Congressional Research Service

Technology Transfer: Use of Federally Funded Research and Development

Wendy H. Schacht
Specialist in Science and Technology Policy

December 3, 2012

Congressional Research Service
7-5700
www.crs.gov
RL33527

CRS Report for Congress
Prepared for Members and Committees of Congress

Summary

The federal government spends approximately one-third of its annual research and development (R&D) budget for intramural work to meet mission requirements in over 700 government laboratories (including Federally Funded Research and Development Centers). The technology and expertise generated by this endeavor may have application beyond the immediate goals or intent of federally funded R&D. These applications can result from technology transfer, a process by which technology developed in one organization, in one area, or for one purpose is applied in another organization, in another area, or for another purpose. It is a way for the results of the federal R&D enterprise to be used to meet other national needs, including the economic growth that flows from new commercialization in the private sector; the government's requirements for products and processes to operate effectively and efficiently; and the demand for increased goods and services at the state and local level.

Congress has established a system to facilitate the transfer of technology to the private sector and to state and local governments. Despite this, use of federal R&D results has remained restrained, although there has been a significant increase in private sector interest and activities over the past several years. Critics argue that working with the agencies and laboratories continues to be difficult and time-consuming. Proponents of the current effort assert that while the laboratories are open to interested parties, the industrial community is making little effort to use them. At the same time, state governments are increasingly involved in the process. At issue is whether incentives for technology transfer remain necessary, if additional legislative initiatives are needed to encourage increased technology transfer, or if the responsibility to use the available resources now rests with the private sector.

Contents

Contacts

Background and Analysis

The federal government will have spent an estimated $138.9 billion in FY2012 on research and development to meet the mission requirements of the federal departments and agencies.[1] Approximately one-third of this is for intramural research and development (R&D) by federal laboratories (including support for Federally Funded Research and Development Centers). While the major portion of federal support has been in the defense arena, government R&D has led to new products and processes for the commercial marketplace including, but not limited to, antibiotics, plastics, airplanes, computers, microwaves, and bioengineered drugs. Given the increasing competitive pressures on U.S. firms in the international marketplace, proponents of technology transfer argue that there are many other technologies and techniques generated in the federal laboratory system which could have market value if further developed by the industrial community. Similarly, the knowledge base created by the agencies' R&D activities can serve as a foundation for additional commercially relevant efforts in the private sector.

The movement of technology from the federal laboratories to industry and to state and local governments is achieved through technology transfer. Technology transfer is a process by which technology developed in one organization, in one area, or for one purpose is applied in another organization, in another area, or for another purpose. In the defense arena it is often called "spin-off." Technology transfer can have different meanings in different situations. In some instances, it refers to the transfer of legal rights, such as the assignment of patent title to a contractor or the licensing of a government-owned patent to a private firm. In other cases, the transfer endeavor involves the informal movement of information, knowledge, and skills through person-to-person interaction. The crucial aspect in a successful transfer is the actual use of the product or process. Without this, the benefits from more efficient and effective provision of goods and services are not achieved. However, while the United States has perhaps the best basic research enterprise in the world—as evidenced in part by the large number of Nobel Prizes awarded to American scientists—other countries sometimes appear more adept at taking the results of this effort and making commercially viable products to be sold in U.S. and world markets.[2]

Despite the potential offered by the resources of the federal laboratory system, the commercialization level of the results of federally funded research and development remained low through the 1970s and 1980s. Studies indicated that only approximately 10% of federally owned patents were ever used. There were various reasons for this, including the fact that many of these technologies and patents had no commercial application. A major factor in successful transfer is a perceived market need for the technology or technique. However, because federal laboratory R&D is generally undertaken to meet an agency's mission or because there are insufficient incentives for private sector research that the government deems in the national interest, decisions reflect public sector, rather than commercial needs. Thus, transfer often depends on attempts to ascertain commercial applications of technologies developed for government use—"technology push"—rather than on "market pull." In other words, a technology is developed and a use for it established because the expertise exists rather than because it is perceived to be needed.

[1] Office of Management and Budget, Fiscal Year 2013 Analytical Perspectives, Budget of the U.S. Government, 370, available at http://www.whitehouse.gov/sites/default/files/omb/budget/fy2013/assets/spec.pdf.

[2] See CRS Report RL33528, *Industrial Competitiveness and Technological Advancement: Debate Over Government Policy*, by Wendy H. Schacht.

