

- The movement of technology developed by one Federal agency to use in another (Technology Transfusion), or
- The movement of technology from the Federal government to the private sector (Technology Diffusion). When applied to American business and industry only, this is most commonly known as Domestic Technology Transfer.

This report focuses on the process of Federal Domestic Technology Transfer and the organizations and mechanisms that foster this process. It discusses the barriers in detail, and discusses options for improving the process including the case for a centralized, user friendly, information system.

UNDERSTANDING THE TECHNOLOGY TRANSFER PROCESS

It is not easy to transfer Federally-sponsored technology from the laboratory and innovator's workbench to the marketplace or public sector programs.

The Philosophical Gap Between Government and Industry

One of the most fundamental barriers is the philosophical gap between the missions of the federal scientific and technical community which does R&D and the motivations of the private sector companies and entrepreneurs who would invest in the commercialization of products and processes which could result from that R&D.

Being more technologically-driven organizations, the federal laboratories and scientific and technical centers make large investments in research and development facilities and have a primary interest in achieving and maintaining a technological superiority. With these goals in mind, they develop technology as the main source of their activities and establish a technology base long before they have a product application.

Being more market-driven, by contrast, private sector companies and entrepreneurs tend more to analyze current and secondary markets in order to predict what types of products will yield a high profit. Based on these analyses, they then develop focused product concepts and make the required investments to produce them.

Because they operate based on different drivers, federal research and development centers and private sector companies frequently talk at each other rather than to each other. The federal research and development centers, being more technologically driven, need not have commercial product divisions, nor are they

required to understand the makeup of private sector markets. However, if they want to make the technology transfer process work, they must actively solicit the interest of private sector firms that not only have commercial product divisions but also desire to make products that will be profitable. Because of this difference in orientation, it is frequently difficult to establish the lines of public-to-private sector communication needed to transfer technology.

Complicating this communication problem are barriers inherent in the transfer of federally-funded technologies to other public sector **programs**. **These** include bureaucratic inertia, a lack of up-to-date information about research activities funded through that federal agency's programs, and intellectual property issues associated with the release of proprietary information about products and processes developed by contractors for that agency.

These barriers--the different drivers motivating public and private sector research and development organizations and the problems associated with public-to-public sector technology transfer efforts--strike at the heart of the challenge Federal agencies face in working to transfer sponsored technologies to the private sector and end-use conservation programs. To bridge these gaps requires a people-to-people technology transfer approach which gets the potential consumer, those groups or individuals with a requirement that can be filled with a Federally-funded technology, to speak with the supplier of that technology, the laboratory or innovator who received Federal funds to do the research and development work required to create the technology.

National Concern and Initiatives

Traditionally, technology transfer from the Federal Government to industry and especially small business has been a challenge due to many factors. There is a general lack of awareness among many small and medium sized companies of the benefits that new technology could bring to the productivity of the company or in creating new product lines. Even with a general awareness that Federal laboratories and other agencies spend billions of dollars annually in research and development, the perception persists that the resulting technology base is of little use to the private sector. Compounding these barriers is a general problem with accessing technology due to the size and dispersion of federal agencies, laboratories, and resources; security and intellectual property issues; and the accompanying reluctance of business to deal with the bureaucratic elements of government.

- Congressional Initiatives

The Congress, keenly aware of these issues, has recently enacted a number of legislative initiatives to foster the transfer of technology from the Federal government to the private sector. Most of this legislation has focused on measurable means of technology transfer such as the number of patents issued, license agreements signed, or Cooperative Research and Development Agreements (CRADAs) established. While these mechanisms of technology transfer are primary tools, there is a great amount of evidence to support the fact that American business and industry also need access to the expertise in government to help them answer technical questions that do not require the cumbersome process associated with intellectual property protection and cooperative agreements.

In an attempt to help technology transfer efforts, the Congress and the Executive Branch have taken a number of steps to create law and policy to break down the barriers. These include!

