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TechLink

By Will Swearingen, Ph.D.

DEVELOPING TECHNOLOGY PARTNERSHIPS WITH THE DEPARTMENT OF DEFENSE

This article focuses on a "partnership intermediary" organization, TechLink, which fosters technology-led economic development by helping companies to access the diverse technology, unique technical capabilities, and sizeable research-and-development funding in the US Department of Defense (DoD) lab system. From its base in the Northern Rocky Mountains at Montana State University, TechLink operates nationally, having brokered partnerships between DoD labs and companies in 35 different states. TechLink's primary activities are helping to establish (1) licensing agreements that give companies access to DoD-developed technology; (2) cooperative R&D agreements between DoD labs and companies; and (3) R&D contracts between DoD and small businesses for new technology development.

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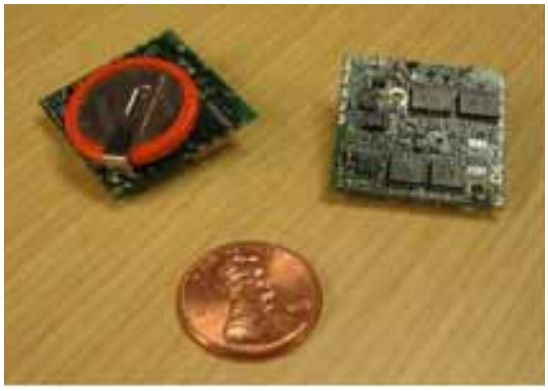
INNOVATION AND ECONOMIC DEVELOPMENT IN THE UNITED STATES

Technology innovations are well-recognized drivers of economic development. In fact, close to half of the economic growth in the United States since World War II can be attributed to advances in technology. In order to foster the development of new technology, the US currently invests around $350 billion a year in research and development. This is equivalent to between 2 and 3 percent of the nation's Gross Domestic Product (GDP). Approximately two-thirds of this funding comes from the private sector, primarily large corporations. The federal government accounts for most of the rest, some $120 billion a year.

Although federal R&D funding is only about half the size of the private sector's R&D investment, it plays an essential role in the nation's innovation enterprise. Federal dollars fund a high percentage of the nation's *early-stage* research, from which path-breaking new discoveries, new technology fields, and major new sectors of the economy emerge. The Internet and GPS are two examples of technologies that are ubiquitous today, which originated from US Department of Defense funding.

Federally funded R&D is conducted by a variety of organizations, including corporations, universities, federal laboratories, and non-profit research centers (*see* Figure. 1). Industry receives the largest share of federal R&D funding – around 42 percent. Universities and colleges receive around 22 percent, and non-profit research centers around 7 percent. Federal laboratories, including those that are contractor managed (FFRDCs), account for the remainder, approximately 31 percent. Major innovations often involve collaborations among several of these sectors. For example, GPS was developed with DoD funding through the combined efforts of the Applied Physics Laboratory at Johns Hopkins University, the Naval Research Laboratory, and the Aerospace Corporation.



A miniature power device is being developed for DoD by a Fargo, North Dakota, company under a TechLink-facilitated contract.

The private sector is responsible for the vast majority of the innovations that drive the country's technology-led economic development. In fact, according to 2008 statistics from the US Patent and Trademark Office (USPTO), US corporations were awarded a total of nearly 70,000 patents – approximately 82 percent of the US patents received by US entities. US individual inventors accounted for around 12 percent of the patents. US universities and colleges accounted