Additional barriers to transfer involve costs. Studies have estimated that research accounts for approximately 25% of expenditures associated with bringing a new product or process to market. Thus, while it might be advantageous for companies to rely on government-funded research, there are still significant added costs of commercialization after the transfer of technology has occurred. However, industry unfamiliarity with these technologies, the "not invented here" syndrome, and ambiguities associated with obtaining title to or exclusive license for federally owned patents also contribute to a limited level of commercialization. Complicating the issue is the fact that the transfer of technology is a complex process that involves many stages and variables. Often the participants do not know or understand each other's work environment, procedures, terminology, rewards, and constraints. The transfer of technology appears to be most successful when it involves one-to-one interaction between committed individuals in the laboratory and in industry or state and local government. "Champions" are generally necessary to see a transfer through to completion because it is so often a time- and energy-consuming process. Given this, technology transfer is best approached on a case-by-case basis that can take into account the needs, operating methods, and constraints of the involved parties.

Technology Transfer to Private Sector: Federal Interest

The federal interest in the transfer of technology from government laboratories to the private sector is based on several factors. The government requires certain goods and services to operate. Much of the research it funds is directed at developing the knowledge and expertise necessary to formulate these products and processes. However, the government has neither the mandate nor the capability to commercialize the results of the federal R&D effort. Technology transfer is a mechanism to get federally generated technology and technical know-how to the business community where it can be developed, commercialized, and made available for use by the public sector.

Federal involvement in technology transfer also arises from an interest in promoting the economic growth that is vital to the nation's welfare and security. It is through further development, refinement, and marketing that the results of research become diffused throughout the economy and can generate growth. It is widely accepted that technological progress is responsible for up to one-half the growth of the U.S. economy and is the principal driving force in long-term economic growth and increases in our standard of living. Economic benefits of a technology or technique accrue when a product, process, or service is brought to the marketplace where it can be sold or used to increase productivity. When technology transfer is successful, new and different products or processes become available to meet or induce market demand. Transfer from the federal laboratories can result in substantial increases in employment and income generated at the firm level.

In addition, cooperation with the private sector provides a means for federal scientists and engineers to obtain state-of-the-art technical information from the industrial community, which in various instances is more advanced than that available in the government. Technology transfer is also a way to assist companies that have been dependent on defense contracts and procurement to convert to manufacturing for the civilian, commercial marketplace. Successful efforts range from advances in the commercial aviation industry, to the development of a new technology for use in advanced ceramics, to the evolution of the biotechnology sector.

Technology Transfer to State and Local Governments: Rationale for Federal Activity

The increasing demands on state and local governments to provide improved goods and services have been accompanied by a recognition that expanded technological expertise can help meet many of these needs. The transfer of technology and technical knowledge from government laboratories to state and local jurisdictions can allow for additional use of ideas and inventions that have been funded and created through federal R&D. Intergovernmental technology transfer can also help state and local officials meet responsibilities imposed by federal legislation.

As state and local governments increasingly looked for technological solutions, the concept of "public technology"—the adaptation and utilization of new or existing technology to public sector needs—emerged. The application of technology to state and local services is a complex and intricate procedure. In transferring technology from the federal laboratories, the application often can be direct. At other times, alterations in technical products and processes may be necessary for application in the state and local environment. However, this "adaptive engineering" generally is not extensive or expensive and can be accomplished by federal laboratory and state and local personnel working together.

State and local government concerns with regional economic growth also have focused attention on technology transfer as a mechanism to increase private sector innovation related activities within their jurisdiction. In order to develop and foster an entrepreneurial climate, many states and localities are undertaking the support of programs that assist high technology businesses, and that often use the federal laboratory system. State and local efforts to develop "incubator centers" for small companies may rely on cooperation with federal laboratories, which supply technical expertise to firms locating at the center. Other larger programs to promote innovation in the state, such as the Ben Franklin Partnership in Pennsylvania, use the science and technology resources of federal personnel. Additional programs have been created involving state universities, private companies, and the federal laboratories, with each program geared to the specific needs and desires of the participating parties.

