Segment: Industry, Government and University Partnerships

Commercializing U.S. Technology

by John Preston
Technology Licensing, Massachusetts Institute of Technology

Universities in the U.S. have a significant impact on business through the transfer of technology. This transfer takes various forms, including faculty communications (such as lecturing and publishing of research results), faculty consulting activities, and the direct transfer of technology through the licensing of patents, copyrights and other intellectual property to industry.

Well-trained students and professional staff who leave the university to work in industry probably represent the universities' greatest transfer of technology. These persons stimulate creativity and bring new ideas and perspectives to industry.

Perhaps the most dramatic form of technology transfer from universities is the creation of new businesses. A 1988 study of MIT spinoff companies by the Bank of Boston revealed that its personnel and technology were involved in 636 companies located in Massachusetts. In 1988, these companies employed over 20,000 Massachusetts residents, with annual revenues of $39.7 billion. Had all of these revenues been within Massachusetts, it would have amounted to about one-third of the Commonwealth's economy. A 1989 study by Chase Manhattan Bank identified 225 MIT spin-off companies in Silicon Valley with annual revenues of over $22 billion. A study of Stanford spinoff companies would probably show similarly impressive economic impact.

Regional economies receive a double benefit from these high tech, spinoff companies. Several studies have indicated that for every high technology job created, four or five low tech jobs (retailing, government, hotels, construction . . .) are also created.

Companies founded by MIT people include Digital Equipment, Raytheon, Analog Devices, Lotus Development, Intel, Genentech and several other large businesses. Many MIT spinoff companies achieve tremendous growth rates. Such companies are often characterized by the following: seed financial investment secured from a quality source of capital; talented entrepreneurs with diverse and complementary management backgrounds; and a core technology with broad applicability, numerous products, and considerable growth potential. These companies seem to play an enormous role in stimulating the economy and creating jobs.

International competitive factors are forcing America to wake up to the importance of encouraging technology transfer and the creation of high tech companies. The U.S. spends more on research and development than any other country. In fact, its research expenditures are roughly equal to the combined research of Japan, Germany, the United Kingdom and France. The U.S. Government has recognized the importance of domestically capturing the value added of our research, and numerous laws have been passed that streamline technology transfer. The net effect is that there has been enormous growth in formalized technology transfer from U.S. research institutions to industry in the last five years. Universities and government laboratories have become much more aggressive in finding mechanisms to get their technology commercialized, no longer relying only on publishing research results and transferring trained people.

The passion of various players is the key determinant of success. Worded differently, any new business will encounter hundreds of barriers before it succeeds. People with no passion will use the first barrier as excuse for failure, while people with high passion will do whatever it takes to overcome the barriers.

There are many ways to kill the passion, but greed takes first place. "Greed" in the form of equity distribution is probably the single largest barrier to creating companies. All players in a new company are trying to maximize their ownership. Often investors feel they should own 100 percent of the company. These people push very hard for a high stock price when they raise venture capital. This behavior typically drives them to raise money from secondary sources (relatives, wealthy friends or unsophisticated investors). This lowers the quality of the investor. Second, very stingy incentive stock plans for their employees again attract second-rate players. Worse yet, in addition to getting second-rate employees and investors, the passion of the employees and investors fades rapidly as they come to realize that the probability is small that they will make significant money from the overvalued stock they acquired. This means the employees will be unwilling to work long, hard hours and the investors will not be willing to come forward when (not *if*) the company needs more money.

Greed can take many other forms. Within a large company, equity is not the primary motivator because it is much less likely to make significant gains. However, credit for good performance is a key incentive. Managers who claim all the credit when anything good happens and dodge the blame when problems arise are killing the passion of the employees under them.

Other killers of passion include destructive criticism. Many groups of individuals are dedicated to criticizing plans to prevent mistakes. For example, the Food and Drug Administration is designed more to prevent a drug which does not perform to standards from reaching the general public than to facilitate getting new helpful drugs to market. Within companies, committees and lawyers provide the watchdog function. These people serve an important function much like the brakes on your car, but often can have devastating effects on the early stages of any new business development. The psychology of these individuals is that when their advice is sought over some new business idea they can only take credit for "preventing a negative event" rather than "facilitating a positive." Worded differently, they cannot take credit for the original idea, only finding its problems. A large dose of criticism kills passion.

