Federal Laboratory Technology Transfer

Fiscal Year 2010

Summary Report to the President and the Congress

Prepared by:
National Institute of
Standards and Technology
U.S. Department of Commerce

August 2012

NIST

Federal Laboratory Technology Transfer

Fiscal Year 2010

Summary Report to the President and the Congress

Prepared by:
National Institute of
Standards and Technology
U.S. Department of Commerce

August 2012

Dan Shechtman, professor at the Technion Israel Institute of Technology, was on a two-year sabbatical and worked as a guest researcher at NIST from 1981 to 1983 when he discovered the quasicrystal—an arrangement of atoms thought to be forbidden by nature. In recognition of this discovery, Professor Shechtman was awarded the 2011 Nobel Prize for Chemistry. A graphic of an electron diffraction pattern from a quasicrystal is incorporated into the design of this cover.

FOREWORD

The Department of Commerce is pleased to submit the FY 2010 Federal Interagency Technology Transfer Summary Report to the President and the Congress. This report captures the continuing efforts of Federal laboratories to ensure that the Nation's investment in innovative research is transferred from our laboratories to the American people.

In the past year, the President issued the Presidential Memorandum entitled "Accelerating Technology Transfer and Commercialization of Federal Research in Support of High-Growth Business." This Presidential Memorandum reiterated the importance of innovation to accelerate the development of new industries, products and services that lead to job creation. This report will help serve as a baseline to measure our continued progress toward achieving the ambitious challenge issued to the Federal agencies to significantly increase technology transfer over the next five years, while achieving excellence in performing our mission-focused research.

With the Administration's focus on job creation and restoring rapid economic growth, comes an appreciation of the importance of invention and technological innovation as drivers of these goals. Federal laboratories, through their mission-oriented research and development, have historically been in the forefront of producing scientific discoveries, technological innovation and inventions. Over the years, many of these have found their way into commercial markets as the basis for new products, services and the formation of new companies, through the technology transfer initiatives of these laboratories.

This report fulfills the requirement of United States Code Title 15, Section 3710(g)(2) for an annual report summarizing the use of technology transfer authorities by Federal agencies. It highlights the achievements of Federal technology transfer and includes data on the use of specific technology transfer authorities. We will use future editions of this report to continue to keep the President and Congress informed of the on-going efforts of Federal laboratories to expand our technology transfer efforts in partnership with U.S. industry, academic institutions, non-profit foundations, and state, local and tribal governments. These efforts will continue to play a vital role in the Nation's economic strength.

Patrick D. Gallagher
Under Secretary of Commerce for Standards and Technology

This page intentionally left blank

TABLE OF CONTENTS

LIST OF TABLES

This page intentionally left blank

CHAPTER 1

Overview of Federal Technology Transfer

Federal laboratories continuously partner with many non-federal organizations in industry, academia, the non-profit sector, as well as state, local and tribal governments. Through these partnerships, Federal agencies are better able to transform the results of their research into economic and social value. Agencies utilize a variety of authorities and agreements to evaluate, protect, transfer, and monitor the utilization and commercialization of technologies developed, in whole or in part, by Federal laboratories. While focusing on important national interests, Federal laboratories continue to develop many new technologies, products, and applications that solve some of our greatest challenges. By making these discoveries accessible to private, academic and other government entities, Federal research and development (R&D) provides expertise and resources resulting in viable products that give the United States a competitive edge in today's global market and improve the quality of life for all Americans.

This report summarizes information from individual reports prepared by each Federal agency conducting R&D within its laboratories. The Department of Commerce's (DOC) National Institute of Standards and Technology (NIST) prepared and organized this report. An electronic version of this report is available at: http://www.nist.gov/tpo/publications/index.cfm.

Scope

This report summarizes the technology transfer achievements of the eleven Federal agencies that have significant Federal laboratory operations:

Department of Homeland Security (DHS)

Department of Commerce (DOC)

Department of Defense (DoD)

Department of Energy (DOE)

Department of the Interior (DOI)

Department of Transportation (DOT)

Environmental Protection Agency (EPA)

Department of Health and Human Services (HHS)

National Aeronautics and Space Administration (NASA)

Department of Agriculture (USDA)

Department of Veterans Affairs (VA)

All of these agencies have established programs for transferring the technology and intellectual property arising from their laboratory R&D endeavors.

Technology Transfer Principles and Approach

Promoting U.S. economic growth and creating jobs through the transfer and commercialization of Federally-developed technologies is a high priority for Federal laboratories and their technology transfer offices. Collaboration between Federal laboratories and non-federal organizations allows greater access to research outcomes and plays an important role in the efficient and timely development of innovative technologies and new products. Efficient technology transfer activities ensure that tax payer investments in cutting edge and fundamental research and development significantly benefit the domestic economy through the transfer of rights to develop, refine, use and market new technologies for the benefit of the public. Since Federal research activities are often driven by a Federal agency's mission, many economically viable advancements might be overlooked, or otherwise go unused, without dedicated efforts by Federal technology transfer offices to promote the dissemination and utilization of the results. Effective technology transfer promotes real economic growth through the development of new products, medical treatments, services, and other innovations that reach the market, and through the creation of jobs resulting from the further development, manufacture and marketing of these new goods and services. In addition to strengthening domestic and regional economies, successful partnerships with non-Federal entities provide additional benefits including:

- Stimulating the flow of ideas between government and other research sectors
- Creating new small businesses
- Attracting and retaining talented scientific personnel within Federal laboratories
- Providing support to the mission of each agency
- Accelerating the development and reducing the costs of products and services to reach the marketplace
- Supporting further research by generating licensing revenue
- Rewarding innovative accomplishments of Federal inventors through royalty sharing
- Creating a wide variety of new and efficient products in health care, defense, domestic security and many other sectors of the economy

Federal technology transfer offices typically rely on the following principal mechanisms to facilitate the transfer of federally developed technologies.

Cooperative Research and Development

Relationships for cooperative research and development between Federal laboratories and non-federal collaborators are widely viewed as an effective and economical means of technology transfer and joint research. These efforts confer a mutually advantageous leveraging of Federal agency and collaborator resources and technical capabilities, and provide avenues for both partners to gain new competencies and develop new skills.

One frequently used mechanism for establishing these joint relationships is the Cooperative Research and Development Agreement (CRADA). CRADAs are agreements between Federal laboratories and one or more collaborators to work together on a R&D project with a defined scope of work. CRADAs allow Federal laboratories to participate in R&D partnerships for purposes that include developing and advancing promising new technologies toward commercialization. Many agencies have other specific authorities which also facilitate cooperative R&D.

Intellectual Property Management

Invention Disclosure and Patenting

The protection of intellectual property can be vital to attracting the additional investment and product development resources necessary for early stage research products to be brought to their full commercial potential. Federal laboratory achievements in the areas of invention disclosures, general publications and patents obtained are often cited as metrics of the active management of intellectual assets and technical know-how by Federal agencies.

Licensing

Licensing is one of the primary mechanisms to create incentives for industry to further develop and commercialize leading-edge technologies. Successful development and commercialization benefits the economy generally and contributes to competitiveness and economic growth. Without the ability to grant licenses to develop and commercialize government-owned technologies and inventions, many innovations would languish within laboratories and would not be further developed into products or services. The terms and conditions under which Federal intellectual property is licensed vary, reflecting on many factors including the state of readiness for the market place, the financial resources needed to further develop the technology for consumer use, fields of use, projected market impact and other factors.

Other Commercialization Mechanisms

Other than licensing, there is a wide variety of technology transfer methods used by Federal agencies. Different mechanisms are used when licensing may not be necessary to efficiently or effectively transfer the technology. Some of the mechanisms used by Federal laboratories are tailored to support the specific focus, needs and mission of a particular Federal laboratory or a particular technology. Some of these other technology transfer mechanisms include:

- Presentations at conferences, workshops, and inquiries
- Utilization of guest researchers and facilities users
- Outreach to trade and technical media
- Technical publications and other reports
- Development of Standard Reference Materials
- Development of Standard Reference Data
- Development of documentary standards
- Material transfer licenses
- Calibration services
- Collaborative research agreements (e.g., Memoranda of Understanding (MOU), Clinical Trial Agreements)

Technology Transfer Metrics and Data

In order to enhance the ability of researchers to understand and analyze the impact of Federal research and technology transfer activities, NIST has assembled and made available in a single location, a core dataset that includes data from previous editions of this report. The dataset

draws on information from a decade of reports and presents data that have been consistently collected over a long time series, e.g., CRADA data from 1987-2009 and Federal R&D obligation data from 1982-2009.

The dataset also includes data on obligated funds for research at Federal laboratories and federally funded research and development centers. These data are drawn from various National Science Foundation (NSF) surveys and contain information at the department and agency level. The dataset also contains R&D deflators and the gross domestic product (GDP) deflator that can be used to control for the changing purchasing power of R&D expenditures.

This information is available at: http://www.nist.gov/tpo/publications/index.cfm under the heading/subheading: "Federal Laboratory (Interagency) Technology Transfer Summary Reports/ Federal Technology Transfer Data 1987 - 2009, October 2011."

CHAPTER 2

Performance in Fiscal Year 2010

Strengthening Performance Metrics

To improve and develop better measures of the effectiveness of Federal technology transfer, the Federal Interagency Working Group for Technology Transfer (IAWGTT) meets regularly and is composed of agency representatives and technology transfer experts from across the Federal government. The IAWGTT serves as a coordination point for Federal technology transfer policy and helps to identify and discuss best practices, emerging concerns and trends through dialogue, interagency comparisons and sharing experience. Through the IAWGTT, Federal agencies jointly discuss and review new and better means to improve both quantitative and qualitative measurements of technology transfer activities and means to improve dissemination of federally developed technologies.

The 2009 edition of this report included a discussion of a study conducted by the Government Accountability Office (GAO) of the effectiveness of technology transfer at DOE laboratories. The GAO report noted that technology transfer was not consistently defined and has proved difficult to measure. While the GAO report did not make specific recommendations for improved metrics, it led to a re-examination of metrics within DOE, and has been considered in on-going work to develop improved metrics for technology transfer from Federal laboratories.

The Institute for Defense Analysis Science and Technology Policy Institute (STPI) released a study entitled "Technology Transfer Commercialization Landscape of the Federal Laboratories" in June of 2011 (available at https://www.ida.org/upload/stpi/pdfs/p-4728nsfinal508compliantfedlabttcreport.pdf). This study began in 2010 and was funded by the Department of Commerce, Economic Development Administration, in conjunction with the National Institute of Standards and Technology. STPI performed an extensive literature review and interviewed representatives from 13 agencies, 26 laboratories, and 33 related organizations to develop an understanding of commercialization from Federal laboratories and serve as a baseline for future actions. The reported noted the substantial activity and a variety of innovative approaches taken by Federal laboratories to accomplish the technology transfer mission.

This study noted nine factors that led to technology transfer. These factors, outlined by STPI, are:

1. **Laboratory mission**. Technology transfer varies across laboratories due to the diversity and scope of their missions. Some laboratories are more inclined towards technology transfer that leads to commercialization because it is in the interest of achieving the mission of the laboratory, agency, or subagency.
2. **Laboratory management.** Differences between Government-Owned, Government-Operated (GOGO) and Government-Owned, Contractor-Operated (GOCO) laboratories can affect technology transfer and commercialization activities. GOCO laboratory leadership is often explicitly tasked to perform technology transfer and commercialization, while GOGO laboratories must comply with certain government regulations that do not affect GOCOs.

3. **Congressional support and oversight**. Despite congressional support for technology transfer at the federal laboratories, congressional action and oversight can have the unintended consequence of encouraging a risk-averse culture towards technology transfer. Furthermore, technology transfer activities can be undermined when congressional priorities shift, as technology transfer requires long-term support.

4. **Agency leadership and laboratory director support**. Support from agency leadership and laboratory directors can have a marked effect on technology transfer and commercialization activities. For example, laboratory directors who support technology transfer may provide resources, flexibility, and creative license to their ORTAs. Those ORTAs who are not supported by their laboratory leadership can be severely constrained.

5. **Organization and coordination of technology transfer and commercialization activities**. The centralization/decentralization of technology transfer functions at the agency and laboratory levels affects the speed of implementation of technology transfer actions, the consistency of policies across laboratories within an agency, and the ability to share best practices. The location of ORTAs within an agency and laboratory can affect the visibility of technology transfer.

6. **Offices of Research and Technology Applications**. Operations that seem to affect technology transfer and commercialization include the responsibilities of the office; the science, technology, and business expertise of the staff; the processes of the office; and the legal authorities available to the laboratory and how ORTA staff interpreted them.

7. **Researchers**. Laboratory researchers, whose participation in technology transfer and commercialization processes varies across laboratories, may lack the knowledge, ability, and incentives necessary to undertake the research, administration, and business development involved in successful technology transfer.

8. **Government-industry interactions**. Federal laboratories are not visible and accessible to industry, and certain regulations make it difficult for federal laboratories and industry to interact. According to partnership intermediaries, groups designed to broker partnerships between the laboratories and industry, industry is largely unaware of opportunities to collaborate with the federal laboratories.

9. **Resources**. Resources devoted to technology transfer and commercialization vary across laboratories and agencies. Further, the extent to which the agencies and laboratories leverage federal, state, and local programs that support technology-based economic development may also affect technology transfer and commercialization.