Current Federal Efforts to Promote Technology Transfer

Over the years, legislative initiatives have fostered the transfer of technology from the federal government to state and local jurisdictions and to the private sector. The primary law affording access to the federal laboratory system is P.L. 96-480, the Stevenson-Wydler Technology Innovation Act of 1980, as amended by the Federal Technology Transfer Act of 1986 (P.L. 99-502), the Omnibus Trade and Competitiveness Act (P.L. 100-418), the 1990 Department of Defense (DOD) Authorization Act (P.L. 101-189), the National Defense Authorization Act for FY1991 (P.L. 101-510), the Technology Transfer Improvements and Advancement Act (P.L. 104-113), and the Technology Transfer Commercialization Act (P.L. 106-404). Several practices have been established and laws enacted that are aimed at encouraging the private sector to utilize the knowledge and technologies generated by the federal R&D endeavor. These are discussed below.

Federal Laboratory Consortium for Technology Transfer

One of the primary federal efforts to facilitate and coordinate the transfer of technology among various levels of government and to the private sector is the Federal Laboratory Consortium for Technology Transfer (FLC). The Consortium was originally established under the auspices of the Department of Defense in the early 1970s to assist in transferring DOD technology to state and local governments. Several years later, it was expanded to include other federal departments in a voluntary organization of approximately 300 federal laboratories. The Federal Technology Transfer Act of 1986 (P.L. 99-502) provided the FLC with a legislative mandate to operate and required the membership of most federal laboratories. Today, over 600 laboratories are represented.

The basic mission of the Federal Laboratory Consortium is to promote the effective use of technical knowledge developed in federal departments and agencies by "networking" the various member laboratories with other federal entities, with state, local, and regional governments, and with private industry. To accomplish this, the Consortium establishes channels through which user needs can be identified and addressed. It also provides a means by which federal technology and expertise can be publicized and made available through individual laboratories to private industry for further development and commercialization. Access to the resources of the full federal laboratory system can be made through any laboratory representative, the FLC regional coordinators, the Washington area representative, or by contacting the chairman or executive director.

The FLC itself does not transfer technology; it assists and improves the technology transfer efforts of the laboratories where the work is performed. In addition to developing methods to augment individual laboratory transfer efforts, the Consortium serves as a clearinghouse for requests for assistance and will refer to the appropriate laboratory or federal department. The work of the Consortium is funded by a set-aside of 0.008% of the portion of each agency's R&D budget used for the laboratories.

P.L. 96-480, P.L. 99-502, and Amendments

In 1980, the U.S. Congress enacted P.L. 96-480, the Stevenson-Wydler Technology Innovation Act. Recognizing the benefits to be derived from the transfer of technology, the law explicitly states that

> It is the continuing responsibility of the federal government to ensure the full use of the results of the Nation's federal investment in research and development. To this end the federal government shall strive where appropriate to transfer federally owned or originated [non-classified] technology to state and local governments and to the private sector.

Prior to this law, technology transfer was not part of the mission requirements of the federal departments and agencies, with the exception of the National Aeronautics and Space Administration. This left laboratory personnel open to questions as to the suitability of their transfer activities. However, P.L. 96-480 "legitimized" the transfer effort and mandated that technology transfer be accomplished as an expressed part of each agency's mission.

Section 11 created the mechanisms by which federal agencies and their laboratories can transfer technology. Each department with at least one laboratory originally was required to make available not less than 0.5% of its R&D budget for transfer activities, although this requirement could be waived. In 1989, this provision was struck and the agencies instead required to provide "sufficient funding" to support technology transfer. Each laboratory must establish an Office of Research and Technology Applications (ORTA); as amended, laboratories with 200 or more full time scientific, engineering, or related technical employees are required to have at least one full-time staff person for this office. The function of the ORTA is to identify technologies and ideas that have potential for application in other settings.

Additional incentives for the transfer and commercialization of technology are contained in various amendments to Stevenson-Wydler. P.L. 99-502, the Federal Technology Transfer Act, amends P.L. 96-480 to allow government-owned, government-operated laboratories (GOGOs) to enter into cooperative research and development agreements (CRADAs) with universities and the private sector. The authority to enter into these agreements was extended to government-owned, contractor-operated laboratories (generally the laboratories of the Department of Energy, DOE) in the FY1990 Defense Authorization Act (P.L. 101-189). A CRADA is a specific legal document (not a procurement contract) which defines the collaborative venture. It is intended to be developed at the laboratory level, with limited agency review. In agencies which operate their own laboratories, the laboratory director is permitted to make decisions to participate in CRADAs in an effort to decentralize and expedite the technology transfer process. Generally, at agencies which use contractors to run their laboratories, specifically DOE, the CRADA is to be approved by headquarters. P.L. 106-398, however, allows the agency to define certain conditions under which the CRADA may be approved by a laboratory itself rather than headquarters.