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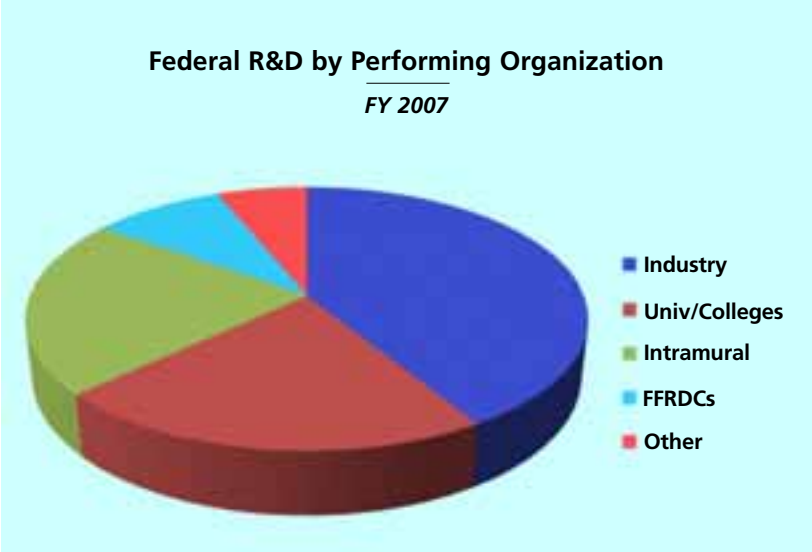
FIGURE 1



Source: AAAS 2008

for 4 percent, and federal laboratories for 2 percent. (Note: Foreign corporations and individuals now receive approximately half of all patents awarded by the USPTO).

FEDERAL LABORATORIES AND TECHNOLOGY-LED ECONOMIC DEVELOPMENT

Despite the fact that federal laboratories generate only 2 percent of the US patents awarded to US entities, these labs play a significant role in fostering technology-led economic development. While the percentage of patents awarded is relatively small, it includes an annual total of approximately 1,400 patents in virtually every major technology field. Most of these technologies are available to industry through licensing agreements, enabling companies to develop cutting-edge new commercial products and services. Indeed, federal laboratories are mandated by Congressional legislation to engage in technology transfer in order to enhance the nation's economic competitiveness.

There are approximately 315 federal research laboratories in the United States, representing 11 US government agencies. California and the Eastern Seaboard are particularly well-endowed with federal labs. However, almost every state has at least one federal research laboratory. In addition to their cornucopia of inventions, these federal labs have unique equipment, facilities, and expertise that can be tapped into to foster economic development. Several different industry-friendly mechanisms exist to enable companies to access federal lab capabilities. These include cooperative R&D and test service agreements.

Besides offering industry access to their technical capabilities, US federal laboratories and agencies are a major source of R&D funding for US technology companies. The Small Business Innovation Research (SBIR) Program and its companion Small Business Technology Transfer (STTR) Program provide major funding, on a competitive basis, to small technology firms throughout the United States. Indeed, these two programs are *the primary source* of R&D funding for the nation's small technology companies. Together, they provide around $2 billion in R&D funding each year to small companies. (For further information, see http://www.sba.gov and http://www.zyn.com/sbir/.)

DEPARTMENT OF DEFENSE

The Department of Defense (DoD) is the largest federal R&D organization in the United States, measured both by its overall budget and by the numbers of scientists and engineers engaged. Its approximately 120 labs account for around 30 percent of the patents awarded to the US government, a total of 412 patents in 2008 covering all major technology fields. In addition, DoD is a significant partner with the private sector in developing new technology. Currently, DoD has nearly 3,000 active cooperative R&D agreements (CRADAs) with industry – far more than any other agency. DoD also has by far the largest SBIR and STTR Programs, accounting for approximately half of all federal funding in these programs, or somewhat over $1 billion per year, which it awards to small businesses to explore and develop new technology.

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TECHLINK'S ORIGINS IN FEDERAL TECHNOLOGY TRANSFER

TechLink was established in Bozeman, Montana, in 1996 through an appropriation to the NASA budget sponsored by the Montana Congressional delegation. It was founded on an unusual premise: that a center helping companies to develop partnerships with NASA could foster technology-led economic development in Montana and the surrounding states. Its mission was to help companies gain access to cutting-edge technologies, facilities, and expertise in the nation's 10 NASA centers.

TechLink's original focus was on the traditional resource-extraction industries in the region, particularly agriculture, forestry, and mining. All of these industries had been suffering economically from global competition, depressed commodity prices, and – some claimed – unfavorable government policies and regulations. The hope was that these languishing industries could be reinvigorated with new technologies from NASA and collaboration with NASA scientists and engineers.