With regard to metrics, the STPI report also noted the difficult task of devising a single set of metrics than spans the broad missions across agencies and laboratories. STPI proposed "the inclusion of process or activity metrics that can describe technology transfer within the diverse missions." STPI also specifically noted that the metrics contained within earlier editions of this report supported the needs of all users who might require indices that reflect the performance and impact Federal technology transfer activities. However, they also recognized the burden and expense of gathering additional information that still may not accurately reflect the impact of technology transfer across widely varying missions and programs of the various Federal agencies conducting mission-oriented scientific research and engineering.

The White House Interagency Working Group on Innovation and Entrepreneurship has been examining the issue of technology transfer in 2009 and 2010. Much of the earlier efforts were focused on university technology transfer and Small Business Innovation Research Program. In 2010, the efforts were more directly focused on technology transfer from Federal laboratories including coordination with the IAWGTT. This effort led to the release of a Presidential Memorandum issued in October 2011 entitled "Accelerating Technology Transfer and commercialization of Federal Research in Support of High-Growth Business" (see http://www.whitehouse.gov/the-press-office/2011/10/28/presidential-memorandum-accelerating-technology-transfer-and-commerciali).

The Presidential Memorandum notes the role of Federal laboratories in fueling the creation of new industries and U.S. global competitiveness. The stated aim of this memorandum is "to increase the successful outcomes of these activities significantly over the next 5 years, while simultaneously achieving excellence in our basic and mission focused research activities."

The President further directed "the following actions be taken to establish goals and measure performance, streamline administrative processes, and facilitate local and regional partnerships in order to accelerate technology transfer and support private sector commercialization."

1. Establish Goals and Measure Progress
    - Each agency is tasked to develop 5-year plans and measures to increase the pace of technology transfer within 180 days
    - The IAWGTT is tasked to recommend opportunities for improving technology transfer from Federal laboratories
    - The Secretary of Commerce is directed to improve and expand, where appropriate, the metrics in future editions of this report
    - All agencies with Federal laboratories are encouraged to include technology transfer in laboratory evaluations.
2. Streamline the Federal Government's Technology Transfer and Commercialization Process
    - Review licensing and CRADA procedures to reduce time required
    - Improve access to information on government technologies and licenses in a public database and develop strategies to increase the usefulness of this information
    - Streamline SBIR processes
3. Facilitate Commercialization through Local and Regional Partnerships
    - Have federal laboratories participate in regional technology innovation clusters
    - Use existing authorities to locate business support programs on or near federal laboratories
    - Strengthen collaboration between the laboratories and their local region

The actions to implement this Presidential Memorandum will be reported in future editions of this report.

Current Performance and Metrics

Each Federal agency performing research and development is required to prepare and submit an annual report of its technology transfer activities as described in 15 USC 3710(f). These reports include details on each agency's technology transfer program and plans to use technology transfer to advance the agency's mission and to promote U.S. competitiveness. In addition, specific data is required to measure the level of basic technology transfer, including:

- Number of patents filed
- Number of patents granted
- Number of licenses and details regarding the license
- Earned royalty income and other royalty statistical information
- Disposition of royalty income
- Number of licenses terminated for cause
- Discussion of other relevant parameters unique to the agency

The tables and charts included present a brief cross-agency summary of the utilization of the above technology transfer tools. Although the standard metrics required by statute continue to demonstrate robust use of these tools, they only address part of the full picture. It remains far easier to assemble statistics on technology transfer activities than to quantify actual downstream benefits and the effectiveness of the transfers because of the many variables and factors involved in commercializing nascent technologies. For example, knowledge gained from initial research may not make an immediate impact on the public, but may open new avenues for discoveries that lead to future products, medical treatments, and services. Technology distribution and use has evolved new mechanisms and Federal laboratories have embraced these approaches along with the more standard business model. Accelerating innovation requires multiple strategies and new metrics to evaluate progress. For example, open innovation demonstrates the value and potential for intellectual property outside the patent/license model. Open source software from Federal research has been proven to have a significant impact on US business without a measurable income stream to the laboratory and is not evident in the statistics presented here. Likewise, fellowships, post-doctoral appointments, and other on-going mechanisms for improving our research by training new scientists also result in knowledge and expertise moving from laboratories to businesses as well as universities.

Anecdotal evidence and success stories demonstrate the broad range of successful outcomes of technology transfer such as life-saving treatments, increased security or awareness about dangers and hazards, and new business start-ups. Chapter 3 of this report highlights a small sampling of the numerous positive impacts and outcomes of Federal technology transfer activities.

The following tables summarize the technology transfer activities compiled from each agency's report for a five year period from fiscal year 2006 through fiscal year 2010. The total figures from the eleven agencies indicate that licenses, income bearing licenses, income from licenses, and earned royalty income generally trended upward over this period. However, invention disclosures, patent applications filed, and patents issued remained steady over the same period. The number of active CRADAs declined slightly in fiscal year 2008 but rebounded to new heights in 2009. Overall, these total figures and trends from the technology transfer activities of the Federal government represent a steady, mature program, as shown by the

consistently high and relatively stable volume of CRADAs, licensing, patenting, and earned royalty income activities.

In Table 1, "Traditional CRADAs" refer to collaborative research and development by a Federal laboratory and non-Federal partners. "Non-traditional CRADAs" are used with non-Federal collaborators for special purposes such as material transfers, specialized equipment calibrations or other technical assistance which may produce information which needs to be protected from disclosure. In table 3, "other IP licenses" include licenses for copyrighted software (not including open source software licenses, which are also copyrighted software), open channel-web and noncommercial software, biological materials, and other forms of intellectual property.

Table 1: Collaborative Relationships for Research and Development

		FY 2006	FY 2007	FY 2008	FY 2009	FY 2010
DHS	• **CRADAs**, total active in the FY	-	-	23	23	36
	- New, executed in the FY	-	-	8	6	14
	• Traditional CRADAs, total active in the FY	-	-	21	22	32
	• Non-traditional CRADAs, total active in FY	-	-	2	1	4
	• Other collaborative R&D relationships	-	-	3	5	3
DOC	• **CRADAs**, total active in the FY	3,008	2,778	2,390	2,386	2,399
	- New, executed in the FY	2,158	1,865	1,583	1,501	1,408
	• Traditional CRADAs, total active in the FY	149	154	131	101	101
	• Non-traditional CRADAs, total active in FY	2,859	2,624	2,259	2,296	1,411
	• Other collaborative R&D relationships[1]	2,114	2,672*	2,816	2,828	2,897
DOD	• **CRADAs**, total active in the FY	2,999	2,971	2,596	2,870	3,248
	- New, executed in the FY	705	641	745	659	720
	• Traditional CRADAs, total active in the FY	2,424	2,383	1,993	2,247	2,516
	• Non-traditional CRADAs, total active in FY	575	588	603	622	732
	• Other collaborative R&D relationships	0	0	3	1	287
DOE	• **CRADAs**, total active in the FY	631	697	711	744	697
	- New, executed in the FY	168	182	178	176	176
	• Traditional CRADAs, total active in the FY	631	697	711	744	697
	• Non-traditional CRADAs, total active in FY	n/r	n/r	n/r	n/r	n/r
	• Other collaborative R&D relationships	0	0	0	0	0
DOI	• **CRADAs**, total active in the FY	82	170	170	248	436
	- New, executed in the FY	38	112	98	74	82
	• Traditional CRADAs, total active in the FY	31	20	33	36	29
	• Non-traditional CRADAs, total active in FY	51	150	137	212	407
	• Other collaborative R&D relationships	0	0	0	0	0
DOT	• **CRADAs**, total active in the FY	59	36	23	22	22
	- New, executed in the FY	6	7	6	7	0
	• Traditional CRADAs, total active in the FY	59	36	23	0	0
	• Non-traditional CRADAs, total active in FY	0	0	0	0	0
	• Other collaborative R&D relationships	0	0	0	2	2
EPA	• **CRADAs**, total active in the FY	94	84	112	112	67
	- New, executed in the FY	16	18	49	83	33
	• Traditional CRADAs, total active in the FY	83	67	74	51	50
	• Non-traditional CRADAs, total active in FY	11	17	38	61	17
	• Other collaborative R&D relationships	0	0	0	0	0

[1] Includes domestic and foreign guest researchers and other researchers working at NIST under CRADAs, Facility Use Agreements and Intergovernmental Personel Act (IPA) agreements

Table 1: Collaborative Relationships for Research and Development (continued)

		FY 2006	FY 2007	FY 2008	FY 2009	FY 2010
HHS	• **CRADAs**, total active in the FY	164	284	453	457	447
	- New, executed in the FY	66	68	83	105	83
	• Traditional CRADAs, total active in the FY	92	206	295	284	300
	• Non-traditional CRADAs, total active in FY	72	79	158	173	147
	• Other collaborative R&D relationships	0	0	0	0	0
NASA	• **CRADAs**, total active in the FY	1	1	1	1	1
	- New, executed in the FY	0	0	1	0	0
	• Traditional CRADAs, total active in the FY	1	1	1	1	1
	• Non-traditional CRADAs, total active in FY	0	0	0	0	0
	• Other collaborative R&D relationships**	4,275*	3,812*	4,076*	4,507*	4,246*
USDA	• **CRADAs**, total active in the FY#	195	230	252	259❖	287
	• - New, executed in the FY	57	69	76	85❖	99
	• Traditional CRADAs, total active in the FY	163	184	202	217❖	233
	• Non-traditional CRADAs, total active in FY	22	23	28	42	54
	• Other collaborative R&D relationships	3,477	4,084	5,466	9,960	11,214
VA	• **CRADAs**, total active in the FY	37*	82*	221*	623	895
	- New, executed in the FY	26*	52*	155*	438	491
	• Traditional CRADAs, total active in the FY	33	74*	207*	581	833
	• Non-traditional CRADAs, total active in FY	2	4	10	46	66
	• Other collaborative R&D relationships	0	0	0	0	18
TOTALS	• **CRADAs**, total active in the FY	7,268	7,326	6,923	7,759❖	8,525
	- New, executed in the FY	3,238	3,009	2,961	3,113❖	3,106
	• Traditional CRADAs, total active in the FY	3,666	3,819	3,664	4,245❖	4,768
	• Non-traditional CRADAs, total active in FY	3,592	3,485	3,235	3,499	3,749
	• Other collaborative R&D relationships	9,738	10,164	11,411	16,319	18,667

- DHS began compiling and reporting data in 2008.
n/r = Data not reported.
* Updated to reflect other R&D relationships that now include software use agreements that do not have an end date and are now being tracked and reported.
** Limited use of CRADA authority; NASA often employs Space Act Agreements instead.
# For 2009 and 2010, only Agricultural Research Service (ARS) data was reported for the purpose of this report. Totals do not include data from Animal and Plant Health Inspection Service (APHIS) or Forest Service (FS). Minor differences may be noted on USDA FY10 Technology Transfer Report (on-line).
❖ Reflects revisions from FY2009 Report.

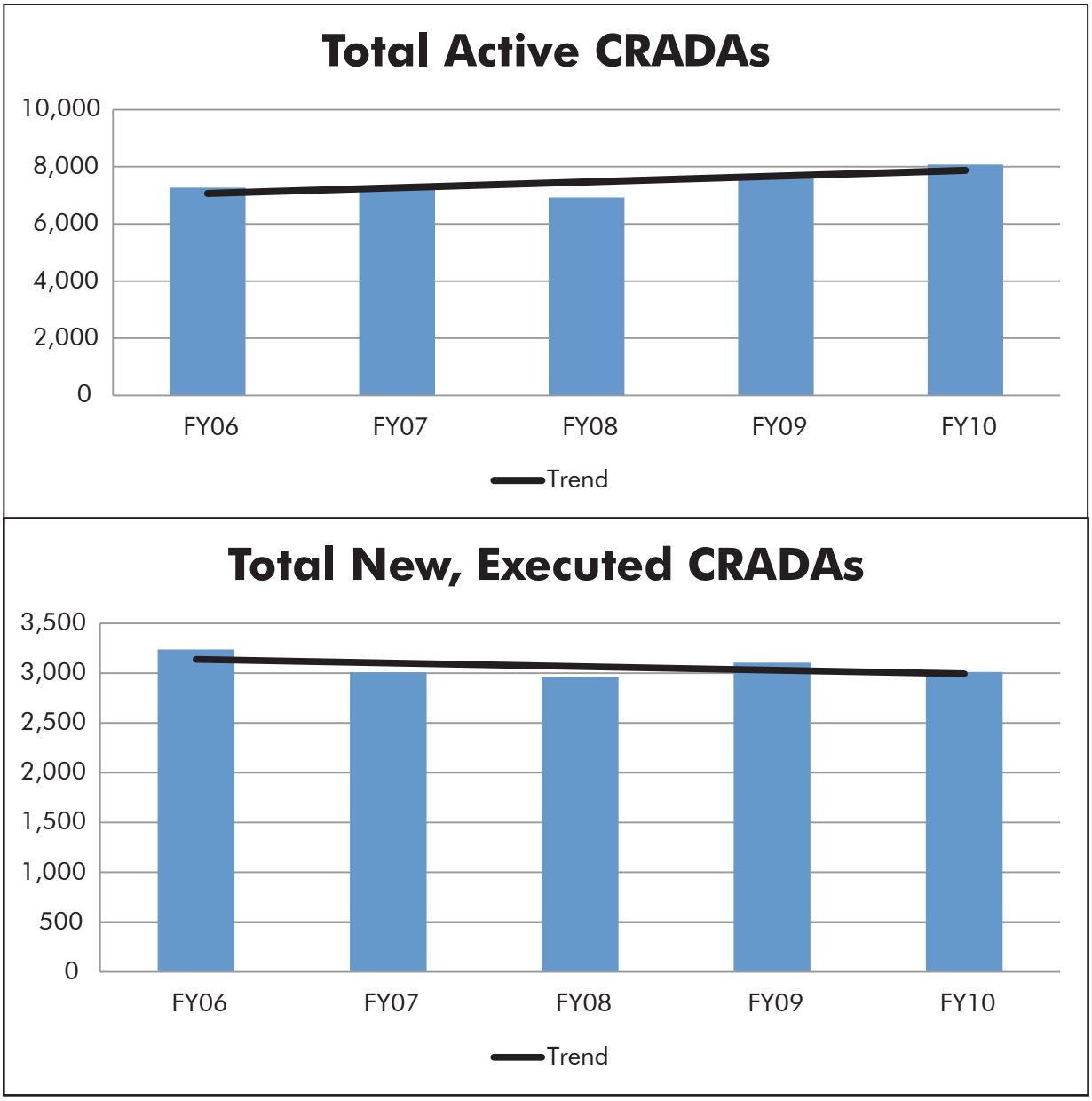

Total Active CRADAs
10,000
8,000
6,000
4,000
2,000
0
FY06
FY07
FY08
FY09
FY10
Trend
Total New, Executed CRADAs
3,500
3,000
2,500
2,000
1,500
1,000
500
0
FY06
FY07
FY08
FY09
FY10
Trend