- The Stevenson-Wydler Technology Innovation Act of 1980
- Patent and Trademark Amendment Act of 1982 (Bayh-Dole Act)
- The Small Business Development Act of 1982.
- The Federal Technology Transfer Act of 1986 (FTTA).
- Presidential Executive Order 12591, of April 10, 1987. "Facilitating Access to Science and Technology"
- The Omnibus Trade and Competitiveness Act of 1988
- The National Competitiveness Technology Transfer Act of 1989
- Provisions of the Defense Authorization Act for FY 1991
- The Small Business Technology Transfer Act of 1992
- Provisions of the Defense Authorization Act for FY 1993

- Administration initiatives

The last administration promoted the use of Federal technology for commercial applications through the National Technology Initiative (NTI). This effort involved cabinet-level briefings and conferences throughout the country to encourage the interaction of business and industry with the federal agencies and laboratories. The conferences indicated a high level of interest on the part of industry to cooperate with Federal agencies in R&D, but also indicated that for success, the research needed to be complimented with manufacturing excellence, the availability of investment capital, and aggressive marketing on the part of government agencies. The NTI report indicated a need to improve access to technology, to overcome the bureaucratic and institutional barriers, to improve the availability of long-term patient capital, and support programs that foster

manufacturing excellence². The NTI reportedly forged a stronger public/private partnership for technological competitiveness and formed the basis for subsequent action on a range of issues important to the innovation process. It created a wider awareness of the existence of technology available for commercialization from the Federal government and laid groundwork for future efforts of the next administration.

One of the current administration's first policy declarations was "Technology for America's Economic Growth, A New Direction to Build Economic Strength"³. This policy signaled a major change in the support of the government for activities such as technology transfer as a key element in America's economic future. The current Technology Reinvestment Project', based on provisions of the FY 93 Defense Authorization Act, focuses directly on this issue with the involvement of the five primary Federal R&D Agencies.

Thus, the interest in technology transfer and commercialization has blossomed from a little known entity to a major visible element of National Economic Policy. Given the existence of the technology and the legislation to promote its use, it would be useful to next examine the processes for technology transfer.

TECHNOLOGY TRANSFER PROCESSES

Technology Transfer activities are generally categorized as either Technology Push or Market Pull. Technology Push is the solution in search of a problem, while Market or Requirements Pull addresses a problem in need of a solution. The latter is generally a much more successful approach to initiating technology transfer activities.

Technology-Push Processes

Technology-push methods are used to facilitate the people-to-people aspect of the technology transfer process. This is done by identifying technologies already developed for Federal Agencies and providing the interested party with information about these technologies. This information is supplied to initiate a process whereby that party can contact the developers of the technologies to find out if the emerging Federal technology of interest can be used in the research, development, or commercialization of other new products or processes.

Technology-push mechanisms used in this process may include the development of database referral services which provide information about current federally-funded efforts and their applications for other private and public sector purposes. Outreach programs can also be established which publish newsletters, brochures,

and reports that publicize Federal technology transfer services or describe new Federally-developed technologies and their applications for other research, development, and commercialization efforts.

Market-Pull Technology Transfer

Market or Requirements-pull methods of technology transfer involves the analysis and assessment of uses and markets for Federally-funded technology. Using these methods, Federal Agencies can evaluate and determine what will make their sponsored technology more attractive to the individual or organization using it for other private or public sector requirements. This can be done by matching existing technology requirements that potential consumers might have with a set of Federally-developed technologies that can be integrated or customized to meet those requirements.

Market-pull methods used in this process can include the organization of conferences and advisory panels that meet to review technology efforts coming from Federally-funded projects; identify potential applications for these technologies to the private sector and federal, state, and local government agencies; and provide guidance on the means by which this transfer takes place. These advisory panels may include panelists representing such diverse communities as academia, industry, professional associations, research institutes, and the federal R&D establishment.

State and Regional Facilitator Programs

The interface between technology transfer programs and State, local, and regional economic development programs is an essential part of technology transfer. Interaction and leverage with organizations such as Small Business Administration-supported Small Business Development Centers (SBDCs), State extension programs, university entrepreneurship centers and incubators, technology councils, and state economic development organizations provides a superior infrastructure for Federal technology to reach small and medium sized businesses throughout the nation. These organizations have the highest potential to be facilitators in technology transfer, yet many of them are not knowledgeable in the essential elements of technology development and commercialization. Many also lack staff trained to understand client's technical needs or to search out potential sources of assistance in the Federal government.