Start-up companies and technology transfer to existing companies will continue to play a major role in economic development. The positive impact from new business creation can be increased by targeting appropriate technologies; finding strong managers and quality investors or sponsors; enhancing the image or credibility of the business; and finally encouraging passionate behavior by the key players toward the success of the new business. These qualities, coupled with a well written, balanced agreement and good will on the part of both the licensee and licensor, will greatly enhance the likelihood for success of the venture and rewards to the licensor.

John T. Preston is the Director of Technology Development at the Massachusetts Institute of Technology (MIT). As Director, he manages the Technology Licensing Office, which is responsible for patenting licensing of MIT Lincoln Laboratory and Whitehead Institute inventions and software.

Technology Transfer: A NASA Model

Kevin Barquinero, Director of the Space Commerce Opportunities Office, was joined by Carol A. Ginty of Lewis Research Center, who recently served on the Agency Special Initiative Team on Technology Transfer; Judith Watson, a research engineer in the Spacecraft Structures Branch at Langley Research Center; and Jonathan Root from the Office of Advanced Concepts and Technology at Headquarters.

A Panel Discussion

Commercializing NASA Technology

by Kevin Barquinero
Space Commerce Opportunities Office

Value-added facilitators for targeted technology transfer is an experiment at NASA to accelerate commercialization of NASA-developed technology. The hypothesis is that by bringing commercialization expertise directly to NASA technologists, the probability of successful technology transfer will be increased. Two new NASA activities–the Joint Space Center and Ames Research Center–taken together, test the value-added facilitator hypothesis.

The phrase "targeted technology transfer" was coined by Dr. Jerry Creedon of Langley Research Center and his Special Initiatives Team on Technology Transfer, chartered by NASA Administrator Daniel Goldin in May 1992. The team was tasked to review and make recommendations for improving NASA's process to transfer and commercialize its aeronautics and space technology. Their report to the Administrator in December 1992 identified *non-targeted* and *targeted* technology transfer activities.

Targeted technology transfer involves NASA's conscious involvement to collaborate with industry to commercialize its technology. The team broke down this category into two subcategories: primary and secondary targeted technology transfer. Primary targeted technology transfer occurs when "the technology is part of NASA's primary mission and is developed from the outset with the purpose in mind of transferring it to an identified aerospace user." NASA's entire aeronautics program represents this category. Newer programs, like the Centers for the Commercial Development of Space, are examples from the Agency's space program.

Secondary targeted technology transfer refers to "technology originally developed for a NASA mission extended by NASA to meet the identified needs of a specific user for a non-aerospace application." The committee noted that NASA dedicates very little effort or resources to this category, although it is this area, the broader U.S. economy, that offers greater opportunity for transfer of NASA technology. This is the only area where the Creedon Committee recommended that NASA increase its budget.

The Creedon Committee report is important because it affirms the need for NASA to be more active in its efforts to transfer its technology. The challenge facing NASA is how to accomplish this mission when its vast technical talents lie in developing technology for its aeronautics and space missions–not in collaborating with industry to commercialize this technology. This is a knowledge gap that thwarts the Agency's best intentions to transfer technology. The premise behind using facilitators is that they fill the knowledge gap between NASA's technology and the know-how needed to target the technology's transfer to industry.

It is possible to compress the time for technology commercialization from a NASA Field Center through employment of value-added facilitators. The facilitator's unique expertise should accelerate the process of technology transfer and commercialization, promote dual-use technology development, and contribute to national and regional economic competitiveness. The metrics for success are: leveraged economic development, technology transfer to existing companies, technology transfer to new firms, and knowledge transfer. If pilot programs are successful, NASA will transform itself from its past role as a civilian fixture of the Cold War to a national technological engine for economic growth through the accomplishments of its aeronautics and space missions.