The work performed under a cooperative research and development agreement must be consistent with the laboratory's mission. In pursuing these joint efforts, the laboratory may accept funds, personnel, services, and property from the collaborating party and may provide personnel, services, and property to the participating organization. The government can cover overhead costs incurred in support of the CRADA, but is expressly prohibited from providing direct funding to the industrial partner. In GOGO laboratories, this support comes directly from budgeted R&D accounts. Prior to the elimination of a line item in the budget to support non-defense energy technology transfer, the Energy Department generally relied on a competitive selection process run by headquarters to allocate funding specifically designated to cover the federal portion of the CRADA. Now these efforts are to be supported through programmatic funds.

Under a CRADA, title to, or licenses for, inventions made by a laboratory employee may be granted in advance to the participating company, university, or consortium by the director of the laboratory. In addition, the director can waive, in advance, any right of ownership the government might have on inventions resulting from the collaborative effort regardless of size of the company. This diverges from other patent law that requires title to inventions made under federal R&D funding be given to small businesses, not-for-profits, and universities. In all cases, the government retains a nonexclusive, nontransferable, irrevocable, paid-up license to practice, or have practiced, the invention for its own needs.

Laboratory personnel and former employees are permitted to participate in commercialization activities if these are consistent with the agencies' regulations and rules of conduct. Federal employees are subject to conflict of interest restraints. In the case of government-owned, contractor-operated laboratories, P.L. 101-189 required the establishment of conflict of interest provisions regarding CRADAs to be included in the laboratories' operating contracts within 150 days of enactment of the law. Preference for cooperative ventures is given to small businesses, companies which will manufacture in the United States, or foreign firms from countries that permit American companies to enter into similar arrangements. According to the Department of

Commerce, between FY2005 and FY2009, approximately 3,700-4,200 traditional CRADAs were active each year.[3]

P.L. 99-502 provides for cash awards to federal laboratory personnel for activities facilitating scientific or technological advancements which have either commercial value or contribute to the mission of the laboratory and for the transfer of technology leading to commercialization. As an additional incentive, federal employees responsible for an invention are to receive at least 15% of royalties generated by the licensing of the patent associated with their work. The agencies may establish their own royalty sharing programs within certain guidelines. If the government has the right to an invention but chooses not to patent, the inventor, either as a current or former federal employee, can obtain title subject to the above-mentioned licensing rights of the government.

To further facilitate the transfer process, a provision of the National Defense Authorization Act for FY1991 (P.L. 101-510) amends Stevenson-Wydler allowing government agencies and laboratories to develop partnership intermediary programs augmenting the transfer of laboratory technology to the small business sector.

P.L. 104-113, the Technology Transfer Improvements and Advancement Act, clarifies existing policy with respect to the dispensation of intellectual property under a CRADA by amending the Stevenson-Wydler Act. Responding to criticism that ownership of patents is an obstacle to the quick development of CRADAs, this bill guarantees an industrial partner the option to select, at the minimum, an exclusive license for a field of use to the resulting invention. If the invention is made solely by the private party, then they may receive the patent. However, the government maintains a right to have the invention utilized for compelling public health, safety, or regulatory reasons and the ability to license the patent should the industrial partner fail to commercialize the invention.

P.L. 100-418, Omnibus Trade and Competitiveness Act

In response to concerns over the development and application of new technology, the 1988 Omnibus Trade and Competitiveness Act contained several provisions designed to foster technology transfer. The law redesignated the National Bureau of Standards as the National Institute of Standards and Technology (NIST), and mandated the establishment of (among other things) (1) an Advanced Technology Program to encourage public-private cooperative efforts in the development of industrial technology and to promote the use of NIST technology and expertise; (2) Regional Manufacturing Technology Transfer Centers; and (3) a Clearinghouse on State and local innovation related activities. The set-aside for operation of the Federal Laboratory Consortium created in P.L. 99-502 was also increased from 0.005% of the laboratory R&D budget to 0.008%.

The now-terminated Advanced Technology Program (ATP) provided seed funding, matched by private-sector investment, to companies or consortia of universities, industries, and government laboratories to accelerate the development of generic technologies that have broad application across industries.[4] The first awards were made in 1991. By the end of the program in 2007, 824

[3] U.S. Department of Commerce, National Institute of Standards and Technology, *Federal Laboratory Technology Transfer, Fiscal Year 2009*, March 2011, 7, available at http://www.nist.gov/tpo/publications/upload/Federal-Lab-TT-Report-FY2009.pdf.