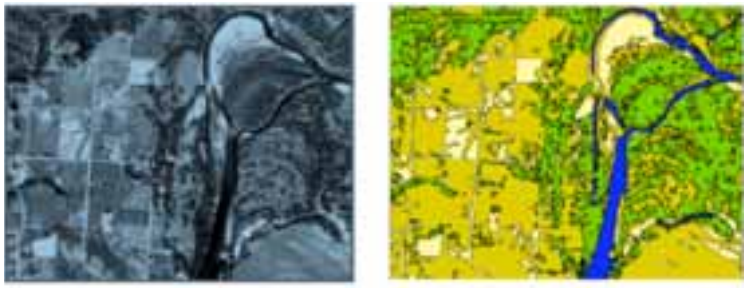
TechLink discovered during its first two years that traditional resource-extraction industries were not the best candidates for NASA-related technology transfer. One reason was the constrained financial resources and general conservatism of these industries, which made them reluctant to adopt new technology. Another reason was the nature of most NASA technology. Because of the agency's highly specialized R&D focus, this technology typically does not have the price-sensitivity or potential market size to be highly attractive to industry.

On the other hand, TechLink discovered that many companies in the emerging high-tech sector in Montana and the region were developing new technologies of keen interest to NASA. As a result, TechLink was able to broker a substantial number of cooperative R&D partnerships between the 10 NASA centers and small companies in the northwestern United States. Under these agreements, the partnering NASA centers and companies jointly developed new technology. Over a six-year period, from 1996 to 2002, TechLink brokered approximately 80 partnerships. While the majority were cooperative R&D agreements, these partnerships also included SBIR and other funding awards, patent license agreements, and even new company start-ups involving technology developed or funded by NASA.

For example, in 1998, TechLink helped to broker a cooperative R&D agreement between Integrated Geoscience of Helena, Montana, and NASA's Jet Propulsion Laboratory. This agreement focused on development of algorithms to automatically detect and classify features in remotely sensed imagery, such as satellite images of the earth. The company's impressive performance under this agreement led in 1999 to a sizeable SBIR award from NASA and creation of a spin-out software development company, Visual Learning Systems (VLS), in Missoula, Montana.

TechLink continued to help VLS to partner with other NASA and federal labs and to receive additional SBIR funding. In 2001, the company launched its first commercial product, Feature Analyst®. This product greatly simplifies digital cartography by enabling automated identification and "extraction" of features, including roads, buildings, vegetation, and water bodies, from all types of geospatial imagery (*see* Figure 2). By 2004, VLS had developed business partnerships with the world's largest geographic information systems (GIS) and remote sensing software corporations to sell Feature Analyst® worldwide as a plug-in module to these corporations' software programs.

FIGURE 2



Feature Analyst® enables rapid automated land classifications (right) from remotely sensed images of the earth (left).

Source: Overwatch Geospatial Systems

As a result of its success, VLS was acquired by Overwatch Geospatial Systems in 2006 (now a division of defense and aerospace contractor, Textron Systems). Today, VLS is a flourishing software development company in Missoula, with over 20 employees. Feature Analyst® and related software modules, LIDAR Analyst® and Urban Analyst™, are the leading analytical tools in their field.

HELPING COMPANIES TO LICENSE DOD TECHNOLOGIES

In 1999, based on its success, TechLink received a Congressional appropriation to help broker technology transfer partnerships between DoD and companies in its region. This represented a major new growth opportunity. It also gradually transformed TechLink's activities and geographic focus.

With approximately 120 labs nationwide, DoD offered TechLink a greatly expanded field for developing partnerships with industry. In addition, it also offered a much broader and more diverse portfolio of technologies. DoD is developing cutting-edge technologies in all major technology fields in order to advance its worldwide defense capabilities. Technology fields range from advanced materials, aerospace, biomedicine, communications, construction technologies, electronics, and energy to environmental technology, lasers, optics, sensors, software, and weaponry. With an output of over 400 new patented inventions per year, DoD has accumulated thousands of technologies available to industry under licensing agreements.