Creedon Commission Recommendations

by Carol Ginty
Special Initiative Team on Technology Transfer

One member of the Creedon Commission, Carol Ginty, elaborated on the findings that current and existing "technology transfer processes are non-integrated, undocumented, and too slow." She presented ten recommendations designed to improve NASA's technology transfer performance:

All NASA elements must implement and be evaluated on their technology transfer program.

1. Each Center must manage to the recommended metrics or define and manage to a more effective set.

2. Headquarters must implement a unified plan to support technology transfer, e.g., provide infrastructure activites supporting all Centers, and institute a proactive effort to change the agency's technology transfer culture and ensure broader participation by all employees.

3. NASA should specifically mention technology transfer in Vision-Mission-Values statements.

4. The Administrator should send a directive to Associate Administrators and Center Directors stating that technology transfer is a mission of NASA and specifically, that secondary targeted and non-targeted transfers are fully valued, important NASA missions which should be managed accordingly.

5. The Administrator should continue strong technology transfer support and measure overall agency performance.

6. Each Center should include technology transfer in its mission statement.

7. Each Center should provide technology transfer training for its employees.

8. Assess, promote and reward employees according to metrics/contributions.

9. Form and empower at least the following process action and process development teams

   - Tech Briefs–information acquisition to publication
   - Patent applications and licensing
   - Software distribution and transfer
   - Conversion of non-targeted to secondary targeted
   - Conversion/integration of primary targeted to secondary targeted
   - Execution of secondary targeted programs
   - Use of jointly sponsored research activities
   - Define relationship of Centers to CCDS
   - Employee motivation and incentive for technology transfer activities.

10. Secondary technology transfer activities should be proactively sought. The budget allocated to each Center for its use in secondary targeted transfer programs should grow and be taken "off the top" as is SBIR.

Continuing improvements must be made in NASA's technology transfer performance for NASA to best serve the country. NASA's culture must change to achieve continuous improvement in technology transfer. Implementing the ten recommendations constitutes an important first step in improving NASA's technology transfer performance.

NASA's Development of the National Technology Transfer Network

Presented by Jonathan Root
Office of Aeronautices and Space Technology

Jonathan Root outlined selected elements of the Clinton Administration's technology policy, described as a flexible, market-oriented means of advancing U.S. economic growth and industrial competitiveness.

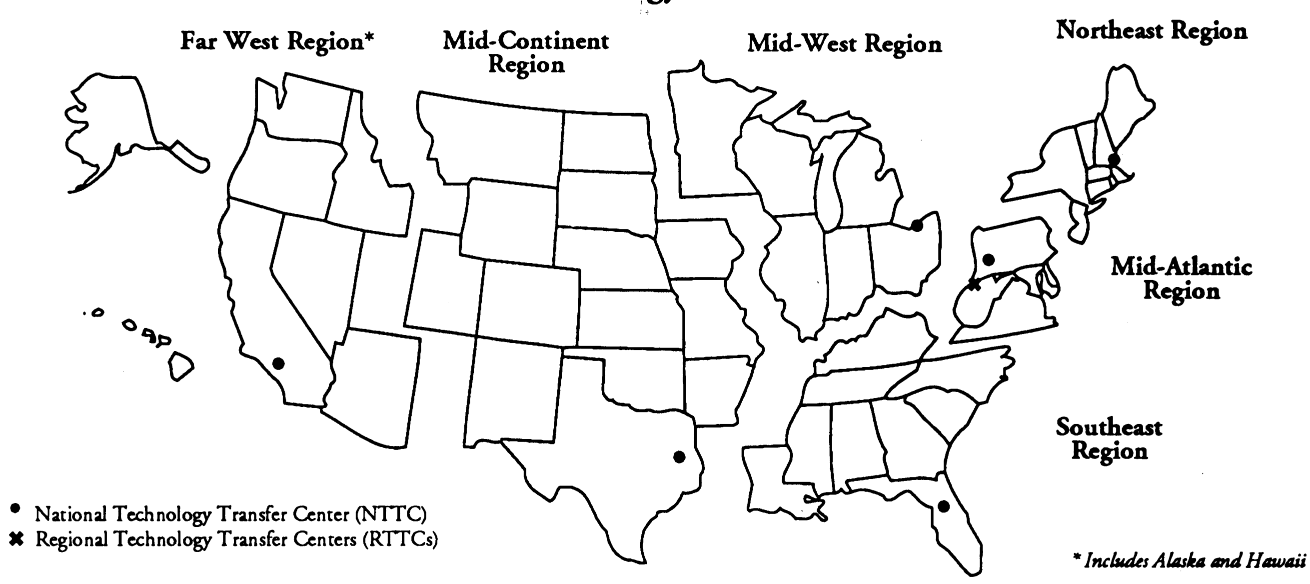
Abroad, consensus among government and industry leaders has developed over the last decade on the importance of applying U.S. leadership in research and development to enhance and promote U.S. economic growth and industrial competitiveness in the global marketplace. This commitment is further strengthened by the President's Technology Policy, which calls for improved strategies for leveraging the federal research and development investment, involving over 700 laboratories, through government/industry cooperation in support of industrial technology.