[4] See CRS Report 95-36, *The Advanced Technology Program*, by Wendy H. Schacht.

projects had been funded representing approximately $1.6 billion in federal dollars matched by $1.5 billion in financing from the private sector. Approximately 28% of awards (227) were made for joint ventures.[5]

The first four ATP competitions (through August 1994) were all general in nature. However, in response to large increases in federal funding, NIST, in conjunction with industry, identified various key areas for long-range support including information infrastructure for healthcare; tools for DNA diagnostics; component-based software; manufacturing composite structures; computer-integrated manufacturing for electronics; digital data storage; advanced vapor-compression refrigeration systems; motor vehicle manufacturing technology; materials processing for heavy manufacturing; catalysis and biocatalysis technologies; advanced manufacturing control systems; digital video in information networks; engineering; photonics manufacturing; premium power; microelectronics manufacturing infrastructure; selective-membrane platforms; and adaptive learning systems. The general competition continued. In FY1999, NIST dropped the focused areas in favor of one competition open to all areas of technology.

P.L. 110-69, the America COMPETES Act, created the Technology Innovation Program (TIP) to replace the Advanced Technology Program.[6] Until funding for the program ended in FY2012, TIP was similar to ATP in the intent to promote high-risk R&D that would be of broad-based economic benefit to the nation. However, there were several differences in the operation of the new activity. Awards under TIP were limited to small and medium-sized businesses whereas grants under ATP were available to companies regardless of size. In addition, in the Advanced Technology Program, joint ventures were required to include two separately owned for-profit firms and could involve universities, government laboratories, and other research establishments as participants in the project but not as recipients of the grant. In the TIP initiative, a joint venture could involve two separately owned for-profit companies but could also be comprised of one small or medium-sized firm and a university. A single company could receive up to $2 million for up to three years under ATP; under TIP, the participating company (which must be a small or medium-sized business) was able to receive up to $3 million for up to three years. In ATP, small and medium-sized companies were not required to cost share (large firms provided 60% of the total cost of the project) while in TIP there was a 50% cost sharing requirement which, again, only applied to the small and medium-sized businesses that are eligible. There were no funding limits for the five-year funding available for joint ventures under ATP; the TIP limited joint venture funding to $9 million for up to five years. The Advisory Board that was created to assist in the Advanced Technology Program included industry representatives as well as federal government personnel and representatives from other research organizations. The Advisory Board for the Technology Innovation Program was comprised of only private sector members.

In January 2009, nine awards were announced for "new research projects to develop advanced sensing technologies that would enable timely and detailed monitoring and inspection of the structural health of bridges, roadways and water systems that comprise a significant component of the nation's public infrastructure." According to TIP, $42.5 million in federal money was expected to be matched by $45.7 in private sector support. Twenty more awards were announced in December 2009 totaling almost $71.0 million in NIST financing with approximately $145.7 million in funding from other sources. Of the projects selected for the two solicitations, thirteen

[5] National Institute of Standards and Technology, *Historical Statistics on ATP Awards/Winners*, available at http://www.atp.nist.gov/eao/statistics.htm.

[6] See CRS Report RS22815, *The Technology Innovation Program*, by Wendy H. Schacht.

were in the area of monitoring and inspection of civil infrastructure; four were in the area of advanced repair of civil infrastructure; eleven were in the area of process scale up for advanced materials; and one was in the area of predictive modeling for advanced materials. Nine additional projects in various areas including biopharmaceuticals, electronics, nanotechnology, renewable energy, and energy sources received awards of more than $22 million in December 2010. Federal funding for these projects was expected to be matched by approximately $24 million in private sector support.[7]

According to NIST, no new TIP awards were made in FY2011. The $44.8 million appropriated for the program in P.L. 112-10 was used for the continued support of ongoing TIP and ATP projects.[8] No FY2012 funds were appropriated for TIP.