Table 2: Invention Disclosure and Patenting

		FY 2006	FY 2007	FY 2008	FY 2009	FY 2010
DHS	• New inventions disclosed in the FY	-	-	10	32	7
	• Patent applications filed in the FY	-	-	0	2	2
	• Patents issued in the FY	-	-	1	2	1
DOC	• New inventions disclosed in the FY	14	32	40	41❖	34
	• Patent applications filed in the FY	5	8	21	20	19
	• Patents issued in the FY	7	3	2	7	11
DOD	• New inventions disclosed in the FY	1,056	838	1,018	831	698
	• Patent applications filed in the FY	691	597	590	690	436
	• Patents issued in the FY	472	425	462	404	304
DOE	• New inventions disclosed in the FY	1,694	1,575	1,460	1,439	1,616
	• Patent applications filed in the FY	726	693	904	919	965
	• Patents issued in the FY	438	441	370	520	480
DOI	• New inventions disclosed in the FY	5	7	7	4	5
	• Patent applications filed in the FY	2	5	7	8	7
	• Patents issued in the FY	5	6	1	4	5
DOT	• New inventions disclosed in the FY	3	2	3	3	1
	• Patent applications filed in the FY	3	2	0	1	1
	• Patents issued in the FY	0	3	2	1	1
EPA	• New inventions disclosed in the FY	12	16	9	8	5
	• Patent applications filed in the FY	13	15	6	3	3
	• Patents issued in the FY	10	10	4	9	9
HHS	• New inventions disclosed in the FY	442	447	437	389	363
	• Patent applications filed in the FY	166	261	164	156	113
	• Patents issued in the FY	164	379	278	397	153
NASA**	• New inventions disclosed in the FY	1,749	1,514	1,324	1,412	1,722
	• Patent applications filed in the FY	142	127	122	141	144
	• Patents issued in the FY	85	68	90	93	129
USDA	• New inventions disclosed in the FY	105	126	133	154❖	164
	• Patent applications filed in the FY	83	114	123	123❖	112
	• Patents issued in the FY	39	37	30	24❖	44

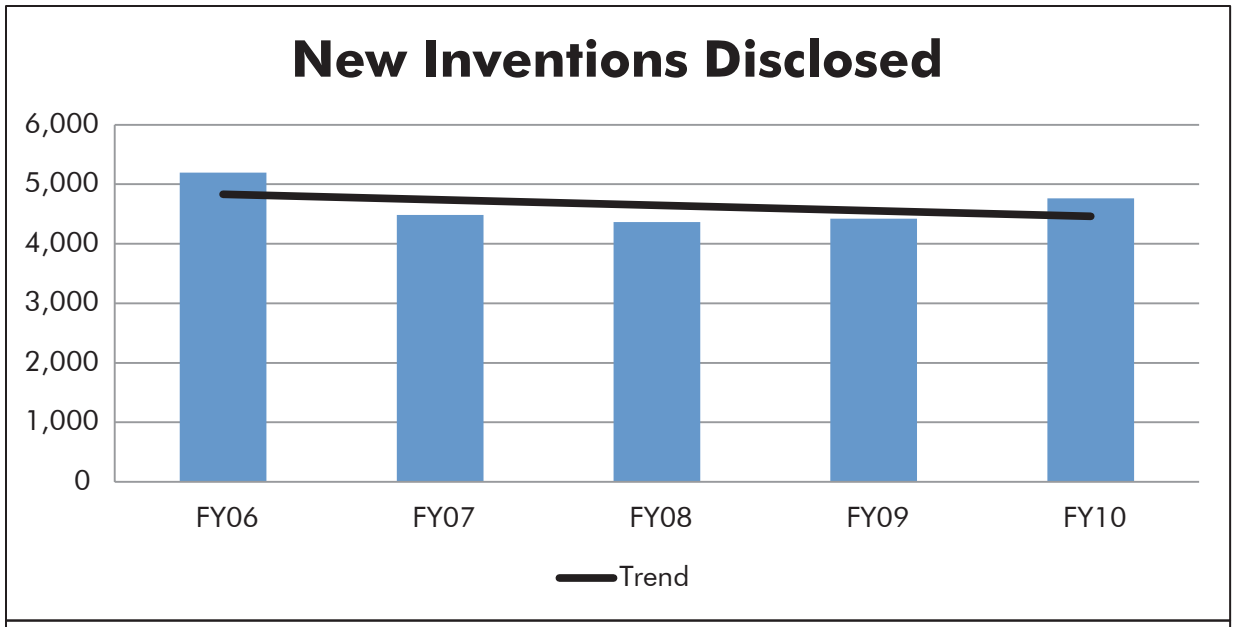
**** Reflects revisions from NASA prior year submissions*OIR**

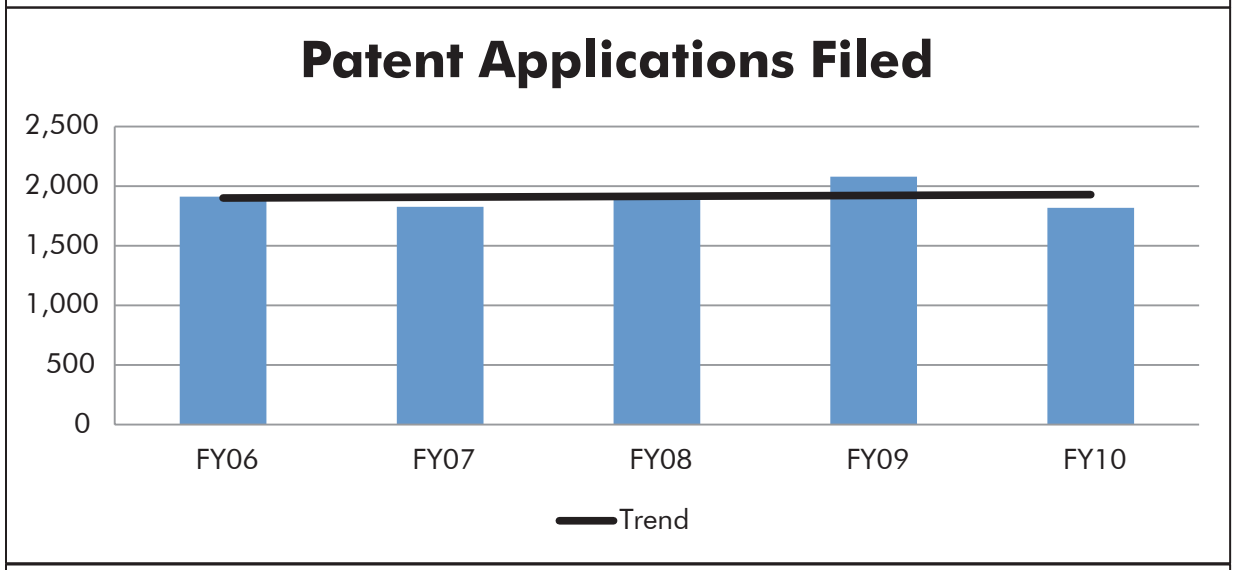
❖ Reflects revisions from FY2009 Report.

Table 2: Invention Disclosure and Patenting (continued)

		FY 2006	FY 2007	FY 2008	FY 2009	FY 2010
VA	• New inventions disclosed in the FY	157	175	164	150	168
	• Patent applications filed in the FY	27	25	13	37	31
	• Patents issued in the FY	5	8	10	15	10
TOTALS	• New inventions disclosed in the FY	5,193	4,486	4,365	4,423❖	4,783
	• Patent applications filed in the FY	1,912	1,825	1,938	2,086❖	1,830
	• Patents issued in the FY	1,284	1,405	1,272	1,497❖	1,143

- DHS began compiling and reporting data in 2008.
❖ Reflects revisions from FY2009 Report.


New Inventions Disclosed
6,000
5,000
4,000
3,000
2,000
1,000
0
FY06
FY07
FY08
FY09
FY10
Trend


Patent Applications Filed
2,500
2,000
1,500
1,000
500
0
FY06
FY07
FY08
FY09
FY10
Trend

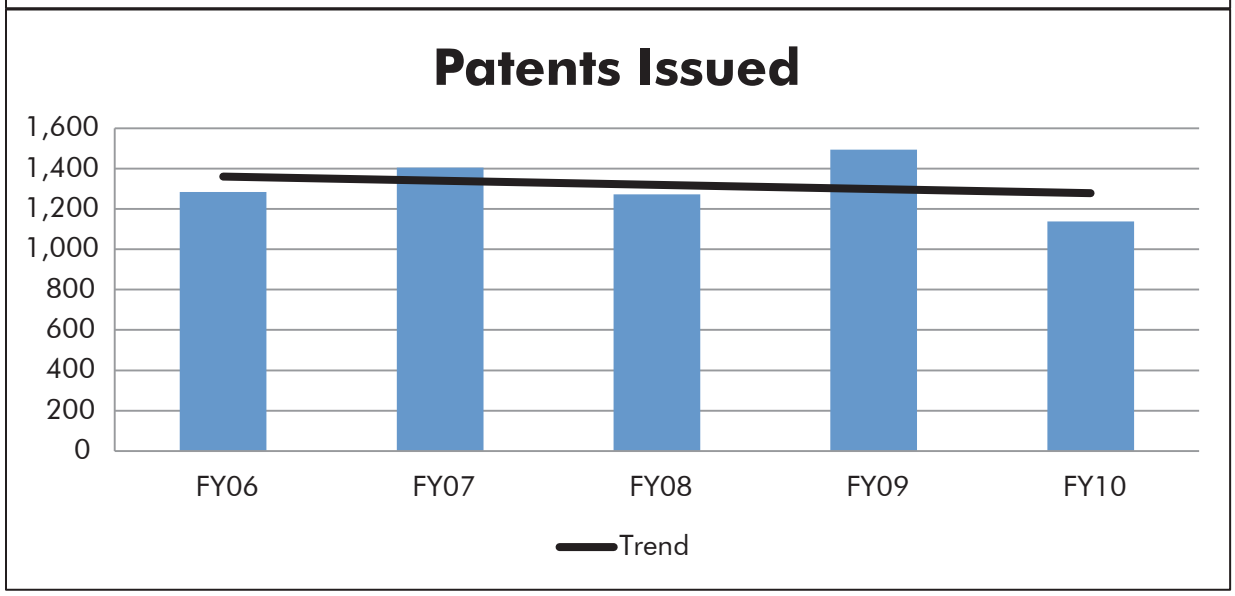

Patents Issued
1,600
1,400
1,200
1,000
800
600
400
200
0
FY06
FY07
FY08
FY09
FY10
Trend

Table 3: Profile of Active Licenses

		FY 2006	FY 2007	FY 2008	FY 2009	FY 2010
DHS	• **All licenses**, number total active in the FY	-	-	18	63	458
	- New, executed in the FY	-	-	0	45	458
	• **Invention licenses**, total active in the FY	-	-	0	0	0
	- New, executed in the FY	-	-	0	0	0
	• **Other IP licenses**, total active in the FY	-	-	18	63	63
DOC	• **All licenses**, number total active in the FY	111	222	29	40	41
	- New, executed in the FY	83	187	2	12	5
	• **Invention licenses**, total active in the FY	111	222	29§	40	41
	- New, executed in the FY	83	187	2	12	5
	• **Other IP licenses**, total active in the FY	0	0	0	0	0
DOD	• **All licenses**, number total active in the FY	444	495	365	432	397
	- New, executed in the FY	56	67	52	57	50
	• **Invention licenses**, total active in the FY	438	460	351	386	341
	- New, executed in the FY	56	67	52	57	50
	• **Other IP licenses**, total active in the FY	6	35	14	46	56
DOE	• **All licenses**, number total active in the FY	5,916	5,842	6,196	5,752	6,224
	- New, executed in the FY	652	606	685	455	357
	• **Invention licenses**, total active in the FY	1,420	1,354	1,418	1,452	1,453
	- New, executed in the FY	203	164	177	139	166
	• **Other IP licenses**, total active in the FY	4,496	4,488	4,748	4,300	4,771
DOI	• **All licenses**, number total active in the FY	21	15	19	21	28
	- New, executed in the FY	1	1	1	4	4
	• **Invention licenses**, total active in the FY	20	15	18	18	23
	- New, executed in the FY	1	0	1	3	3
	• **Other IP licenses**, total active in the FY	1	0	1	1	1
DOT	• **All licenses**, number total active in the FY	5	5	5	2	3
	- New, executed in the FY	0	0	0	0	0
	• **Invention licenses**, total active in the FY	5	1	5	3	3
	- New, executed in the FY	4	0	0	0	0
	• **Other IP licenses**, total active in the FY	0	0	0	0	0
EPA	• **All licenses**, number total active in the FY	35	38	37	40	37
	- New, executed in the FY	2	5	2	3	2
	• **Invention licenses**, total active in the FY	35	38	37	40	37
	- New, executed in the FY	2	5	2	3	2
	• **Other IP licenses**, total active in the FY	0	0	0	0	0

