

FACTORS INFLUENCING THE EFFECTIVENESS OF TECHNOLOGY TRANSFER

Barriers to technology transfer

There are a number of barriers which must be overcome in successfully transferring technology from the Federal Government to the private sector. These barriers can best be seen from the perspective of the two groups. It is acknowledged that most of these issues are perceptions, but when it comes to technology transfer, perception on the part of the private sector is the major challenge.

Private Sector Issues

- **Awareness**

From the perspective of the private sector, there is little awareness of the technology available from the Federal government and a poor perception of how it could apply to the needs of most businesses and industry. To address the awareness issue, it is paramount that technology transfer programs pursue a proactive outreach program, using all means available to reach potential users of advanced technology.

- **Poor Perception of Commercial Applications**

Both the general public and business have a poor perception of the value and application of Federal technology, especially that which comes from Defense and Aerospace-related R&D. The technologies are deemed as too sophisticated and expensive to have basic applications, even though programs as the Strategic Defense Initiative have spun off such practical applications as air bag switches, brighter brake lights, and higher efficiency spark plugs for automobiles to better medical imaging diagnostics,

- **Access**

Up until recently, access to new technology information was hampered by the diversity and dispersion of information throughout the Federal government. Industry could obtain technical reports from NTIS, but for the most part, the leading edge technology developed by the DOD, DOE and NASA was not available to those who did not have an existing contract with these agencies. The FLC attempted, through its Administrator function, to make referrals to the appropriate federal laboratories which had expertise in a given area. The ORTA staff at these

laboratories relied on their phone directories and personal knowledge of what research was being done in the lab , but there was no consolidated information system that contained a full range of R&D and technology from the Federal laboratories. For the most part, industry - especially that which was not defense-related - was left out in the cold in terms of accessing most of the advanced technology so important to its advancement.

In the latter part of the 1980's, with the advent of the FTTA and advancements in computer capabilities, various organizations began to develop information systems internally which cataloged various R&D efforts and technology. With these developments, many of the agencies relied then, and even today on paper publications to disseminate information on R&D and technology. The capability of business and industry to quickly find technology and expertise, whether assisted or through computer access, is only a very recent phenomena.

- Size, Diversity, and Dispersion of Federal Agencies and Laboratories

Another barrier to technology transfer from the perspective of industry is the vast diversity and geographic dispersion of Federal resources. Companies (particularly small businesses) are more prone to work with an laboratory which is in their neighborhood than one on the other coast, If the laboratory in the neighborhood happens to deal in technology that is applicable to the business, there is a chance for collaboration, If not, the virtual size and dispersion of the Federal laboratory system is a major deterrent,

- Not Invented Here (NIH)

Pride of ownership, while it may not be practical, plays a major role in deterring the adoption of new technology. Especially in large corporations, the perspective is that internally-generated inventions and technology are far superior to whatever could be created in some government laboratory.

- Intellectual Property Concerns

Rights to inventions and technology are a principal factor in deterring technology transfer, The process starts when companies, under federal contracts, create a new technology and do not disclose it so that it can be retained for internal use. Government enforcement of disclosures under Federal contract provisions is poor, thus much new technology is retained and not disclosed by corporations unless there is a proactive attempt on the part of the government sponsor to help in the spin-off and application of the technology to other markets.

Government claims to royalty-free use of technology developed in cooperative efforts is also a deterrent to many companies and investors who perceive that their investment in a cooperative venture may not have enough pay-off if it must be shared with the Government.

- **Reluctance to Deal with Federal Government**

Willingness to deal with the Federal bureaucracy, in the face of mountains of paperwork, legal clauses, lengthy processing times, and bureaucratic attitudes are a major deterrent to small and medium size businesses. For this reason, extension activities, professional and trade associations, and small business centers are the most effective ways to reach the “grass root” companies of America.

- * **Financing**

By far, the most significant issue in any commercialization effort is financing. The availability of investment capital is the primary determinant in any commercialization effort. Perspectives of large corporations are based on short-term return on investment, thus they are loathe to invest in potentially risky, long-term technology adaptations based on a technology not created within the corporation. Small businesses simply may not have the capital resources to invest in new technology commercialization. For these reasons, any attempt at technology transfer must be based on a sound business plan which includes a market assessment, intellectual property protection, and a commercialization plan which addresses every phase of the commercialization process.

- **Understanding the Innovation Process**

Another significant barrier to successful technology transfer and commercialization is a lack of understanding of the complexity of the innovation process, especially by small businesses. Most technology available for transfer from the Federal government is in the pre-product stage and requires a considerable amount of technical expertise, investment, marketing, and sound business management to bring it to the marketplace^s (see Appendix C). Most technology transfer facilitators (staff of SBDCs, MTCs, etc.) do not have a sufficient understanding of the process to permit them to give adequate assistance to small business entrepreneurs who may wish to develop a new technology into a product.

Federal Agency/Laboratory Issues

- **Mission Priority**

Much of the time, the ability of a Federal Agency or Laboratory is hampered by the basic fact that the primary mission precludes the investment of time or resources to adequately respond to the demands for technology transfer activities. This institutional barrier of primary mission conflict is especially apparent in DOD and some DOE laboratories. Based on the recent internal study, even many NASA activities do not perceive that technology transfer is a primary responsibility. Some of the larger laboratories and centers have recognized the importance of technology transfer to their own survival in the new economic environment and more are beginning to see the relevance and importance of this activity to the economic survival of the Nation.