In recognition of this challenge, the NASA Technology Transfer Program initiated in 1991 the development of the National Technology Transfer Network (NTTN), in cooperation with other Federal agencies. Under NASA's leadership, six Regional Technology Transfer Centers (RTTCs) and the National Technology Transfer Center (NTTC) currently operate as the core elements of this innovative national network. The NTTN serves as a market-driven means of facilitating government/industry technology partnerships and the transfer of Federally funded technology to the marketplace.

Driven by the pressures of economic competition, and, more recently, by the defense downsizing, NASA management recognized that the new environment offered unprecedented opportunities for collaboration between industry, state programs, and Federal research and development agencies and their technology transfer programs and labs. Accordingly, the RTTCs and the NTTC were concurrently designed and developed to form the core structure of a national network, linking together federal and state programs and resources to address the technology and related needs of industry.

The implementation of the national network began in January 1992 with the start-up of RTTC operations in six regions spanning the U.S. The regional deployment has allowed the RTTCs to establish innovative linkages and partnerships with a wide range of Federal labs and state-level programs, along with the regional organizations of the Federal Laboratory Consortium for Technology Transfer. The RTTCs draw upon their regional networks and other elements of the national network to serve the technology and related business needs of U.S. firms and industry groups. The RTTCs assist industry clients to access and commercialize technologies developed by NASA and other agencies, and to form technology partnerships with NASA Centers and other Federal labs. The RTTCs' market orientation and knowledge of industry needs also

National Technology Transfer Network



"Techology . . . from the lab to the marketplace"

enables them to assist Federal labs to locate industry partners and market their technologies for commercial use. In their first year of operation, the RTTCs provided services to over 2,500 industry clients. Call 1-800-472-6785 to contact the RTTC in your region.

At the direction of Congress, NASA initiated in 1991 the development of the NTTC to assist and enhance the technology transfer efforts of all Federal agencies. Thus, NASA was uniquely positioned to integrate the NTTC with the RTTCs to form the basis for the national network. Planning for the center resulted in the NTTC serving as the national "hub" for the network, providing core capabilities and services in several key areas. For example, the NTTC operates a national gateway service that assists U.S. firms to rapidly locate federal laboratory technology and associated technology transfer assistance. The NTTC gateway service, which began in October 1992, currently handles between 200 to 300 technical inquiries from industry per month. Other key NTTC activities include technology transfer training and education services; outreach to industry to promote federal technology transfer; and other initiatives to stimulate private/public technology partnerships with Federal labs and further develop the national network. Call 1-800-678-NTTC to contact the national center.

Overall, the NTTC, the RTTCs and their affiliated Federal and state programs provide a national framework for the public and private sectors to work together to leverage the federal Research and Development budget for commercial purposes and advance U.S. economic growth.