Table 3: Profile of Active Licenses (continued)

		FY 2006	FY 2007	FY 2008	FY 2009	FY 2010
HHS	• **All licenses**, number total active in the FY	1,535	1,418	1,675	1,584	1,941
	- New, executed in the FY	290	293	277	221	269
	• **Invention licenses**, total active in the FY	1,213	915	1,376	1,304	1,240
	- New, executed in the FY	253	234	233	198	217
	• **Other IP licenses**, total active in the FY	322	460	352	327	683
NASA	• **All licenses**, number total active in the FY	2,856*	3,520*	3,912*	4,181*	3,901
	- New, executed in the FY	655*	721*	633*	803	498
	• **Invention licenses**, total active in the FY	308*	316*	330*	146	354
	- New, executed in the FY	47*	45*	34*	49	36
	• **Other IP licenses**[1], total active in the FY	2,548*	3,204*	3,582*	3,835	3,547
USDA	• **All licenses**, number total active in the FY	332	339	328	329❖	343
	- New, executed in the FY	25	25	28	25	22
	• **Invention licenses**, total active in the FY	332	339	328	329❖	343
	- New, executed in the FY	25	25	28	29❖	26
	• **Other IP licenses**, total active in the FY	0	0	0	0	0
VA	• **All licenses**, number total active in the FY	112	130	153	163	169
	- New, executed in the FY	11	18	23	10	6
	• **Invention licenses**, total active in the FY	112	130	153	163	169
	- New, executed in the FY	11	18	23	10	6
	• **Other IP licenses**, total active in the FY	0	0	0	0	0
TOTALS	• **All licenses**, number total active in the FY	10,186	10,352	11,098	10,926❖	13,542
	- New, executed in the FY	1,495	1,463	1,377	1,250	1,671
	• **Invention licenses**, total active in the FY	4,163	3,935	4,172	4,239❖	4004
	- New, executed in the FY	711	728	544	517❖	511
	• **Other IP licenses**, total active in the FY	6,023	6,405	6,972	6,730	9,121

- DHS began compiling and reporting data in 2008.
1 NASA "Other IP licenses" refer to copyrights, most of which arise out of JPL.
* Updated to reflect corrected data.
§ Reflects a change in the way licenses for technological products are defined for technology transfer purposes, e.g., sale of standard reference material and data are no longer considered as granting licenses to use material and data.
❖ Reflects revisions from FY2009 Report.

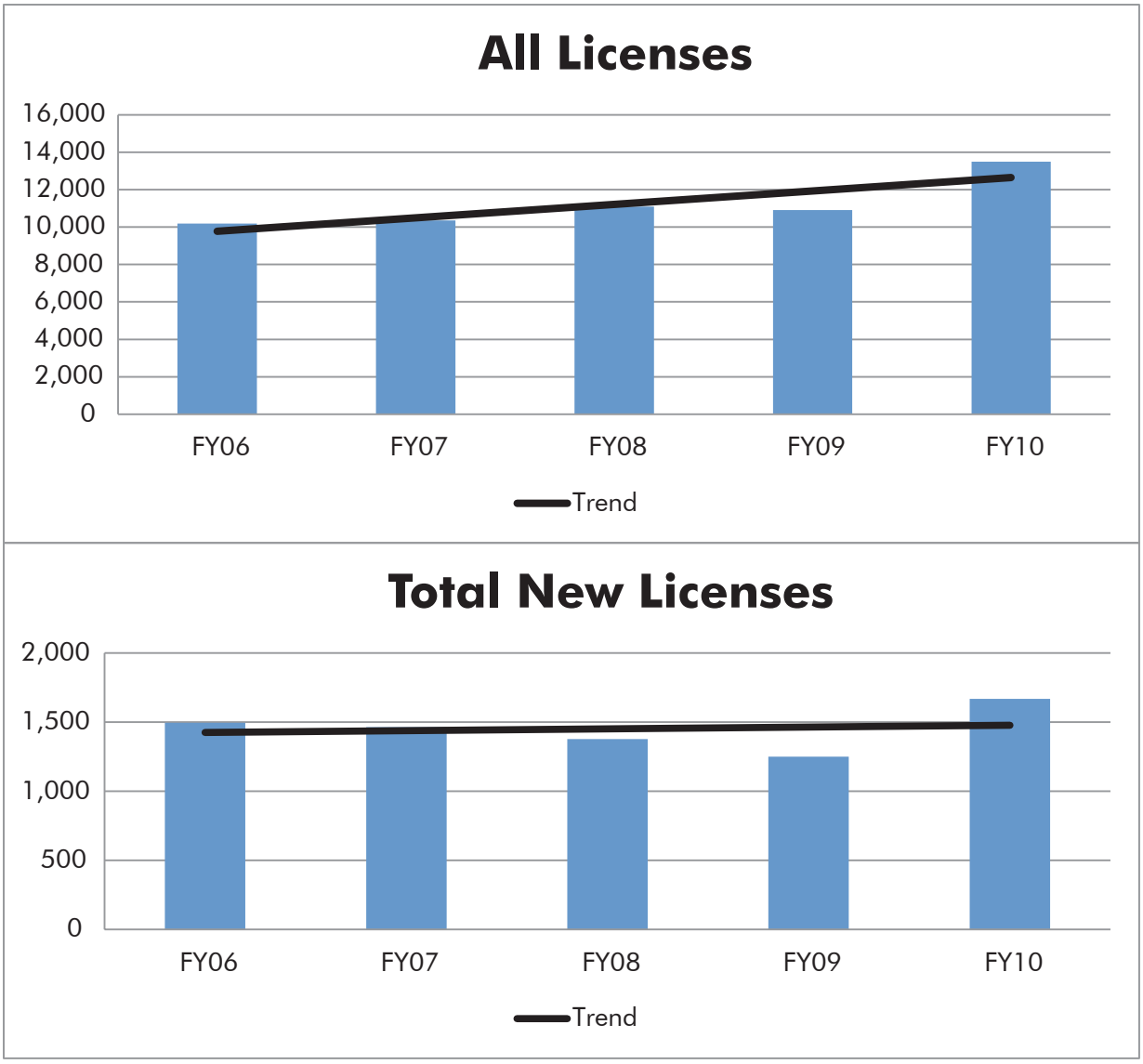

All Licenses
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
FY06
FY07
FY08
FY09
FY10
Trend
Total New Licenses
2,000
1,500
1,000
500
0
FY06
FY07
FY08
FY09
FY10
Trend

Table 4: Characteristics of Income Bearing Licenses

		FY 2006	FY 2007	FY 2008	FY 2009	FY 2010
DHS	• **All income bearing licenses**, number	-	-	0	0	0
	• Exclusive	-	-	0	0	0
DOC	• **All income bearing licenses**, number	30	35	25	27	26
	• Exclusive	17	16	14	15	15
DOD	• **All income bearing licenses**, number	112	194	210	227	134
	• Exclusive	64	84	70	78	67
DOE	• **All income bearing licenses**, number	2,822	3,291	4,397	3,339	3,489
	• Exclusive	353	352	372	411	462
DOI	• **All income bearing licenses**, number	18	14	16	18	19
	• Exclusive	9	4	5	4	5
DOT	• **All income bearing licenses**, number	4	4	4	3	3
	• Exclusive	3	2	1	3	3
EPA	• **All income bearing licenses**, number	35	38	37	40	37
	• Exclusive	6	6	7	8	7
HHS	• **All income bearing licenses**, number	849	901	1,057	899	838
	• Exclusive	134	144	149	111	113
NASA	• **All income bearing licenses**, number	249*	254*	271*	276*	271
	• Exclusive	106*	110*	119*	122*	122
USDA	• **All income bearing licenses**, number	330	337	313	314	321
	• Exclusive	233	241	223	222	230
VA	• **All income bearing licenses**, number	93	115	138*	144	150
	• Exclusive	24	44	61	64	69
TOTALS	• **All income bearing licenses**, number	4,537	5,165	6,444	5,274	5,286
	• Exclusive	949	999	1,014	1,035	1,092

- DHS began compiling and reporting data in 2008.
* updated to reflect corrected data.

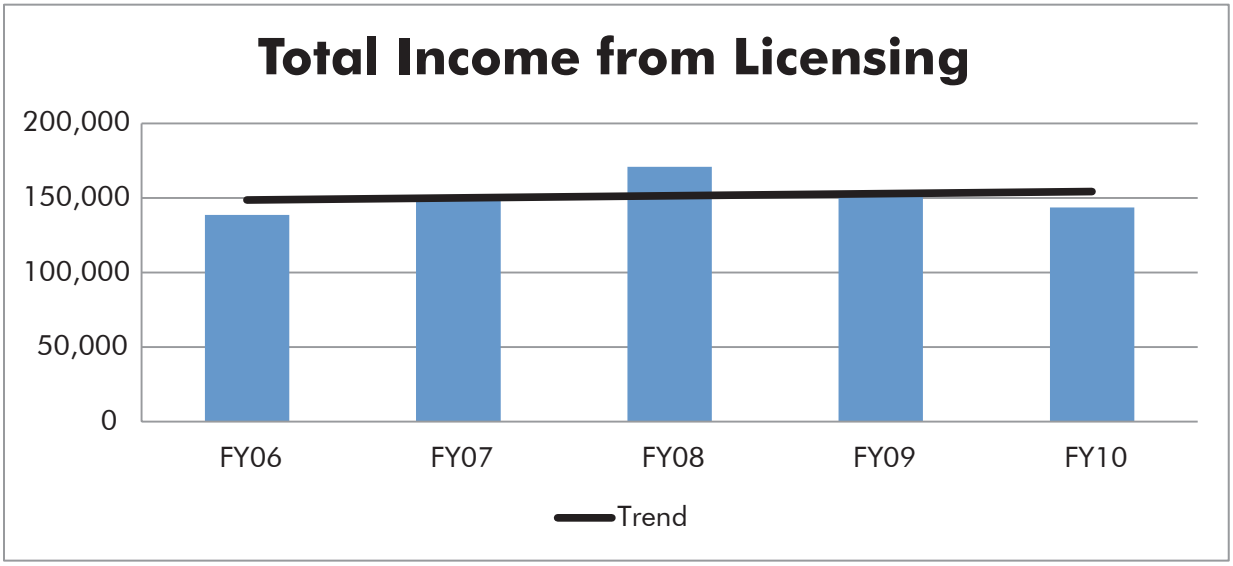
Table 5: Income from Licensing (Dollars reported in thousands)

		FY 2006	FY 2007	FY 2008	FY 2009	FY 2010
DHS	• **Total income**, all licenses active in FY	-	-	$0	$0	$0
	• **Invention licenses**	-	-	$0	$0	$0
	• **Other IP licenses**, total active in the FY	-	-	$0	$0	$0
	• **Total Earned Royalty Income**, (ERI)	-	-	$0	$0	$0
DOC	• **Total income**, all licenses active in FY	$194	$225	$293	$336	$237
	• **Invention licenses**	$194	$225	$293	$336	$337
	• **Other IP licenses**, total active in the FY	$0	$0	$0	$0	0
	• **Total Earned Royalty Income**, (ERI)	$170	$217	$293	$336	$337
DOD	• **Total income**, all licenses active in FY	$10,963	$14,246	$16,057	$16,439	$13,424
	• **Invention licenses**	$10,961	$14,240	$16,048	$16,165	$13,026
	• **Other IP licenses**, total active in the FY	$2	$6	$9	$274	$397
	• **Total Earned Royalty Income**, (ERI)	n/a	n/a	n/a	n/a	n/a
DOE	• **Total income**, all licenses active in FY	$35,572	$39,165	$49,318	$43,496	$40,642
	• **Invention licenses**	$32,211	$34,933	$43,108	$40,238	$37,066
	• **Other IP licenses**, total active in the FY	$3,362	$4,233	$6,210	$3,258	$3,576
	• **Total Earned Royalty Income**, (ERI)	$18,332	$18,759	$31,718	$28,901	$25,220
DOI	• **Total income**, all licenses active in FY	$47	$57	$79	$89	$80
	• **Invention licenses**	$47	$57	$79	$89	$80
	• **Other IP licenses**, total active in the FY	n/a	n/a	n/a	n/a	n/a
	• **Total Earned Royalty Income**, (ERI)	$46	$57	$79	$89	$80
DOT	• **Total income**, all licenses active in FY	$22	$34	$18	$44	$17
	• **Invention licenses**	$22	$34	$18	$44	$17
	• **Other IP licenses**, total active in the FY	$0	$0	$0	0	$0
	• **Total Earned Royalty Income**, (ERI)	$22	$34	$9	$34	$3
EPA	• **Total income**, all licenses active in FY	$632	$544	$1,038	$849	$536
	• **Invention licenses**	$632	$544	$1,038	$849	$536
	• **Other IP licenses**, total active in the FY	$0	$0	$0	$0	$0
	• **Total Earned Royalty Income**, (ERI)	$29	$107	$571	$255	$397
HHS	• **Total income**, all licenses active in FY	$83,097	$88,799	$97,609	$85,059	$80,923
	• **Invention licenses**	$82,187	$67,108	$94,712	$83,041	$79,805
	• **Other IP licenses**, total active in the FY	$909	$19,128	$2,897	$998	$1,119
	• **Total Earned Royalty Income**, (ERI)	$63,250	$70,743	$80,805	$77,251	$76,665