- **Funding**

Funding of activities is, of course, the major factor in allocation of resources to technology transfer activities. Laboratory ORTAs have been traditionally under-funded and understaffed to provide adequate support for technology transfer activities. In many cases, the single individual assigned to perform ORTA functions has other responsibilities as well, including management of SBIR activities, public affairs, and/or information security functions. Often these jobs create a conflict of interest between disseminating information to the public while being responsible for protecting it. Even at the top levels of management in technology transfer, the individuals responsible for policy and implementation of programs at the Secretariat level in several branches of the military are not provided with adequate staff, support or travel funds.

Funding of CRADA expenses within the laboratories is not consistent across agencies, DOE, for instance, designates laboratory funding to support CRADA efforts that covers salaries, use of facilities, etc.; some DOD activities do not. This disparity causes an imbalance in the effectiveness of technology transfer efforts among agencies and is a deterrent to technology transfer in agencies where the private sector CRADA partner must pay for dedicated government personnel and other expenses.

- **Security Issues**

Security concerns form a major barrier to technology transfer from the DOD and parts of the DOE and NASA. To most agencies and offices in the Pentagon,

“Technology Transfer” literally means the leakage of vital military technology to potential adversaries and thus, most offices with “technology transfer” in their mission are there to prevent it from happening. Almost every report and publications from the DoD dealing with technology transfer up until very recently has focused on stories of espionage and the constant threat to our security by overt and covert actions of our potential adversaries.

Classified programs in DoD and DOE automatically create a mind set that all elements and technical developments within a classified program are also unequivocally classified. While the many components and subsystems of a military or nuclear system contribute to the overall system, many in and of themselves are not and should not be classified when broken out from the system. More appropriately, the subsystem and components - or perhaps the processes used to create them - should be properly protected, but not necessarily by classification. Designation as a military or space critical technology to prevent export is much more appropriate and also facilitates transfer of the technology to other unclassified applications in Federal programs and the private sector while still protecting the technology from leaking off shore. This can easily be accomplished under legislation and policy established for the export control of militarily critical technology established by Congress in 1983⁶.

- Institutional Barriers and Culture

~~A final consideration regarding the effectiveness of technology transfer in any federal agency is the culture of the agency itself. While the defense agencies are couched in a culture of secrecy with regard to technology sharing, other agencies have different perspectives,~~

While success of technology transfer in the DoD is limited by the institutional mindset and culture, this is not a unique situation to the DoD. Cultural perspectives on technology transfer vary among federal agencies. To illustrate, it is interesting to look at the perspective of the medical research community associated with NIH. Before the FTTA of 1986, academically-oriented NIH scientists shared the fruits of their research freely with non-profit organizations, universities, and industry without regard to the legalities of patents and license agreements. With the advent of the FTTA, scientists and researchers were burdened with a bureaucratic process that they found to be complicated, poorly understood, and too legalistic. Most of the scientific community reacted with a “too hard to work” attitude toward the FTTA requirements and continue to believe that this new legislated bureaucracy hinders technology transfer, scientific research, and the free exchange of ideas in an academic environment.

University technology transfer programs face other cultural issues and institutional barriers. The primary perspective of university faculty is to research, not develop products. The focus is to fund long term research programs that support graduate students and faculty members over several years. This mindset directly conflicts with the objectives of some state economic development organizations who attempt to fund cooperative R&D programs through universities. Businesses want fast results - Academia wants to study the problem. Academia needs to "publish or perish" - Industry wants to have intellectual property rights before it makes large investments in commercialization activities. Also, it must be recognized that university technology is very embryonic. Industry looks for ready-to-market technology only to be disappointed that considerable development and investment is needed to take the technology through the prototype to the market. For this reason, the effectiveness of technology transfer programs from universities are somewhat hampered, yet many do succeed in spite of the odds.

- Bureaucratic Barriers

In addition to institutional and cultural barriers, the basic bureaucratic processes related to technology transfer are formidable. Concerns about conflict of interest, micromanagement of laboratory activities, legal concerns, negotiations over potential value, exclusive rights, and other factors cause significant delays and considerable legal expense to the transferee in the processing of CRADAs and license agreements. Often the time required to process is sufficient to miss a major market penetration opportunity. Most prominent in the bureaucratic process is DOE, whose centralized CRADA administration activities have drawn criticism and led the GAO to conclude that "Despite the strong motivation by DOE's headquarters to control the CRADA implementation process and to ensure the laboratories' survival, the centralized process of implementing a CRADA appears to have left the considerable technology transfer potential of the technical resources at DOE's laboratories unrealized".'

- Technical Barriers

Technical barriers to information dissemination with regard to technology transfer have all but disappeared in the last decade due to the advancement of computer-based information technology. Today, data bases of information are maintained in electronic format by virtually every agency, even if the data is in the form of publications. Even the existence of two industry standards (DOS vs Apple) no longer causes a problem in integrating data. Powerful search software has been developed and is in use to rapidly scan millions of documents for keywords, phrases, and combinations of information. Access to these systems is easily obtained via computer modems which have become an embedded component of