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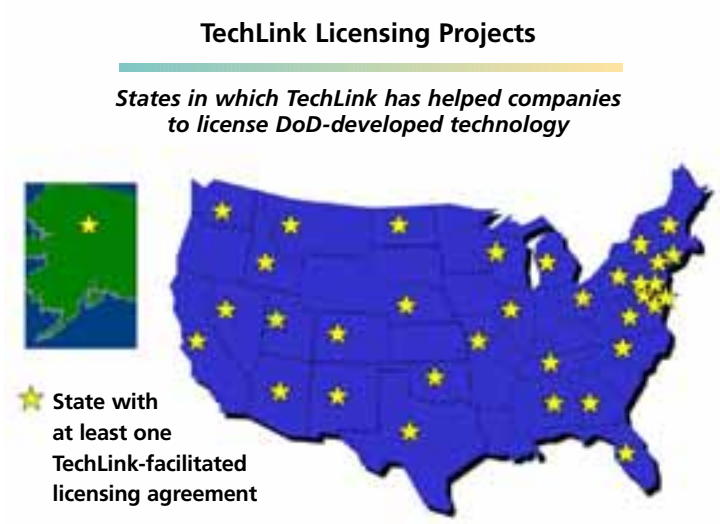
FIGURE 3 TechLink licensing projects by state



As a new DoD "partnership intermediary," TechLink initially concentrated on increasing cooperative R&D agreements between DoD labs and companies in the northwestern United States for joint development of new technology. However, DoD soon gave it a new mission: increasing the number of DoD licensing agreements with industry nationwide. Companies need licensing agreements to use DoD inventions (usually patented) for development and sale of new products and services.

TechLink's licensing mission reflected an agency need. DoD far outpaced other federal agencies in the number of cooperative R&D agreements with industry. For example, in FY 1999, DoD had a total of around 1,350 active cooperative R&D agreements. However, it brokered only 32 licensing agreements with industry that same year.

Responding to its new assignment, TechLink broadened its geographic focus for marketing and licensing of DoD technology to the United States as a whole. In addition, it developed a *five-step process* to support its licensing focus:

1) Screening *all* DoD-issued patents and published patent applications for technology transfer potential. Criteria used included the following: technology development level, innovativeness of the technology, strength of the patent claims, and commercial viability.
2) Selecting a manageable portfolio of DoD technologies for active marketing to industry.
3) Engaging in highly focused marketing of the select technologies by conducting background research and directly contacting companies identified as promising licensing candidates.
4) Helping interested companies to evaluate the technologies for their intended applications, understand government licensing regulations, and prepare high-quality license applications and commercialization plans.
5) Remaining involved until the signing of the licensing agreement between the company and DoD lab to facilitate the flow of communications and to help resolve any problems that might arise.

TechLink's shift to a licensing focus resulted in a gradual increase in the number of new DoD licensing agreements. The number of TechLink-facilitated licensing agreements grew from 1 in FY 2000 to 32 in FY 2009. Concurrently, the overall number of DoD licensing agreements each year essentially doubled – increasing from 32 in FY 1999 to an average of 58 per year during the FY 2007-2008 period. By FY 2007, TechLink was brokering or facilitating slightly over half of all DoD licensing agreements with industry.

As of September 2009, TechLink had successfully brokered or facilitated over 200 licensing agreements between DoD labs and industry. These licensing agreements involved companies in 35 different states and the District of Columbia (*see* Figure 3). Figure 4 provides representative examples of TechLink-facilitated licensing agreements. They include:

- A Navy-developed biosensor that can rapidly detect food-borne pathogens, being commercialized by a Pennsylvania company to increase the safety of fresh produce;
- A human liver cell line developed by the Army's Walter Reed Institute of Research, which was licensed by a Maryland company to support development of a malaria vaccine;
- A safer welding cart developed by the Air Force, licensed by a Montana company, which is manufacturing and selling an improved version of this cart; and
- A miniature sensor developed by the Navy that enables affordable, real-time monitoring of water quality, licensed by a California company.

FIGURE 4

Examples of TechLink Licensing Projects

Pathogen sensor for food safety

License from Naval Research Lab to company in Carlisle, Pennsylvania.

Human liver cell line for malaria vaccine research

License from Army Walter Reed Institute of Research to company in Rockville, Maryland.