Findings of the NASA Technology Integration Review Team

by Judith Watson
Spacecraft Structures Branch, Langley Research Center

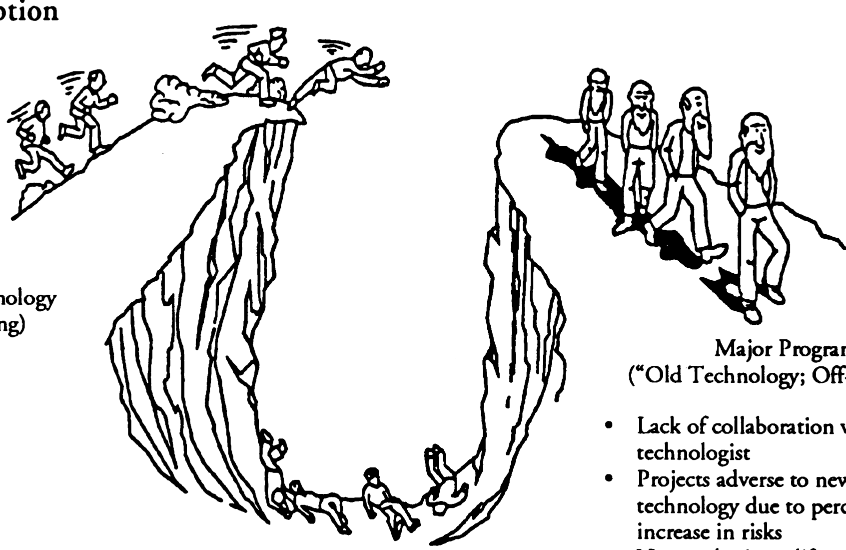
The Technology Integration Team was established in May 1992 as a NASA institutional team commissioned to assess present requirements and approaches for achieving the integration of state-of-the-art technology into NASA programs, and to develop recommendations to improve current practices and processes for identifying, developing, and integrating technology into NASA programs. This inter-Center team is chaired by Dr. J. Wayne Littles, Deputy Director of the Marshall Space Flight Center.

The team gathered data from a wide spectrum on pertinent sources including NASA Headquarters program offices, technologists from three NASA Centers, NASA project managers, industry, OAST space technology red and blue teams, the OAST Technology Integration Study, and the Technology Transfer Institutional Team. The Technology Integration Team found that the agency lacks a consistent vision to which technology research and development can be directed for successful integration into NASA programs. Consequently, the Team offered the following recommendations.

NASA:

- Should develop a nationally accepted vision and strategy in sufficient depth to provide guidance for identification and development of required technologies. The development, use and transfer of technology should be a mission of the Agency.
- Investment in technology (approximately 30 percent) should be doubled during the next three years, with two-thirds of the increase devoted to Advanced Technology Development and one-third to Research and Technology.
- Should shift its emphasis from controlling initial development costs to maximizing cost effectiveness over the life of its programs. Life cycle cost

Technology Perception

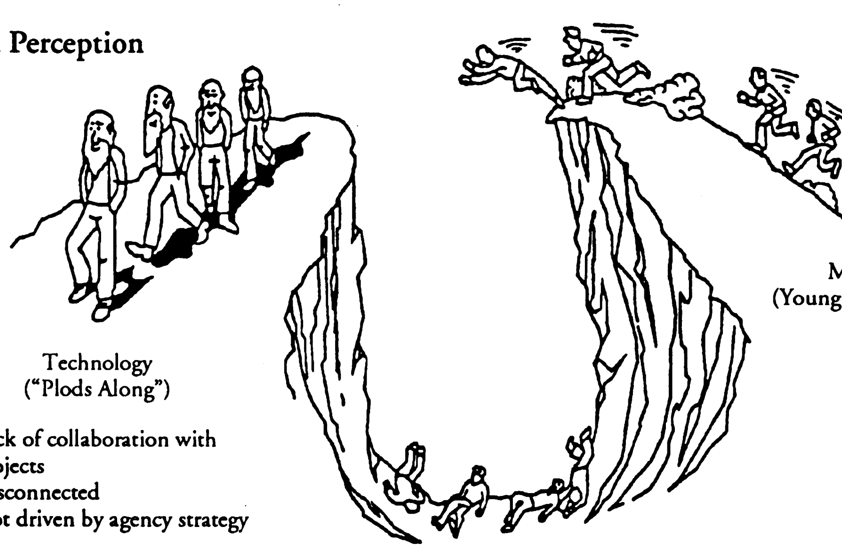


should be an integral part of the phased development process. In addition, the Agency's technology development programs should address life cycle cost as well as performance factors.

