports. Specifically, the inclusion of specific laboratories and contact points within the laboratories and contractor personnel will make accountability and traceability of the technology transfer process more complete. Additionally, contract numbers and periods of performance, where applicable, will insure proper credit is given to original technology developers.

The NASA "Spinoff" publication represents the broadest documentation of technology spinoffs available. However, at this point in the transfer process, many good examples remain undocumented. It is therefore not sufficient to rely only upon the "Spinoff" publication to document technology transfers. Tables 2, 3, and 4 give additional details concerning spinoffs documented.

Focus Areas	Number of Items
Industrial Productivity	23
Public Safety	13
Health & Medicine	6
Computer Technology	2
Energy	4
Transportation	2
Consumer/Home/Recreation	15
Technology Demonstration	1
Manufacturing Technology	13
Environmental	3
Resources Management	2
Construction	1

Table 2. Distribution of Spinoff Areas

Clearly the information contained in Table 3 indicates that additional effort is necessary in documenting the technology transfer process. This documentation is critical to the continued growth and visibility of the technology spinoffs.

Information Source	Number of Items
UNKNOWN	30
Clipping Service	21
NASA Field Center	12
Other	11

Table 3. Sources of Spinoff Information

Transfer Mechanism	Number of Items
NASA Tech Brief	13
NASA Contract	4
Contractor Diversification	18
Personnel Transfer	4
Technology Demonstration	3
COSMIC	4
UNKNOWN	15

Table 4. Technology Transfer Mechanisms

The NASA Tech Briefs publication represents the largest number of potential spinoffs in all the resources documented. More than 200 items published have their origin in or were used and modified in the shuttle program. Additionally, the number of requests for information, in the form of Technical Support Packages (TSPs), is quite large. For those items which have a TSP available through CASI an average of approximately 200 requests per item have been processed. If only a small percentage of these requests have resulted in a successful technology transfer, then a large number of potential "success stories" remain undocumented. Additional research into these requests, through information available from CASI, is necessary to document this hypothesis.

The COSMIC Software Center has documented a large number of programs whose origin are in or related to the shuttle program. Additionally, many requests for this software or documentation have been processed through the COSMIC Center. Approximately 600 requests for shuttle software and 1500 requests for documentation have been processed to date. Additional research into these requests, through information available from COSMIC, is necessary to document properly the potential technology transfers.

Technology transfer information has also been provided through contractor and laboratory personnel at the Marshall Space Flight Center. Although not always mature, these cases represent emerging technologies available for technology transfer. Specific technologies which show promise for successful technology transfer include environmental applications, new materials testing procedures including nondestructive evaluation, new welding processes including weld seam tracking and defect minimization procedures, and others. The research efforts at Productivity Enhancement Complex at the Marshall Space Flight Center are representative of these advancements and should be appropriately noted.

Additional resources for documenting technology transfer, which have not been used but are available, include the NASA patent licensing process, additional electronic databases (NTB Online, Spacelink, etc.), and the Technology 2000 Conference series. Each of these resources hold promise for documenting additional technology transfer.

Conclusions and Recommendations

Although this report is viewed, by the author, as a success in initially documenting examples of technology transfer, a number of improvements may be made to insure

continued growth and successful documentation of the NASA spinoffs. These include: an incorporation, expansion, and updating of existing electronic databases for documenting technology transfer (NASA RECON, CASI databases, NTB Online, COSMIC, Spacelink, etc.) to a single point of documentation; an updating and standardization of the technology transfer reporting process across the NASA field center TU offices (the MSFC TU office could be used effectively as a model for this change); and, a procedure adopted to insure new technology development is properly documented with information necessary to document promote new technology transfers and subsequent database documentation.

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