Safer welding cart

License from Air Force to company in Lewistown, Montana.

Low-cost water quality monitor

License from Navy to company in San Ramon, California.

Licensing technology from DoD or other federal labs provides companies with a number of distinct advantages. First, US government labs often have world-class scientists, engineers, and facilities that produce truly cutting-edge technologies in many fields. Second, these technologies often are at a later stage of development than innovations emerging from universities. Frequently, there is a working prototype. Third, licensing represents a fairly rapid way to acquire new technology around which to develop a new product or service. It is usually much faster to license than to develop new technology – even assuming that the company has the requisite R&D capabilities. Fourth, licensing the technology as opposed to developing it reduces the company's risk. This is because a relatively small percentage of R&D projects actually result in patented inventions. Finally, it is usually much less expensive for a company to license technology than to develop it in-house. This is particularly true when licensing from federal labs. US government labs typically are willing to license technology on favorable terms. Terms usually involve reasonable upfront payments and modest royalties on sales of products or services embodying the technology.

ESTABLISHING COOPERATIVE R&D AGREEMENTS

In addition to brokering licensing agreements, TechLink helps establish cooperative R&D agreements (CRADAs) between DoD labs and companies for developing innovations having both commercial and military applications. A major advantage of a CRADA is that it enables a company to leverage a federal lab's expertise and resources in developing a specific technology. This reduces the company's R&D costs and possibly provides access to unique capabilities. The benefits to the DoD lab are essentially the same. Under a CRADA, the collaborating parties can share information, personnel, materials, equipment, and facilities.

Federal labs are prevented by contracting regulations from providing funding directly to a company under a CRADA. However, CRADAs can establish good working relationships that lead to future contracting opportunities for the company. For CRADAs in which the majority of the benefit is going to the company, the company needs to cover the fair cost of the lab's personnel, materials, equipment, or facility use. However, in exchange, it gains access to often unique capabilities at a very reasonable rate.

In addition to providing a cost-effective way for a company to develop new technology, CRADAs have several other valuable applications. First, they enable companies to showcase their innovations and capabilities to DoD. For example, under a CRADA, a DoD lab can evaluate a company's innovation and provide suggestions for how to improve it to more fully meet DoD needs. Second, under a CRADA, a DoD lab can help a licensee of DoD technology to adapt the technology to the commercial marketplace. Third, CRADAs can enable companies to acquire valuable new intellectual property. Should any joint inventions occur under the CRADA, both parties own the technology. Moreover, DoD can grant the company an exclusive license for DoD's share of the invention in exchange for reasonable compensation. In the case of inventions made solely by the DoD lab under the CRADA, the company automatically receives a non-exclusive, irrevocable, paid-up license. In addition, it can request an exclusive license, which will be granted for reasonable terms. Inventions made exclusively by the company under the CRADA belong to the company.

The following example illustrates how the CRADA mechanism can assist small technology companies. In 2001, TechLink helped Trout Headwaters, Inc., of Livingston, Montana, to create a new spin-out company called THI Riverworks. This spin-out was created to develop and commercialize software to model ways to stabilize stream banks using natural vegetation – as opposed to lining these banks with stone or concrete blocks ("riprap") to protect against erosion. Subsequently, in 2003, TechLink helped to broker two CRADAs between THI Riverworks and the Army Corps of Engineers. The first of these was a CRADA with the Corps' Waterways Experiment Station for modeling of stream bank biostabilization techniques; the second was with the Corps' Environmental Laboratory for integration of data and software into a decision support system for stream bank stabilization.

These joint R&D projects led to the development of a new, patented hand-held device for stream assessment and monitoring called RRAS, for "RiverWorks Rapid Assessment System" (*see* Figure 5). Launched as a prod-

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FIGURE 5

Stream assessment device developed under CRADAs between a Montana company and the Army Corps of Engineers.