The Omnibus Trade and Competitiveness Act (P.L. 100-418) also created a program of regional centers to assist small manufacturing companies' use of knowledge and technology developed under the auspices of the National Institute of Standards and Technology and other federal agencies.[9] Federal funding for the centers is matched by non-federal sources including state and local governments and industry. Originally, seven Regional Centers for the Transfer of Manufacturing Technology were selected and are operational: the Great Lakes Manufacturing Technology Center at the Cleveland Advanced Manufacturing Program in Ohio; the Northeast Manufacturing Technology Center at Rensselaer Polytechnic Institute in Troy, New York (now called the New York Manufacturing Extension Partnership); the South Carolina Technology Transfer Cooperative based at the University of South Carolina in Columbia; the Midwest Manufacturing Technology Center at the Industrial Technology Institute in Ann Arbor, Michigan; the Mid-American Manufacturing Technology Center at the Kansas Technology Enterprise Corporation of Topeka; the California Manufacturing Technology Center at El Camino College in Torrance; and the Upper Midwest Manufacturing Technology Center in Minneapolis.

The original program expanded in 1994 creating the Manufacturing Extension Partnership (MEP) to meet new and growing needs of the community. In a more varied approach, the Partnership involves both large centers and smaller, more dispersed organizations sometimes affiliated with larger centers. Also included is the NIST State Technology Extension Program which provides states with grants to develop the infrastructure necessary to transfer technology from the federal government to the private sector (an effort which was also mandated by P.L. 100-418) and a program that electronically ties the disparate parties together along with other federal, state, local, and academic technology transfer organizations. There are now centers in all 50 states and Puerto Rico. Since the program was created in 1989, awards made by NIST for extension activities resulting in the creation of approximately 400 regional offices. (It should be noted that the Department of Defense also funded 36 centers through its Technology Reinvestment Project [TRP] in FY1994 and FY1995. When the TRP was terminated, NIST took over support for 20 of these programs in FY1996 and financed the remaining ones during FY1997.)

The America COMPETES Act authorized (but did not fund) a new NIST program of partnerships between industry and other educational or research institutions to develop new manufacturing

---

[7] National Institute of Standards and Technology, NIST Announces $22 Million in Funding for Advanced Manufacturing Research in Electronics, Biotechnology, and Nanotechnology, December 15, 2010, available at http://www.nist.gov/tip/tip_121510.cfm.

[8] See http://www.nist.gov/tip/.

[9] See CRS Report 97-104, *Manufacturing Extension Partnership Program: An Overview*, by Wendy H. Schacht.

processes, techniques, or materials. In addition, a manufacturing fellowship program would be created with stipends available for post-doctoral work at NIST.

In October 2010, NIST announced the award of $9.1 million in cooperative agreements for 22 projects "designed to enhance the productivity, technological performance and global competitiveness of U.S. manufacturers."[10] The funding was granted on a competitive basis to non-profit organizations that will work with the MEP centers and address one or more of the areas that have been identified by NIST as critical to U.S. manufacturing. These activities differ from the established MEP effort in which no new manufacturing research is conducted and funded as existing manufacturing technology is applied to the needs of small and medium-sized firms.

Patents

The patent system was created to promote innovation. Based on Article I, Section 8 of the U.S. Constitution which states: "The Congress Shall Have Power ... To promote the Progress of Science and useful Arts, by securing for limited Times to Authors and Inventors the exclusive Right to their respective Writings and Discoveries ... ", the patent system encourages innovation by simultaneously protecting the inventor and fostering competition. Originally, it provided the inventor with a lead time of 17 years (from the date of issuance) to develop his idea, commercialize, and thereby realize a return on his initial investment. Today, in response to the Uruguay Round Agreements Act, the term of the patent has been changed to 20 years from date of filing. The process of obtaining a patent places the idea in the public domain. As a disclosure system, the patent can, and generally does, stimulate other firms or inventors to invent "around" existing patents to provide parallel technical developments or meet similar market needs.

Ownership of patents derived from research and development performed under federal funding affects the transfer of technology from federal laboratories to the private sector. Generally, the government retains title to these inventions and can issue to companies either an exclusive license or, more commonly, a nonexclusive license. However, it is argued that without title (or at least an exclusive license) to an invention and the protection it conveys, a company will not invest the additional time and money necessary for commercialization. This contention is supported by the fact that, although a portion of ideas patented by the federal government have potential for further development, application, and marketing, only about 10% of these are ever used in the private sector. However, there is no universal agreement on this issue. It also is asserted that title should remain in the public sector where it is accessible to all interested parties since federal funds were used to finance the work.