Table 5: Income from Licensing (Dollars reported in thousands) (continued)

		FY 2006	FY 2007	FY 2008	FY 2009	FY 2010
NASA	• **Total income**, all licenses active in FY	$4,734*	$3,651*	$2,802*	$3,144*	$3,850
	• **Invention licenses**	$4,512*	$3, 462*	$2,725*	$2,288*	$3,589
	• **Other IP licenses**, total active in the FY	$344*	$201*	$71*	$105*	$252
	• **Total Earned Royalty Income**, (ERI)	$2,161*	$1,520*	$1,711*	$732*	$1,798
USDA	• **Total income**, all licenses active in FY	$3,162	$3,634❖	$3,978❖	$5,383❖	$3,646
	• **Invention licenses**	$3,162	$3,364❖	$3,978❖	$5,383❖	$3,646
	• **Other IP licenses**, total active in the FY	$0	$0	$0	$0	$0
	• **Total Earned Royalty Income**, (ERI)	$2,337	$2,687❖	$3,035❖	$4,428❖	$3,080
VA	• **Total income**, all licenses active in FY	$138	$358	$141	$202	$167
	• **Invention licenses**	$138	$358	$141	$202	$167
	• **Other IP licenses**, total active in the FY	n/a	n/a	n/a	n/a	n/a
	• **Total Earned Royalty Income**, (ERI)	n/a	n/a	n/a	n/a	n/a
TOTAL	• **Total income**, all licenses active in FY	$138,689	$149,974*	$170,926*	$154,285*	$143,662
	• **Invention licenses**	$134,280	$123,775*	$161,810*	$148,721*	$138,209
	• **Other IP licenses**, total active in the FY	$4,409	$23,367	$9,116	$4,544	$5,344
	• **Total Earned Royalty Income**, (ERI)	$86,348	$93,956*	$117,669*	$112,013*	$107,520

- DHS began compiling and reporting data in 2008.
n/a = Data not available from agency.
* updated to reflect corrected data.
❖Reflects revisions from earlier years' reports.



This page intentionally left blank

CHAPTER 3

Outcomes and Impact of Technology Transfer Activities

Reports of the successful commercialization of Federally-developed technologies cut across industrial sectors and demonstrate the broad reach of technology transfer into the lives of American citizens. The cases provided below are examples of the downstream outcomes arising from technology transfer activities.

Department of Homeland Security (DHS)

Mission Statement

The DHS's Office of Research and Technology Applications (ORTA) is housed in the Science and Technology Directorate. The ORTA is responsible for developing and instituting policies to facilitate technology transfer in accordance with 15 USC 3710 throughout DHS and its laboratories. The ORTA's responsibilities include:

- Standardizing and approving DHS Cooperative Research and Development Agreements (CRADAs), licensing, and other technology transfer agreements;
- Preparing application assessments for selected research and development projects in which the DHS Laboratory is involved and may have commercial application;
- Providing and disseminating information on Federally owned or originated technologies which have potential application to state and local governments and private industry;
- Preparing and providing an annual report to Congress and the President through submission to the National Institute of Standards and Technologies (NIST);
- Developing training programs on technology transfer and intellectual property for DHS employees; and
- Establishing an intellectual property program for DHS to track and prosecute patents and other intellectual property, and to develop a royalty and rewards policy.

The DHS has laboratories with varying capabilities throughout the United States. With the exception of the Coast Guard Research and Development Center, the DHS laboratories listed are within the Science and Technology Directorate. Data included in this report was provided by:

- Chemical Security Analysis Center (CSAC)
- Coast Guard Research and Development Center
- Environmental Measurements Laboratory (EML)
- National Biological Analysis and Countermeasures Center (NBACC)
- Plum Island Animal Disease Center (PIADC)
- Transportation Security Laboratory (TSL)
- Federal Law Enforcement Training Center (FLETC).

For more information on DHS laboratories and their capabilities, visit the website at http://www.dhs.gov/xres/labs/.

2010 DHS Downstream Outcome Success Stories

Advanced Use of Force Training System Partnership

The Federal Laboratory Consortium (FLC) recently presented its prestigious Interagency Partnership Award to Federal Law Enforcement Training Center (FLETC) and the Naval Air Warfare Center Training Systems Division (NAWCTSD) for their collaborative efforts in the development of the Advanced Use of Force Training System. The award recognizes the efforts of federal science and technology employees from at least two different agencies who have collaboratively accomplished outstanding work in the process of transferring a technology.

The collaborative efforts of FLETC and NAWCTSD resulted in the production of a prototype simulator that can enhance the training, performance and safety of law enforcement officers across the nation. NAWCTSD developed the system by leveraging DOD technology and FLETC provided law enforcement expertise during the development and continues to test the system at multiple sites.

Department of Commerce (DOC)

Mission Statement

At the Department Commerce, research and development in numerous areas of science and technology is conducted at the National Institute of Standards and Technology (NIST), the National Oceanic and Atmospheric Administration (NOAA), and the Institute for Telecommunication Sciences (ITS) within the National Telecommunications and Information Administration (NTIA).

More information about DOC technology transfer is available on the following websites:

- NIST: http://www.nist.gov/tpo/index.cfm;
- NOAA: http://www.noaa.gov/
- ITS: http://www.its.bldrdoc.gov/programs/tech_transfer/

National Institute of Standards and Technology

NIST's mission is to promote U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology in ways that enhance economic security and improve quality of life. NIST laboratories develop and disseminate measurement techniques, reference data, test methods, standards, and other technologies that support U.S. industry, scientific research, and the activities of many federal agencies. In carrying out its mission, NIST works directly with industry partners, academia, associations, and other government agencies.

National Oceanic and Atmospheric Administration

The mission of the National Oceanic and Atmospheric Administration (NOAA) is to understand and predict changes in the Earth's environment and conserve and manage coastal and marine resources to meet the Nation's economic, social, and environmental needs. This mission will become ever more critical in the 21st century as national needs intensify concerning global warming, freshwater supply, and ecosystem management.

National Telecommunications & Information Administration/Institute for Telecommunication Sciences

The Institute for Telecommunication Sciences (ITS) is the chief research and engineering arm of the National Telecommunications and Information Administration (NTIA). ITS supports NTIA telecommunications objectives of promoting advanced telecommunications and information infrastructure development in the United States, enhancing domestic competitiveness, improving foreign trade opportunities for U.S. telecommunications firms, and facilitating more efficient and effective use of the radio spectrum. ITS also serves as a principal federal resource for solving telecommunications concerns of other federal agencies, state and local governments, private corporations and associations, and international organizations.

2010 DOC Downstream Outcome Success Stories

Advanced Combinatorial Testing Suites

A NIST software testing tool, the "Advanced Combinatorial Test Suites" (ACTS), is available to industry, academia and other government agencies. The software provides a systematic means for testing complex software failure modes, caused by the interaction of changing software parameters, during high user/high data volume operations. A 2002 study[1] by the US Department of Commerce found that ineffective or incomplete software testing costs US industry $59.5 billion a year.

ACTS generates failure test suites based on possible modes of system failure defined by various combinations of system operating parameters. ACTS can accommodate combinations of 2 to 6 different parameter. Prior to ACTS, construction of test scenarios for combinations of 2 to 6 parameters, even with the fastest processors, required many hours or days for large and/or complex configurations. The ACTS tool represents a breakthrough in software testing technology; it constructs smaller test suites in a fraction of the time required of other available tools.

The NIST ACTS team used an innovative approach – distribution of test copies via world-wide-web – to field test the ACTS software. In January 2009 the ACTS team initially distributed 185 copies of ACTS on an open-source basis to targeted federal agencies, academic institutions, and private sector firms. Recipients were urged to share the technology with others having an interest in software testing. Through the use of innovative social networking based marketing, the number of systems deployed increased to more than 800. As a part of the overall technology transfer effort, NIST team members were available to all recipients for technical consultation and collaboration. At present, the total number of ACTS units deployed throughout the world, both through target distribution and user sharing, is estimated to be in excess of 5,000 and growing.

1Gregory Tassey, "The Economic Impacts of Inadequate Infrastructure for Software Testing," Planning Report 02-2, May 2002, http://www.nist.gov/director/prog-ofc/report02-3.pdf

RoboCrane® Erects New Safe Confinement Structure for Chernobyl Nuclear Plant
A modified version of the RoboCrane®, a unique floating platform developed by NIST, will be used for cleanup operations over the destroyed reactor number four at the former Chernobyl nuclear power plant in northern Ukraine. PaR Systems, a company based in Minneapolis/St. Paul, Minn., licensed the computer-controlled roving tool platform for use in the area immediately surrounding the exploded reactor core to help erect the New Safe Confinement structure for the reactor.

The RoboCrane®, developed at NIST in the 1990s, expands on the principle of a Stewart platform, a device that uses three sets of paired winches (motor-driven spools of cable) to suspend and manipulate a platform with six degrees of freedom (lateral, longitudinal, vertical, roll, pitch and yaw). Stewart platforms are commonly used as the base for flight simulators. The platform's precision maneuverability throughout a large space, and its ability to accommodate a large variety of tools, make it ideal for this type of cleanup operation. PaR will affix a variety of interchangeable tools to the end of the spine, including a robotic arm, drill, jackhammer, shear, high-power vacuum system and closed circuit television viewing system, all of which will be operated remotely.

Tsunami Training
NOAA's Pacific Marine Environmental Laboratory (PMEL) Center for Tsunami Research (NCTR) has developed training programs to assist states and collaborating countries to improve tsunami readiness for their citizens. Training includes instruction in the development and implementation of tsunami forecast systems, and in providing "train the trainer" classes for improving tsunami readiness at the local level.

- *Tsunami Awareness Training*
  The NCTR and the Natural Disaster Preparedness Training Center (NDPTC) at the University of Hawaii have developed a training course for emergency management officials. The course focuses on tsunami mitigation, risk analysis, preparedness, and recovery. In 2010, 125 students attended three courses presented in Honolulu (HI), Pago Pago (American Samoa), and Camp Murray, (WA).

- *ComMIT Training*
  A Community Model Interface for Tsunami (ComMIT) is a major avenue to transfer modeling expertise and capabilities from NOAA to other countries, primarily countries in the Indian Ocean. ComMIT can also be used to transfer modeling information between these countries. The community model is a critical tool for building tsunami-resilient communities. It provides tools for the construction of tsunami inundation maps under different scenarios and for real-time tsunami forecast applications. The United Nations Educational Scientific and Cultural Organization and the United States Agency for International Development provided funds to PMEL/NOAA to develop ComMIT, and it allows nations access modeling tools via an internet-enabled interface. ComMIT enables government agencies and others in the region to run tsunami models, using data from local or remote databases. This approach allows nations without a significant cadre of trained modelers to build tsunami modeling capability for forecast and hazard assessment. Further, it allows nations with restrictions on sharing geo-spatial data to input that data locally and not share it with other web-based model users. Most importantly, the internet-based approach creates a virtual regional and global community of modelers using the same tools and approaches to understand tsunami threats. In 2010, seventeen scientists received training in ComMIT at Daejeon, Republic of Korea.

Transforming Fish Wastes into Useful Products

Scientists at NOAA's Northwest Fisheries Science Center (NWFSC) have partnered with the State of Alaska's Industrial Development and Export Authority (AIDEA) and a private sector fish processing plant in Sitka, AK to develop a process for economically transforming fish processing wastes into high quality fish meal and oil for aquaculture feeds. The process uniquely combines a double drum dryer process commonly used in other industries and includes a plant design from a previous (NWFSC) research. The process was successfully piloted at the Center and demonstrated to industry.

This new technological breakthrough includes: 1) creation of a method to stabilize the waste enabling managers to "bank" the material when it is either in excess or under the amount needed for efficient processing, 2) using a mobile plant to handle multiple fisheries and operate more days per year, and 3) using drum dryers to gently dehydrate the meal and preserve quality. The process produces high quality fishmeal, oil, gelatin, and bone meals that perform well in fish feeds and pet food.

The process can be used in a variety of remote and seasonal fisheries that cannot use existing waste refining technology. It promises to reduce coastal nutrient pollution from seafood processing plants worldwide while providing an environmentally sound source of fishmeal and oil for aquaculture and the animal feed industries. With funding from AIDEA, several seafood processors in Sitka, Alaska plan to build a plant that will transform the 17 million pounds of waste dumped into Sitka harbor every year into useful products having an estimated annual value of at least $3.5 million.