Source: THI Riverworks

An advanced wheelchair brake is being developed by a San Antonio, Texas, company and Army researchers under a cooperative R&D agreement brokered by TechLink

Together, TechLink's SBIR outreach programs have directly assisted companies in winning approximately 239 SBIR and related awards totaling around $123 million. This funding has been highly significant to technology-led economic development in the region. Outside of coastal California and the Puget Sound area, SBIR and STTR funding serves as the primary source of funding for technology companies. It is an essential substitute for scarce venture capital.

uct in 2005, RRAS is a complete hardware and software system with a Bluetooth®-enabled wireless GPS receiver and digital imaging capabilities. RRAS is being used for stream and wetland restoration, fisheries enhancement, watershed conservation, environmental assessments, mining reclamation, and ecological inventories. It helps resource managers to effectively address fundamental issues such as erosion, pollution, irrigation water use, water quality, flood prevention, and endangered species preservation.

To promote visibility of this new product within the Army Corps of Engineers, TechLink helped establish a third CRADA between THI Riverworks and the Corps' Environmental Lab for field evaluation of RRAS in December 2005. RRAS is now being sold internationally and is in wide use by the US government. In addition to helping develop this successful commercial project, the CRADAs enabled THI Riverworks to establish a number of lasting, high-value relationships with the Corps of Engineers, which have helped build business success in other key ways.

SBIR ASSISTANCE

In addition to brokering licensing and CRADA agreements, TechLink provides SBIR and STTR assistance to companies throughout the western United States. It currently has two distinctly different programs. With DoD funding, TechLink helps companies in 12 western states, including Montana, to compete effectively in DoD SBIR programs and to secure follow-on Phase III contracts. In addition, within Montana only, TechLink helps companies to develop successful proposals for the 10 other federal agencies having SBIR or STTR programs.

Assistance in both TechLink programs includes:

(1) Promoting the funding opportunity to appropriate technology companies and educating them about this opportunity;

(2) Searching SBIR/STTR solicitations as soon as they appear to find topics of relevance to specific client companies – in effect, serving as an "early warning system" so that the companies will have maximum time to respond;

(3) Counseling companies on how to conduct essential background research and prepare high-quality proposals;

(4) Providing commercialization planning assistance;

(5) Helping companies to link up with university researchers, where outside expertise is needed;

(6) Providing professional graphic art assistance;

(7) Providing small grants as incentives for companies to prepare proposal drafts well ahead of the deadline; and

(8) Providing proposal reviews by seasoned experts.

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ECONOMIC IMPACTS

TechLink's technology-transfer activities for DoD have helped to generate sizeable technology-led economic development. An economic impacts survey completed in summer 2009 determined that sales of products or services (including R&D services) resulting from TechLink license agreements, CRADAs, and SBIR/STTR contracts already exceed $240 million (see Table 1). This figure will grow rapidly. It invariably takes several years to convert a raw technology into a product, then several more years to successfully launch the product

and ramp up the sales figures. The majority of the products and services resulting from TechLink-facilitated agreements are still relatively new. In addition, there is a sizeable pipeline of new products and services, still under development, that will be launched in the next few years.

The 2009 survey also discovered that TechLink's technology-transfer activities have resulted in the creation or retention of at least 1,250 jobs in the United States (Table 1). These figures do not include any economic multipliers. When standard economic multipliers are taken into consideration – both *indirect effects*, such as inter-industry purchases, and *induced effects*, such as purchases by the labor force – the national economic output attributable to TechLink activities is approximately $729 million, with approximately 4,290 jobs created or retained.

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In sum, TechLink fosters technology-led economic development by helping companies to access the diverse technology, unique technical capabilities, and sizeable research-and-development funding in the DoD system. This involves identifying technology-transfer opportunities, linking together prospective partners, facilitating communications between the parties, helping solve problems that arise, and serving as a mediator throughout the entire technology-transfer process.

TABLE 1. Nationwide economic contribution attributable to TechLink (millions of 2009 dollars)

	Direct	Indirect	Induced	Total
Output	240	192	298	729
Employment (jobs)	1,258	1,041	1,991	4,290
Employee Compensation	92	54	82	228
Proprietary Income	16	9	12	38
Total Labor Income	108	63	94	266

Source: Bureau of Business and Economic Research, University of Montana
Note: Totals may not add due to rounding of figures