Despite the disagreements, the Congress has accepted to some extent the proposition that vesting title to the contractor will encourage commercialization. P.L. 96-517, Amendments to the Patent and Trademark Laws (commonly known as the Bayh-Doyle Act), provides, in part, for contractors to obtain title if they are small businesses, universities, or not-for-profit institutions. Certain rights are reserved for the government and these organizations are required to commercialize within a predetermined and agreed-on time.[11] Yet it continues to be argued that

[10] National Institute of Standards and Technology, NIST Manufacturing Extension Partnership Awards $9.1 Million for 22 Projects to Enhance U.S. Manufacturers' Global Competitiveness, Press Release, October 5, 2010, available at http://www.nist.gov/mep/upload/100410-MEP-Competition-press-release-FINAL.pdf.

[11] See CRS Report RL32076, *The Bayh-Dole Act: Selected Issues in Patent Policy and the Commercialization of Technology*, by Wendy H. Schacht.

patent exclusivity is important for both large and small firms. In a February 1983 memorandum concerning the vesting of title to inventions made under federal funding, President Reagan ordered all agencies to treat, as allowable by law, all contractors regardless of size as prescribed in P.L. 96-517. This, however, does not have a legislative basis.

Further changes in the patent laws made by the enactment of P.L. 98-620 also affect the transfer of technology from federal laboratories to the private sector. In a provision that was designed to increase interaction and cooperation between government-owned, contractor-operated (GOCO) laboratories and private industry in the transfer of technology, Title V permits decisions to be made at the laboratory level as to the award of licenses for laboratory generated patents. The contractor is also permitted by this legislation to receive patent royalties for use in additional research and development, for awards to individual inventors on staff, or for education. A cap exists on the amount of the royalty returning to the laboratory so as not to distort the agency's mission and congressionally mandated R&D agenda. However, the creation of discretionary funds gives laboratory personnel added incentive to encourage and complete technology transfers.

P.L. 98-620 also permits private companies, regardless of size, to obtain exclusive license for the full life of the government patent. Prior restrictions on large firms allowed exclusive license for only five of the (then) 17 years of the patent. The law permits those government laboratories that are run by universities or nonprofit institutions to retain title to inventions made in their institution (within certain defined limitations). Federal laboratories operated by large companies are not included in this provision.

The Federal Technology Transfer Act and the FY1990 DOD authorization give all companies (not just small businesses, universities, and nonprofits) the right to retain title to inventions resulting from research performed under cooperative R&D agreements with government laboratories. If this occurs, the federal government retains a royalty-free license to use these patents. In addition, the Federal Technology Act states that the government agencies may retain a portion of royalty income rather than returning it to the Treasury. After payment of the prescribed amount to the inventor, the agencies must transfer the balance of the total to their government-operated laboratories, with the major portion distributed to the laboratory where the invention was made. The laboratory may keep all royalties up to 5% of their annual budget plus 25% of funds in excess of the 5% limit. The remaining 75% of the excess returns to the Treasury. Funds retained by the laboratory are to be used for expenses incurred in the administration and licensing of inventions; to reward laboratory personnel; to provide for personnel exchanges between laboratories; for education and training consistent with the laboratories' and agencies' missions; or for additional transfer.

P.L. 106-404, the Technology Transfer Commercialization Act, signed into law on November 1, 2000, made alterations in practices concerning patents held by the government to make it easier for federal agencies to license such inventions. The law amends P.L. 96-480 and P.L. 96-517 to decrease the time necessary to obtain an exclusive or partially exclusive license on federally owned patents. Previously, agencies were required to publicize the availability of technologies for three months using the *Federal Register* and then provide an additional 60 day notice of intent to license by an interested company. The new law shortens the period to 15 days in recognition of the ability of the Internet to offer widespread notification and the time constraints faced by industry in commercialization activities. Certain rights would be retained by the government. The legislation also allows licenses for existing government-owned inventions to be included in CRADAs.

The CREATE Act, P.L. 108-453, made changes in the patent laws to promote cooperative research and development among universities, government, and the private sector. The legislation amended Section 103(c) of title 25, United States Code, such that certain actions between researchers under a joint research agreement will not preclude patentability.[12]