Table Mountain Research

The Table Mountain Field Site and Radio Quiet Zone supports fundamental research in the nature, interaction, and evaluation of telecommunication devices, systems, and services. Each year, private companies, universities and other organizations conduct research at Table Mountain under Cooperative Research and Development Agreements (CRADAs). The following are brief descriptions of some of these recent CRADAs:

- For the past four years, the University of Colorado's Research and Engineering Center for Unmanned Vehicles has conducted measurements on the performance of ad hoc wireless networks with both ground-based and airborne terminals at Table Mountain.
- In FY 2010 several companies have performed antenna, Light Detection and Ranging (LIDAR)/Global Positioning Satellite (GPS), and other testing at the Table Mountain turntable facility under a CRADA.
- Lockheed Martin Coherent Technologies is in its eleventh year field-testing and characterizing components, subsystems and systems for eye-safe coherent laser radar. This has benefited NTIA and the Department of Defense.
- In FY2010, ITS performed testing for the National Weather Service to identify the strengths and weaknesses in commercial NOAA weather radio receivers.

Department of Defense (DoD)

Mission Statement

The mission of the DoD Office of Technology Transition is to ensure, to the maximum extent practicable, technology developed for national security purposes is integrated into the private sector of the United States in order to enhance national technology and industrial base, reinvestment and conversion activities.

DoD is unique in applying the principles, practices, and tools of technology transfer in the execution of its mission. DoD funds and develops mission focused technology, and technology transfer statutory authorities enable it to promote and facilitate the commercialization of that technology for both military and civilian purposes. Concurrently, DoD is a technology buyer as it strives to purchase new technology embodied in products and systems to meet the challenges faced by our warfighters. In many instances technology transfer and technology transition are becoming a seamless path to fielding new technology critical to responding to the new and dynamic threats of asymmetric warfare, and the ever expanding role of civil assistance and disaster recovery worldwide. In the 1980's when much of the technology transfer legislation was enacted, the Federal Government, including DoD, was the principal funding source for R&D. Consequently, technology transfer was viewed as a "spin out" to the marketplace, a stimulus to the domestic economy, and a return on investment for taxpayer funded R&D. Today, the majority of U.S. R&D is industry funded. This shift in funding has led to a greater emphasis on technology transfer as a collaborative effort between DoD labs and their partners in industry, academia, and state and local government.

Each of the Military Services, Defense Agencies, and Office of the Secretary of Defense (OSD) maintain technology transfer websites to inform the public and make available general information.

More information about DoD technology transfer is available on the following websites:

http://www.acq.osd.mil/ott/techtransit

http://www.arl.army.mil/main/Main/default.cfm?Action=6

http://www.onr.navy.mil/en/Science-Technology/Directorates/Transition/Technology-Transfer-T2.aspx http://www.wpafb.af.mil/library/factsheets/factsheet.asp?id=6026

http://www.mda.mil/business/tech_apps.html

http://www.jfcom.mil/about/industry.htm

2010 DoD Downstream Outcome Success Stories

National Center for Simulation

The Naval Air Warfare Training Systems Division actively participates in a not-for-profit National Center for Simulation that includes all the military services, NASA Kennedy Space Flight Center, the University of Central Florida and over 300 modeling and simulation companies. In addition, the Naval Center shares spaces and engages in a number of project collaborations in two "Partnership Buildings" adjacent to but outside of the Navy's installation. In these partnership buildings, the Navy is working side-by-side with the National Institute of Justice and their Federal Law Enforcement Training Center, the Marine Corps Program Managers for Training Systems, and the University of Central Florida. Through these collaborative relationships with other Government Activities, academia, and leading edge companies the military and in particular the law enforcement community can realize significant benefits in the fast moving dynamics of software development.

Institute for Development and Commercialization of Advanced Sensors Technology

The Air Force Research Laboratory Sensors Directorate initiated a collaborative relationship several years ago that brings together state and local economic development interests in Dayton, Ohio, three Ohio universities to start (Ohio State University, Wright State University, and the University of Dayton), and a number of small and large businesses into what can best be described as a hands-on-business incubator. This activity is the Institute for Development and Commercialization of Advanced Sensors Technology (IDCAST). IDCAST provides a collaborative environment to foster research, development, and commercialization of remote sensing and chemical, biological, radioactive, nuclear, and explosive sensor technologies. With the facilities and equipment at IDCAST, collaborative teams from industry (over 30 companies), academia (now six Ohio universities) and several Federal Labs, specific projects are undertaken to develop and mature promising technologies that have both military and commercial applications. Prototyping, test and evaluation, product engineering, and scale-up to manufacturing, all benefit from this collaborative work space. Technologies are being adapted for wide area airborne sensor technology for video monitoring of large areas, use of sensors for improved water quality monitoring, a commercial product that would enable highly accurate breast cancer surgery, and a different adaptation of the cancer cell detection technology that enables real-time quality control of microcircuit manufacturing.

Department of Energy (DOE)

Mission Statement

The Department of Energy's seventeen national laboratories and several of its facilities conduct much of its fundamental and applied research, and they license to and collaborate with industry and academia to develop and commercialize a wide spectrum of products and processes for commercial use. Technology partnering has been an important focus for DOE technology transfer, and it is a significant means for DOE laboratories and facilities to engage Federal, private and academic entities in arrangements to advance the process of technology development and commercialization. These arrangements leverage capabilities of DOE's top notch scientists and world-class facilities, including national user facilities, computational facilities, and science laboratories, with industrial research and production facilities.

The Department oversees the construction and operation of some of the Nation's most advanced research and development user facilities, located at national laboratories and universities. These state-of-the-art facilities are shared with the science community worldwide and offer some technologies and instrumentation that are available nowhere else. These facilities include particle and nuclear physics accelerators, synchrotron light sources, neutron scattering facilities, genome sequencing facilities, supercomputers, and high-speed computer networks. In the 2009 fiscal year, these facilities were used by more than 21,000 researchers from universities, national laboratories, private industry, and other federal science agencies.

In an effort to enhance technology transfer activities and facilitating access to its facilities, the Department recently appointed its first full-time Technology Transfer Coordinator who is working with the Laboratories to streamline and increase efforts to partner with industry. The Coordinator is also teaming with others to identify and implement new and innovative ways to accelerate the time-to-market for innovations arising at the laboratories.

The Department launched a new single-entry web presence for all the DOE laboratories conducting technology transfer: http://technologytransfer.energy.gov. This website goes beyond simply providing information on technology transfer arrangements at DOE. It provides searching capabilities across multiple databases to help identify laboratories and investigators who have capabilities in a searcher's desired subject matter, including contact information to ease and increase the potential for partnering and licensing laboratory technologies. Combined with direct access to laboratory and laboratory technology transfer websites, information on partnering with DOE laboratories, and additional access to related web resources to enhance collaborative opportunities and success of licensed technologies, the searching capabilities provide a vast and easy-to-use resource for individuals, small and large businesses, and any potential collaborator or licensee.

2010 DOE Downstream Outcome Success Stories

Argonne Battery Technology Helps Power Chevy Volt

Early in 2011, the new Chevy Volt became the first mass-produced plug-in hybrid electric car. The development of the vehicle took many years and includes important breakthrough technology from the DOE's Argonne National Laboratory in the nearly 400-lb. battery that powers the vehicle in electric mode.

The battery's chemistry is based in part on a revolutionary breakthrough pioneered by scientists at the U.S. Department of Energy's Argonne National Laboratory. The new development helps the Volt's battery—a lithium-ion design similar to those in a cell phone or laptop—last longer, run more safely and perform better than batteries currently on the market.

This success was many years in the making and began in the late 1990s, when the DOE's Office of Basic Energy Sciences funded an intensive study of lithium-ion batteries. These materials developed from that program significantly extend the range for an electric vehicle.

At its most basic level, a lithium battery is composed of a negatively charged anode and a positively charged cathode. Between them is a thin membrane that allows only tiny, positively charged lithium ions to pass through. When a battery is fully charged, all of the lithium ions are contained in the anode. When the battery is unplugged from the charger and then used, the lithium ions flow from the anode through the membrane to react with the cathode—creating an electrical current.

This T-shaped battery, a replica of the battery used in the Chevy Volt, includes Argonne cathode technology. LG Chem licensed the materials and created the battery. **Image courtesy General Motors.**

The innovators focused on improving the cathode, the positively charged material. They began by using incredibly intense X-rays from Argonne's Advanced Photon Source synchrotron to monitor and understand reactions that occur in lithium batteries—in real time. Next, they set out to modify and optimize the cathode materials. Using new synthesis methods, they created lithium- and manganese-rich materials that proved remarkably more stable than existing designs.

Because manganese-rich cathodes are more stable than those used in today's batteries, the new batteries are safer and less likely to overheat. Manganese is inexpensive, so the battery will cost less to manufacture. The researchers also increased the upper charging voltage limit to 4.6 volts—higher than the usual operating voltage—which resulted in a tremendous jump in the battery's energy capacity.

The battery design is a radical leap forward because it is cheaper, safer, and longer-lasting. Batteries for electric and plug-in hybrid cars are much larger—and thus far more expensive—than laptop batteries, and they make up a large percentage of the car's price. It is predictable that lowering the cost of the battery will lower the cost of all-electric and hybrid cars, and subsequent improvements will improve battery performance even further. Based on lab data, it is expected that the next generation of batteries will last twice as long as current models.

LG Chem licensed the technology from Argonne and used the materials to create the battery supplied for the 2011 Volt. GM has also licensed the technology for its own tests.

Sealing in Energy Savings

If every home in the United States sealed its leaky HVAC ducts, the nation would save approximately $5 billion annually in energy costs. Typical ductwork systems, both residential and commercial, lose 25-40 percent of heating and cooling energy; even newly installed systems experience 10-30 percent leakage.

Solving this energy-wasting problem, once a costly, labor-intensive process, can now be achieved in four to eight hours using technology developed at Lawrence Berkeley National Laboratory and funded by the DOE's Office of Energy Efficiency and Renewable Energy together with the California Institute for Energy Efficiency, the EPA and the Electric Power Research Institute (EPRI). Aeroseal, LLC commercialized the technology, and scores of Aeroseal dealers employing trained staff provide service to homeowners and building owners nationwide.

The Aeroseal technology uses airborne adhesive particles to seal leaks from inside the ducts reaching previously unfixable leaks at low cost and minimal disruption to building occupants. Sealant particles of two to twenty micrometers are injected into a duct system while specialized software allows both technician and customer to view the process in real time. Prior to sealing, furnaces, fans and grilles are blocked, directing all adhesive particles towards cracks, leaks, and holes. Aeroseal's technique has been proven to seal from 70 to 90 percent of duct leaks and is guaranteed to last for ten years.

Besides sealing ducts in thousands of residences, Aeroseal has been used successfully in commercial buildings across the country. Most notably, it has reduced energy use in HVAC-intensive buildings such the Cleveland MetroHealth Hospital, university residential buildings in Buffalo, New York and Boston, and casinos and a city center complex in Las Vegas.

Aeroseal was named one of "This Old House" magazine's Top 100 Home Products for its proven ability to reduce home energy costs.

The Aeroseal Hardware Kit

The Aeroseal technology injects aerosolized vinyl polymer particles into a pressurized duct system. The particles stay suspended in the air stream until they reach leaks, where they are deposited and build up at the leak edges until the leaks are sealed.

Securing the Water Supply:
AquaSentinel Licensed to an East Tennessee Start Up Company

A Tennessee startup, SecureWaters Inc., recently licensed technology developed at the Department of Energy's Oak Ridge National Laboratory to monitor the safety of water supplies. Municipal, military and other governmental organizations that are responsible for safeguarding water supplies now have access to this water monitoring technology, called AquaSentinel, which offers around-the-clock detection of waterborne toxic agents.

AquaSentinel can help protect reservoirs, lakes and streams that furnish drinking water supplies. Over the past decade, there has been an increased awareness of the water supply's vulnerability both to accidental contamination and to bioterrorist attacks.

AquaSentinel, developed at Oak Ridge National Laboratory, uses naturally occurring algae that act as tiny biosensors. Like microscopic canaries in a coal mine, the algae provide an early warning of water contamination by responding to toxins with variations in their photosynthetic behavior. Fluorometer measurements capture any photosynthetic changes in the algae, and the resulting data are then transferred by encrypted wireless telecommunications to a remote facility, where operators can respond to any potential threats. It uses the fundamental principles of photosynthesis and state-of-the-art optoelectric instrumentation to provide continuous, unattended protection of sunlight-exposed primary source drinking water supplies. Because algae naturally grow in all water that is exposed to light, the monitoring technique is applicable for detection purposes in all reservoirs, rivers and lakes that serve as drinking water supply sources.

In addition to its applications in threat detection, AquaSentinel can be used as a tool for companies or utilities to demonstrate environmental compliance. The generated monitoring data is archived for 30 days, allowing users to access historical measurements and determine whether water quality standards are within mandated limits. With this technology, facilities can continually monitor their own effluent in a cost-effective manner. It eliminates the need to randomly collect water samples in the field, does not require special training, is self-operating and self-cleaning.

LandScan broadens its environmental and humanitarian applications into serving telecon, avionics and insurance fields

East View Cartographic (EVC) has become an exclusive commercial distributorship for the LandScan High Resolution Global Population Dataset. The license will enable the company to apply its marketing and distribution power to increase access to the dataset worldwide. Based in Minneapolis, Minn., EVC is a leading provider of authoritative worldwide maps, geospatial data, and GIS production services.

LandScan, an R&D 100 Award winner, refines the best available census data using geographic information system and remote sensing technologies and has emerged as an international community standard for sustainable development, environmental protection, disaster response and humanitarian relief. Research using LandScan has resulted in publications on subjects of interest to policy decision makers such as predicted effects of global climate change. For example, after the devastating Indian Ocean tsunami of late 2004, LandScan was used to estimate the number of people affected and where to send emergency supplies.