- Should implement a phased development process which includes the early identification of requirements, early identification of technology options in collaboration with technologists, and the maturation and selection of technologies prior to phase C/D.
- The Agency should establish a process to enable its many organizations to work as a system in identifying, developing, and integrating technology into its programs. Agency investments in base research and focused technology programs and in advanced technology development must be based on Agency prioritized needs and potential benefits.

These findings and recommendations are available in more detail in the team's final report, ***Assessment of Current Processes for Integration of Technology into NASA's Space Programs.*** Also, as part of the team's recommendations, an NMI is has been developed and is currently under review, which should improve NASA technology development planning.

Program/Project Perception



Commercialization and Dual Use Technologies

The other concurrent Industry, Government and University Partnership panel was devoted to "Commercialization and Dual Use Technologies," led by William J. Huffstettler, Manager, New Initiatives Office at Johnson Space Center. He was joined by Dr. Syed Shariq, Assistant to the Deputy Director, Science and Technology at Ames Research Center; and Dr. Molly K. Macauley, a Fellow at Resources for the Future.

Dr. Shariq was also a member of the Creedon Commission and he presented an overview of their findings on technology transfer, especially the finding that there is "no clear NASA policy for technology transfer." As a result of legislation passed in the 1980s, NASA is being held accountable for its performance under the standards set in recent and emerging technology transfer statutes.

A Panel Discussion

NASA's EOCAP Program

by Dr. Molly K. Macauley
Senior Fellow, Resources for the Future

NASA's Earth Observations Commercialization Applications Program (EOCAP) was established upon recommendation from a 1986 report by NASA's Space Application Advisory Committee, *Linking Remote-Sensing Technology and Global Needs: A Strategic Vision.* The program is intended to encourage U.S. industry jointly to find NASA remote sensing research that had commercial potential. A key assumption is that NASA technology beyond the "proof-of-concept" stage can readily become commercially profitable.

The first phase of EOCAP, EOCAP I, involved nine commercial projects each competitively awarded between $100,000 to $500,000 annually for up to the three-year duration of the program (1988-1990). Awards for EOCAP II, involving 11 projects and federal funds totaling about $6 million, were made in 1991. In both EOCAP I and II, co-funding by industry partners has roughly matched the level of Federal funding.

EOCAP has been carefully designed to limit government's role in a commercial activity to those aspects of the activity where the private market, operating on its own, might fail. Specifically, EOCAP serves to provide financial and technical support for a limited time and in areas where markets might fail because of gaps between science or technology and commercial markets. Extensive oversight of the program included periodic reviews using several criteria to measure success. These criteria include:

- Net commercial profitability and/or net public benefit;
- Development of new product lines with verifiable customer willingness to pay;
- Reportable innovations that improve the efficiency of relevant markets (for example, standards for data format, developments in iconography); and
- Lessons for public policy (when the lessons are seen as uniquely provided by the EOCAP experience).

These criteria implicitly admit that even "money losers" can be successful in some dimensions–profitability may come later, beyond EOCAP, in the case of the first item above, or some contribution can be made in terms of innovations that improve the functioning of remote sensing markets. And, of course, lessons can be learned in ascertaining why projects failed to be successful in any of these dimensions, contributing to measurable improvements in future EOCAP activities.

EOCAP's performance for it first two years included $5.3 million in gross revenue and $700,000 in net revenue, for about an 8 percent return on NASA plus industry investment, a return consistent with commercial market rates of interest during this period.