Small Business Technology Transfer Program

P.L. 102-564 created a three-year pilot program designed to facilitate the commercialization of university, nonprofit, and federal laboratory R&D by small companies. The Small Business Technology Transfer program (STTR) provides funding for research proposals which are developed and executed cooperatively between a small firm and a scientist in a research organization and fall under the mission requirements of the federal funding agency. Until the recent reauthorization, up to $100,000 in Phase I financing was available for one year to test the viability of the concept. Phase II awards of $500,000 could be made for two years to perform the research. Funding for commercialization of the results is expected from the private sector. Financial support for this effort comes from a phased-in set-aside of the R&D budgets of departments which spend over $1 billion per year on research and development. Originally set to expire at the end of FY1996, the program was extended one year. P.L. 105-135 reauthorized the STTR through FY2001, while P.L. 107-50 extended the program through FY2009. Since its last expiration on October 31, 2008, the program was temporarily extended numerous times until passage of P.L. 112-81 which extended the STTR through September 30, 2017. The original set-aside used to fund the activity was increased to 0.3% in FY2004 and increased to 0.35% in FY2012 and FY2013 by the current reauthorization legislation. Earlier changes had increased the amount of money available for individual Phase II grants from $500,000 to $750,000; under the new law, Phase I awards of up to $150,000 and Phase II awards of up to $1 million may be made to companies.[13]

Further Considerations

The federal laboratories have received a mandate to transfer technology. This, however, is not the same as a mandate to help the private sector in the development and commercialization of technology for the marketplace. While the missions of the government laboratories are often broad, direct assistance to industry is not included, with the exception of the National Institute of Standards and Technology. The laboratories were created to perform the R&D necessary to meet government needs, which typically are not consistent with the demands of the marketplace.

The missions of the federal laboratories are under review, due, in part, to budget constraints and the changing world situation. National security is now being redefined to include economic well-being in addition to weapons superiority. The laboratories which have contributed so much to the defense enterprise are being re-evaluated. These discussions provide an opportunity to debate whether the mandate of the federal R&D establishment should include expanded responsibilities for assistance to the private sector. Whether or not the missions of the U.S. government laboratories are changed to include expanded assistance to industry, there are various initiatives

[12] See CRS Report RS21882, *Collaborative R&D and the Cooperative Research and Technology Enhancement (CREATE) Act*, by Wendy H. Schacht.

[13] See CRS Report 96-402, *Small Business Innovation Research (SBIR) Program*, by Wendy H. Schacht.

which may facilitate the technology transfer process under the laboratories' current responsibilities. These include making the work performed in government institutions more relevant to industry through augmented cooperative R&D, increased private sector involvement early in the R&D efforts of the laboratories, and expanded commercialization activities.

Because a significant portion of the laboratories are involved in defense research, questions arise as to whether or not the technologies in these institutions can be transferred in such a way as to be useful to commercial companies. In addition, the selection of one company over another to be involved in a transfer or in a cooperative R&D agreement raises issues of fairness and equity of access, as well as conflict of interest. And, while it is virtually impossible to prevent the flow of scientific and technical information abroad, there is ongoing interest in the extent of foreign access to the federal laboratory establishment. How these concerns are addressed may be fundamental to the success of U.S. technology transfer.

Over the past 30 or more years, the Congress has enacted various laws designed to facilitate cooperative R&D between and among government, industry, and academia. These laws include (but are not limited to) tax credits for industrial payments to universities for the performance of R&D, amendments to the antitrust laws as they pertain to cooperative research and joint manufacturing, changes to government patent policies, and improved technology transfer from federal laboratories to the private sector. The intent behind these legislative initiatives is to encourage collaborative ventures and thereby reduce the risks and costs associated with R&D as well as permit work to be undertaken that crosses traditional boundaries of expertise and experience leading to the development of new technologies and manufacturing processes for the marketplace.

Today, the perspectives on joint R&D, technology transfer, and cooperative research and development agreements appear mixed. The results of legislative activity are open to discussion. In the recent past, both national political parties have supported measures to facilitate technological advancement. There are some indications that there may be a refocus on federal support for basic research as well as indirect measures to encourage technology development in the private sector. CRADAs, in particular, are a means to take this government-funded basic research from the federal laboratory system and move it to the industrial community for commercialization to meet both agency mission requirements and other national needs associated with the economic growth which comes from new products and processes. While the Advanced Technology Program faced much opposition in the House, the program continued to be funded, although at decreased levels until FY2008 when it was replaced by the Technology Innovation Program which then received reduced support in FY2011 and no funding in FY2012. When the Manufacturing Extension Partnership had its budget cut the funds were restored the following fiscal year. As the Congress makes decisions concerning funding for R&D, the role of the federal government in technology transfer, technology development, and commercialization might be expected to be explored further.

Author Contact Information

Wendy H. Schacht
Specialist in Science and Technology Policy
wschacht@crs.loc.gov, 7-7066