Developed at the Department of Energy's Oak Ridge National Laboratory (ORNL), LandScan has already seen success in a number of research, educational, humanitarian and corporate applications and has become one of the most successfully licensed products out of ORNL. In addition to being a powerful database for environmental and humanitarian applications, there is strong demand from telecom, insurance and avionics customers from around the world, as well as from media and risk management companies. The license to East View Cartographic will help put this valuable population dataset into the hands of more users.

LandScan was developed with funding from the Department of Defense and is updated annually by a team from ORNL's Computational Sciences and Engineering Division.

Shedding light on need for more efficient bulbs

Reflector Compact Fluorescent Lamps (R-CFLs) were initially developed as an alternative for incandescent reflector lamps commonly found in popular recessed can lighting fixtures. During the course of Pacific Northwest National Laboratory's (PNNL's) lighting work, researchers discovered the number and types of existing R-CFLs was limited, and that the R-CFLs experienced high failure rates when used in existing residential recessed downlight fixtures. Additionally, they didn't deliver enough light, were not ENERGY STAR® compliant, and were more expensive.

PNNL's Emerging Technology Program initiated the R-CFL Technology Procurement – Phase 1 to spur the introduction of improved, energy efficient, R-CFL products into the marketplace. By identifying improvements and developing new specifications for advanced, high-performance R-CFLs, PNNL provided lighting manufacturers and buyers with minimum specifications for energy-efficient R-CFL models that operate reliably while also delivering the desired light levels, and that fit into existing light fixtures.

The Technology Procurement project was so successful in aiding technology transfer that it became self-sustaining, and the R-CFL testing specifications developed by PNNL were adopted by DOE in the latest draft of the revised ENERGY STAR specification for the reflector lamp category of CFLs.

Sixteen new R-CFL models are now available for purchase in the marketplace, including from major retailers such as Costco, Lowe's, and Home Depot. PNNL continues to serve as a distribution point of contact for these 16 models.

Department of the Interior (DOI)

The United States Geological Survey

The United States Geological Survey (USGS) is a bureau of DOI. The mission of the USGS is to serve the nation by providing reliable scientific information to describe and understand the Earth, minimize loss of life and property from natural disasters, manage water, biological, energy, and mineral resources, and enhance and protect our quality of life.

Since delivery of science information is a primary purpose of the agency, technology transfer activities with the public sector and the private sector, including academia and non-profits, typically support the collection and transference of scientific data (knowledge dissemination).

The USGS cooperates with its public and private collaborators to help them maintain necessary services, better understand the environmental consequences of their commercial and non-commercial activities, and to develop new products and services.

Bureau of Reclamation

The Bureau of Reclamation (Reclamation) is responsible for water and hydropower deliveries throughout the 17 Western states. Reclamation's stated mission is to "manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public." In support of this mission, Reclamation operates 348 reservoirs and 58 hydroelectric plants, making it the nation's largest wholesale water supplier and the second producer of hydroelectric power in the West. Reclamation conducts and sponsors research in the following four mission-related focus areas:

- Water & Power Infrastructure Reliability & Safety
- Water Delivery Reliability
- Reservoir & River Operations Decision Support
- Water Supply Technologies

Reclamation research solutions should demonstrate mission relevancy by improving Reclamation water management practices, increasing water supply, and/or ensuring cost-effective power generation operations that benefit Reclamation's project managers and stakeholders, western water community, other federal agencies, non-federal sector and the general public.

More information about DOI technology transfer is available on the following websites:

United States Geological Survey:
http://www.usbr.gov/research/science-and-tech/research/results/index.html

Bureau of Reclamation:
http://www.usgs.gov/tech-transfer/index.html

2010 DOI Downstream Outcome Success Stories

Improving Earthquake Hazard Assessments

The Pacific Gas and Electric Company (PG&E), a publicly regulated utility providing service within California, is engaged in a long-term, multi-element, action-based seismic risk management program to reduce the impact of future earthquakes on the performance of their gas and electric systems, and to maintain acceptable levels of customer service. To further this program, PG&E and the USGS have been involved in a series of CRADAs since 1992.

In 2009, the USGS and PG&E extended their CRADA for five years. In this period, PG&E seeks (1) the development and rapid application of data, methods, and technologies that improve earthquake hazard assessments in the regions where its electric power and natural gas facilities, service centers, and office buildings are located and where its customers live and work; and (2) the improvement of emergency response to earthquake occurrence by incorporating real-time earthquake hazard information.

The USGS Earthquake Program, under the auspices of the National Earthquakes Hazards Reduction Program, includes a broad range of applied earthquake hazards research, data compilation and archiving, and distribution of earthquake information products and services. The PG&E CRADA complements the USGS Earthquake Program, and is carried out using the capabilities of five USGS Science Centers (Earthquake, Geology and Geophysics, Pacific Coastal and Marine, California Water, and Geologic Hazards).

Protecting Plants from Harsh Conditions

The USGS co-owns a patent with Montana State University (MSU) entitled "Use of Endophytic Fungi to Treat Plants" that teaches methods of protecting plants from harsh environmental conditions such as drought and extreme heat (U.S. Patent No. 7,232,565 B2, issued June 19, 2007). This is accomplished by inoculating a target plant with endophytic fungi isolated from Curvularia species grass found in geothermal zones of the Lassen Volcanic and Yellowstone National Parks. The extracted fungi, a microorganism, may be inoculated into plants, plant parts, seedlings, or seeds. These microorganisms are too small to see, even with electron microscopes, but are believed to occupy the intercellular spaces of plant tissues. Within host plants, they seem to produce bioactive substances and, possibly in concert with the plant's genome, help such plants adapt to harsh external conditions. Inoculated plants demonstrate asymptomatic stress tolerance and enhanced plant growth.

Additional benefits conferred by such treatments to plants are protection from metals and metal ions (that can harm or kill plants) and from abnormal pH (both acidic and alkaline). The potential for the invention is significant for both crop plants and other plants, particularly in light of the possibility of harm to plant life caused by climate change. In addition to other agricultural uses, these microorganisms may ultimately be shown to be beneficial in medical and industrial applications. The invention is currently exclusively licensed by MSU to a U.S. company that is seeking patent protection in Europe, Brazil, and China, in addition to the U.S.

Controlling Invasive Quagga and Zebra Mussels

Invasive quagga and zebra mussels are spreading rapidly through the western U.S. and could impair or interrupt water and hydropower deliveries as well as create long term ecological impacts. Mussels can attach to virtually all water related infrastructure surfaces and thereby clog water delivery systems, pumps, debris racks, cooling water systems, and fire protection systems. Reclamation is directing research and development toward several approaches to detect and control invasive mussels. One effort is through a CRADA with Marrone Bio Innovations to conduct research trials to help bring Zequanox to market for this field of use. Zequanox is a naturally occurring soil microorganism that can selectively kill large numbers of invasive mussels, but is not harmful to water quality or other organisms. Zequanox is a technology patented by New York State Museum who is working in partnership with Marrone Bio Innovations to mature their technology.

Reclamation and Municipal Utilities Turn Impaired Waters into Useable Waters

The Colorado River is the principal source of water for irrigation and domestic use in Arizona, southern California, and southern Nevada. Ensuring adequate water availability for this region of the country is an ongoing challenge. Research continued in 2010 under a CRADA between Reclamation, Metropolitan Water District of Southern California, Southern Nevada Water Authority and the Central Arizona Water Conservation District to help address this challenge. The CRADA objective is to research best methods and new processes for purifying a variety of

impaired source waters so that they can be added to the overall water supply of the Colorado River by utilizing Reclamation's Yuma Desalting Plant in Yuma, AZ. CRADA partners conducted the research at the Water Quality Improvement Center which is a Reclamation water treatment research center co-located at the Yuma Desalting Plant. Research findings will serve to advance the capabilities to purify waters not only along the Colorado River, but will be applicable to other national and international desalination and water reuse facilities.

Department of Transportation (DOT)

Mission Statement

The U.S. Department of Transportation (DOT) is the federal steward of the nation's transportation system. DOT consists of multiple modal Operating Administrations, which carry out mission-related research, development and technology (RD&T) programs in support of the DOT strategic goals: Safety, Livable Communities, State of Good Repair, Economic Competitiveness, and Environmental Sustainability. In 2004, the Research and Innovative Technology Administration (RITA) was charged by its enabling legislation[4] with coordination of DOT-wide RD&T and technology transfer activities.

DOT defines technology transfer as the process of transferring scientific technology information to stakeholders who may apply it for public or private use. DOT's current approach to technology transfer is diverse and unique to each mode of transportation. Each modal Operating Administration conducts its own type of deployment activities tailored to its mode and type of research.

Technology Transfer activities are executed by the following DOT laboratories:

- Federal Aviation Administration's (FAA): The FAA's Federal laboratory is the William J. Hughes Technical Center located at the Atlantic City International Airport, New Jersey.
- Federal Highway Administration's (FHWA) Turner-Fairbank Highway Research Center (McLean, VA),
- The Research and Innovative Technology Administration's (RITA) John A. Volpe National Transportation Systems Center (Volpe Center, Cambridge, MA).

2010 DOT Downstream Outcome Success Stories

FAA Cooperative Research

Many CRADAs and other agreements have been established between the FAA and its partners, which are examples of the synergistic benefits of FAA's Technology Transfer Program. The William J. Hughes Technical Center is one of world's leading aviation engineering, research, development and testing facilities, and serves as the national scientific test bed for the FAA. The FAA Technology Transfer Program at the laboratory provides an opportunity for government, academia, state and local governments, and industry to access our advanced technologies, state-of-the-art facilities, and the expertise of our highly skilled scientists and engineers. This access benefits the FAA and the collaborating party to develop products and technologies that can play an active role in maintaining our world leadership in aviation.

[4] P.L 108-426, November 30, 2004 (118 STAT.2423).

- A cooperative research and development agreement between the FAA and the Boeing Corporation established the National Airport Pavement Test Machine at the William J. Hughes Technical Center.
- Engineered Arresting Systems Corporation developed a soft ground arrestor system using light weight cellular concrete to safely stop aircraft that outrun the runway end providing deceleration and a safe stop. This technology has been deployed at many airports to date and has been successful at saving lives with little damage to the aircraft.

FHWA Innovation Delivery and Technology Deployment

FHWA is responsible for the delivery of technologies and innovations to end users, which include State Departments of Transportation, Metropolitan Planning Organizations, and other highway stakeholders. For this reason, FHWA must develop strong partnerships with those who use and implement highway technologies and with those responsible for making decisions related to funding innovations.

Because FHWA does not implement technologies, the agency utilizes technology transfer or innovation delivery activities including workshops, seminars, and conferences; technical assistance; peer exchanges; cooperative research and development projects; information dissemination centers; technical reports; news releases; and journal and magazine articles. Examples of successful technology transfer activities carried out by FHWA and partners are discussed below.

FHWA working with States on Pavement Rehabilitation and Construction

As state transportation agencies balance the need to rehabilitate and reconstruct existing highways with the goals of reducing congestion and improving safety, accelerated construction is more important than ever. A new software tool, Construction Analysis for Pavement Rehabilitation Strategies (CA4PRS), assists agencies in accelerating construction. The software was developed under an FHWA pooled fund study by the Institute of Transportation Studies at the University of California, Berkeley. The states of California, Minnesota, Texas, and Washington participated in the study. Through the pooled fund study, these states now have access to the CA4PRS and its technical support.

CA4PRS can be used to identify optimal highway rehabilitation strategies that balance the construction schedule with projected inconvenience to drivers and transportation agency costs. The program's scheduling module estimates project duration, while its traffic module quantifies the impact of work zone lane closures on the traveling public. The cost module estimates total project cost (including construction, traffic handling, and supporting costs).

In 2009, FHWA made the implementation of CA4PRSa high priority. In support of this deployment, FHWA worked with the American Association of State Highway and Transportation Officials (AASHTO) Technology Innovation Group to promote the use of the CA4PRS and other construction analysis software tools as a means of assisting highway agencies in accelerating construction and reducing traffic impacts, particularly in heavily traveled urban areas.

States that have used CA4PRS successfully to date include California, Utah, and Washington State. The California Department of Transportation (Caltrans) used it in the design stage of a project on I-15 in Ontario to select the most efficient rehabilitation strategy for the roadway. Caltrans' use of the software on a previous project on I-15 in Devore resulted in a 25 percent

reduction in construction and traffic control costs, for a total savings of $6 million, as well as saving $2 million in road user costs. http://www.fhwa.dot.gov/research/deployment/ca4prs.cfm

Next Generation Simulation (NGSIM)

Operation of roadways is growing more and more complex. Today's transportation professionals are faced with evaluating many diverse and comprehensive solutions to address congested transportation facilities. Instead of simply deciding how many lanes to design for a new freeway or how long the turn bays should be at a traffic signal, practitioners are now required to analyze such complex strategies as ramp metering, adaptive traffic signal control, complicated weaving patterns, multimodal corridor management plans and congestion pricing. Traffic simulation analysis tools can help evaluate these complex solutions by modeling real-world transportation networks on a system-wide scale that is difficult with more traditional methods. It is critical these traffic simulation tools be accurate and trustworthy, so that they can be used to make sound investment decisions.