Mechanisms

There are numerous mechanisms for technology transfer employed by the Federal Agencies, Laboratories, and Centers. Not all organizations employ or exploit every mechanism. The most well known mechanisms include:

- Cooperative Agreements - instruments entered into by the government with industry, universities, and others to support or stimulate research; agreements are cost-shared with the non-federal participant.
- Cooperative Research and Development Agreements (CRADAs or CRDAs) - agreements formed under the provisions of the FTTA between government and non-federal parties in which both participants provide personnel, services, facilities, or equipment for the conduct of specified R&D, The non-federal parties may also provide funds (no direct funding is provided by the laboratory or center). Rights to inventions and other intellectual property are negotiated between laboratory and participant, and certain data may be protected from disclosure for up to five years.
- R&D Consortia - multiple federal and non-federal parties working together for a common R&D objective, Funding for R&D consortia may be shared, but usually no funds are exchanged between participants.
- Exchange Programs - arrangements allowing government or laboratory staff to work in industry facilities and industry personnel to work in government laboratories to exchange technical capabilities and support research in specific areas. Costs are borne by the organization sending the personnel. Intellectual property arrangements can be addressed in exchange agreements.
- Patent Licensing Agreements - the transfer of less than ownership rights in intellectual property, such as a patent or a software copyright, to permit its use by the licensee. Licenses can be exclusive or non-exclusive, for a specific field of use or for a specific geographical area. The potential licensee usually must present plans for commercialization. In many cases, such action can result in the creation of a new "spinoff company" which is based solely on the licensed technology. Examples of this rapid commercialization can be found in the 22 new companies spawned over the past six years through licensing of technology produced by the Strategic Defense Initiative.

- **User Facility** Agreements - arrangements permitting private parties to conduct R&D in a laboratory. For proprietary R&D, the laboratory is paid for the full cost of the activity. If the work will be published, cost can be adjusted. Intellectual property rights generally belong to the user.
- Work-for-Others - agreements whereby proprietary work for an industry may be conducted by technically qualified government laboratory staff using laboratory facilities with the full cost charged to the client industry. The intellectual property generally belongs to the industry sponsor. The government usually retains a non-exclusive, royalty-free license to such intellectual property.
- Small Business Innovation Research (SBIR) Program - mandated under the Small Business Innovation Development Act, and its reauthorization under P.L. 99-443 and PL 102-564, the SBIR programs are specifically oriented to technology transfer. The following agencies are currently participating in the SBIR program:
 - Department of Agriculture
 - Department of Commerce
 - Department of Defense
 - Department of Education
 - Department of Energy
 - Department of Health and Human Services
 - Department of Transportation
 - Environmental Protection Agency
 - National Aeronautics and Space Administration
 - National Science Foundation
 - Nuclear Regulatory Commission

Phase III of the SBIR Program is specifically oriented toward the commercialization of the technology developed in phases I and II for government purposes. These technologies make up a significant part of the national technology base and should be considered fruitful areas for Federal Technology Transfer Programs,

Information on SBIR-sponsored technology available for commercialization from all Federal programs is made available through the NTTC.

- Small Business Technology Transfer Pilot (STTR) Program

The new STTR Program, mandated under PL 102-564, specifically provides for a process similar to the SBIR program for the commercialization of Federally-sponsored technologies. The objective of this program is to involve small businesses with not-for-profit organizations in licensing new Federal technologies and commercializing them into products and processes for industry. This program becomes effective in FY 94, and agencies affected are currently developing implementing policies and procedures.

- Demonstration Projects - funded by technology transfer organizations including regional FLC managers to show the viability of a process, procedure, or outreach mechanism for technology transfer. These may involve cooperative agreements with state, local or regional economic development groups, universities, small businesses, or not-for-profit organizations,
- Professional and Trade Associations - these organizations provide access to audiences with interests in specific types and applications of technology. Interface between technology transfer managers and these organizations provides a capability to combine the best features of Market Pull and Technology Push activities,

Supporting Organizations and Associations

There are several organizations which support the profession of technology transfer.

- The Technology Transfer Society is the National organization with chapters across the country who focus on the professional development of Technology Transfer managers. The T²Society provides its members with a monthly newsletter, a quarterly journal, an annual symposium, a directory of members, and reduced rates on selected professional books and periodicals related to technology transfer.
- The Association of Federal Technology Transfer Executives (AFT²E) is a newly formed organization that supports activities oriented toward professional development which supplement the training and networking activities of the FLC,