U.S. DOT began the Next Generation Simulation (NGSIM) (ngsim.fhwa.dot.gov) program in a new role of market facilitator that manages public resources in a focused way. The goal is to influence and stimulate the commercial modeling market by fostering an environment of public-private coordination. This new role has resulted in a unique public-private partnership between the U.S. DOT, transportation consulting companies, university researchers and commercial simulation software developers. U.S. DOT is not developing software, but instead is fostering conditions under which the software is developed by private vendors. The government's role is one where a core of open behavioral algorithms has been developed, along with supporting documentation and validation data sets that describe the movement and interaction of multimodal travelers and vehicles within the roadway system. Four core algorithms (freeway lane selection, cooperative/forced freeway merging, arterial lane selection, and oversaturated freeway flow) and four data sets (I-80 in Emeryville, CA; U.S. 101 and Lankersham Boulevard in Universal City, CA; and Peachtree Street in Atlanta, GA) have been developed under NGSIM.

Commercial software developers are showing great interest in NGSIM. PTV (www.vissim.us), Traffic Simulation Systems (www.tss-bcn.com) and Quadstone (www.paramics-online.com), developers of the traffic simulation models VISSIM, AIMSUN and Paramics, respectively, have incorporated the freeway selection algorithm into their products on a test basis and validated the algorithm, meaning that the results of the simulation can be trusted as an accurate forecast. Over the coming year, responsibility for continued development, maintenance and support of NGSIM will be transferred from the government to an Open Source community. In an Open Source community, software is distributed to a community's members, with membership open to all interested individuals, many of whom contribute to the development, maintenance and support of that software. NGSIM's many developers and users applaud NGSIM's transition to an Open Source environment and see it as key to making the software even more useful.

Intelligent Transportation Systems Deployment Analysis System (IDAS)

Transportation planners use software models to get answers to key questions about the future, such as: "What benefits can I expect if I make this particular investment?", "Will those benefits outweigh the costs?", and "Which scenario would give me the most value for my money: doing a lot, doing only a little, or doing nothing?" Most models, however, forecast using average conditions, such as a typical weekday with good weather and no traffic incidents, and ignore the extreme cases, such as a holiday weekend with a severe snowstorm and multiple crashes on the

freeway. Intelligent Transportation Systems (ITS) and other operational improvements excel at tackling those extreme conditions, making the bad traffic days more like the average. The tools that many transportation planners use to determine benefits and costs often miss the benefits offered by ITS and improved operations.

ITS Deployment Analysis System (IDAS) (http://idas.camsys.com/) was developed to address this need. IDAS estimates the benefits and costs of over 60 different types of ITS technologies and operational improvements, either working individually or in combination with each other. IDAS operates as a post-processor to travel demand models. In other words, transportation planners take the outputs of their travel demand models and input them into IDAS. IDAS then outputs the benefits and costs of ITS and operational improvements under all types of conditions, from typical to extreme. The benefits estimated include reduced travel time, reduced delay, reduced crashes, reduced costs, increased throughput, and increased travel time reliability. U.S. DOT sponsored the development, maintenance and support of IDAS, which is available for purchase for $795 through the McTrans Center for Microcomputers in Education (http://mctrans.ce.ufl.edu/).

IDAS has been used successfully in dozens of studies nationwide, including analysis of both ITS and operational improvements, as well as more traditional capacity and freight improvements. Nathan Masek of the Mid-Region Council of Governments in Albuquerque, NM used IDAS to evaluate the costs and benefits of individual ITS projects and the results were surprising: a benefit-to-cost ratio of 10:1 for large projects, compared with 2:1 or 3:1 for smaller projects. He said that IDAS "provided us a clear, comparative mechanism to evaluate benefits of projects that aren't necessarily apparent or considered in the normal project programming and prioritization process."

Compliance, Safety, Accountability (CSA) for Large Trucks and Buses

The Federal Motor Carrier Safety Administration's (FMCSA) Compliance, Safety, Accountability (CSA) Program is a novel way to carry out its safety mission of reducing large truck and bus crashes, injuries, and fatalities on our nation's highways. It enables the Agency and its State Partners to better target high risk motor carriers for early intervention, and to assess the safety performance of a much larger segment of the motor carrier industry. FMCSA developed the CSA program with the assistance of the Volpe Center. CSA consists of three primary components. (1) The Safety Measurement System (SMS), (2) CSA progressive interventions and (3) the Safety Fitness Determination rule. The first two elements were the focus of work during this time period.

SMS organizes violation and crash data associated with a given motor carrier into seven behavioral areas, called Behavior Analysis and Safety Improvement Categories (BASICs): Unsafe Driving, Fatigued Driving (Hours-of-Service), Driver Fitness, Controlled Substances/Alcohol, Vehicle Maintenance, Cargo-Related, and a Crash Indicator. SMS then generates "Alerts" for motor carriers whose violations in a given behavioral area, or crashes, indicate that they should be candidates for CSA Intervention. Every month, the CSA SMS evaluates centrally collected data describing violations of the Federal Motor Carrier Safety Regulations and commercial motor vehicle crashes, in order to: assess the relative safety performance of regulated truck and bus companies (motor carriers); determine the specific safety problems exhibited by a motor carrier; monitor whether safety problems are improving or getting worse; and identify candidates for interventions.

The CSA Intervention tools can reach more carriers to improve unsafe behaviors early on: they range from warning letters for carriers with emerging problems to Onsite Comprehensive Investigations for carriers with recurring safety problems, and enable officials to move beyond fact-finding and simple verification of problem areas to a deeper exploration of why the violations occurred and how they can be corrected in order to save lives on the road.

Environmental Protection Agency (EPA)

Mission Statement

EPA's Federal Technology Transfer Act Program was established to promote collaboration between private and federal research. EPA offers exceptional opportunities to develop and commercialize new technologies. EPA facilitates the transfer of new technologies to the marketplace while protecting intellectual property rights of all parties.

Partners in the FTTA Program will have the benefit of collaborating with world class EPA scientists involved in leading-edge research. Collaboration enhances the quality of research projects and helps move the environmental technologies into the marketplace more quickly, resulting in better protection of human health and the environment.

Highlights of several outcomes of the Agency's technology transfer activities are provided below. For more information please visit: http://www.epa.gov/osp/ftta.htm.

2010 EPA Downstream Outcome Success Stories

Arsenic Removal from Drinking Water

Some environmental scientists never see the end result of their work; typically findings become a piece of a larger puzzle. But for drinking water specialists at EPA's National Risk Management Research Laboratory, the effort to discover the best available technology for arsenic removal in small communities can be readily traced from the laboratory studies to the actual adoption by local water utilities.

Arsenic is an odorless, tasteless element that enters ground water drinking sources through erosion of natural deposits or from human-made sources. Chronic exposure to low levels of arsenic has been linked to skin, kidney, lung and bladder cancers, as well as neurological and cardiovascular effects. In 2001, EPA established a new, lower level of 10 parts per billion for arsenic in drinking water, which impacted around 5,000 water systems, the majority of them small systems serving fewer than 10,000 people.

Recognizing the technical and financial burden the new standard could impose on small drinking water systems, EPA conducted a technology demonstration program to test a variety of arsenic-removal technologies in small systems across the country. Beginning in 2003, EPA drinking water specialists worked with communities at 50 sites in 27 states to select an optimum removal technology from approximately twenty available.

Concurrent with the full-scale, "real-world" testing of the arsenic demonstration program, NRMRL researchers conducted lab and pilot studies on ways to reduce costs and improve the performance of the technologies. In one example, lab and pilot testing of onsite regeneration of the media led to substantial reductions in the operational cost of the adsorptive media process. Following successful testing, the State of California approved the technique for a full-scale demonstration at Twentynine Palms, CA. Success at this site led to a second full-scale test at a demonstration project in New Hampshire. Other utilities have now expressed interest in the process.

These projects are unique in that they show EPA researchers at work—not only in the laboratory, but also in the on-site application of research results and their real-world impacts on communities. For more information, please go to the EPA Arsenic Research website.

Water Sample Concentrator

The possibility of terrorists or criminals intentionally contaminating drinking water with pathogenic microorganisms is a significant public health concern. This concern has given rise to the need to rapidly and effectively sample water to detect small concentrations of potentially dangerous microorganisms. Historically, analysis of water for the presence of low levels of microorganisms requires that either a large volume sample be collected and transported to a laboratory where the sample is concentrated before analysis, or concentrated in the field with cumbersome, yet delicate laboratory equipment.

In response to these challenges, the United States Environmental Protection Agency (EPA), in partnership with the Department of Energy's Idaho National Laboratory (INL), developed a rugged and automated field deployable sample concentration device. The device significantly reduces the sample volume by concentrating the microorganisms contained in a large sample into a small volume of water. The device can concentrate the microbes contained in a 26-gallon sample into less than 2 cups of water, often in under an hour. Following concentration, the smaller, concentrated sample can be more easily and safely transported to a laboratory. A patent for this technology is pending. The device has been used by the Centers for Disease Control and Prevention, the U.S. Geological Survey, and water utilities in Connecticut and Oregon.

The device was primarily developed for helping to protect the Nation's drinking water from bioterrorism attacks. The water sample concentrator could also be used by water utilities during their routine regulatory compliance sampling. This routine sampling includes testing for several different microorganisms in drinking water. The ultrafiltration device has potential to be used whenever a large volume of water needs to be concentrated, examples which include sampling the following:

- Bilge water on shipping vessels
- Process control liquids from the brewing and pharmaceutical industries
- Surface water for environmental studies
- Decontamination water from cleanup areas.

In 2007, the EPA hosted the Clean Water Partnership Summit, which was held to foster partnerships between the EPA and private sector organizations. At this summit the EPA developers of the concentration device met with a representative of Teledyne-Isco, a manufacturer of environmental sampling devices. This initial meeting eventually led to a licensing agreement between INL and Teledyne-ISCO.

The water sample concentrator was recognized among the top 100 innovations of 2009 by R&D magazine and was placed on the R&D 100 list.

Department of Health and Human Services (HHS)

Mission Statement

Research at the Department of Health and Human Services is conducted by the Centers for Disease Control and Prevention (CDC), the Food and Drug Administration (FDA), and the National Institutes of Health (NIH).

The NIH has as its mission the conduct and support of biomedical research to improve the public health. The NIH Office of Technology Transfer (OTT) is responsible for identifying, evaluating, protecting and marketing technologies derived in NIH intramural laboratories. OTT transfers these technologies through licenses to the private sector, where they can be further developed into products used in the prevention, diagnosis, or treatment of disease.

Effectively measuring the public health outcomes that result from such technologies is challenging and complex. Traditionally, efforts to measure the effect of technology transfer activities focus on outputs such as the number of patents and licenses or the amount of royalties generated. However, this approach does not reflect the full scope and complexity of these technology transfer activities in terms of their impact, and may, in fact, over-emphasize the importance of commercializing biomedical inventions and innovations.

NIH has created a Product Showcase (http://www.ott.nih.gov/productshowcase/default.aspx) that displays products from its intramural research program utilized every day to detect, treat or prevent disease or assist researchers as they continue to explore ways to develop newer and more effective health care products and procedures. The Showcase includes products that are now or have been on the market. Some are FDA-approved and many do not necessitate FDA approval.

For more information about the HHS technology transfer program please visit:

- CDC: http://www.cdc.gov/od/science/techTran;
- NIH: http://www.ott.nih.gov/ and
- FDA: http://www.fda.gov/ScienceResearch/CollaborativeOpportunities/default.htm

2010 DHHS Downstream Outcome Success Stories

MenAfriVac® Meningitis Vaccine for Sub-Saharan Africa.

Under a novel partnership mechanism organized by PATH (Program for Appropriate Technology in Health), NIH Office of Technology Transfer (OTT) licensed a conjugate vaccine technology developed by Dr. Che-Hung Robert Lee and Dr. Carl Frasch of the U.S. Food and Drug Administration (FDA) to the Serum Institute of India, which agreed to produce the vaccine cheaply in exchange for technical know-how. The collaboration agreement was been described in *SciDev.Net* as an "intriguing model" of vaccine development in developing countries, in which a vaccine with specific characteristics tailored to a particular population is developed at a modest cost and provisions to ensure sustainable access are built in from the start. "The collaboration is the first of its kind," S. S. Jadhav, Executive Director of the Serum Institute, is quoted as saying in *SciDev.Net*. "The key was the transfer of technology from NIH."

The result of this unique collaboration was MenAfriVac®, a meningitis vaccine specifically developed for sub-Saharan Africa. Country-wide vaccination with MenAfriVac® began in December 2010, and to date almost 20 million people have been vaccinated. It is PATH's goal to vaccine 300 million by 2015. This vaccine addresses a significant public health issue in Africa's "meningitis belt", where regular epidemics over the past century have sickened hundreds of thousands, with about ten percent resulting in death. With nearly half a billion people in sub-Saharan Africa, the impact of meningitis can be enormous, costing families months of disposable income to receive appropriate treatment and placing a significant burden on the region's healthcare infrastructure. The vaccine, in effect, holds promise for unprecedented change in the countries of Africa's meningitis belt and their people.

Prostate Cancer Immunotherapy

While the research and development required to bring a cancer treatment to market is long and expensive, the benefit for patients is incalculable. Dr. Jeffrey Schlom, Chief of the Laboratory of Tumor Immunology and Biology at the NIH National Cancer Institute, led the scientific team that developed PROSTVAC, a prostate cancer immunotherapy that triggers the patient's own immune system to attack prostate cancer cells. An exclusive patent license was granted to Bavarian Nordic to further develop the technology. The company recently released encouraging clinical data at the American Society for Clinical Oncology Annual Meeting. Phase 2 clinical trials demonstrated an improved survival of 8.5 months, on average. In contrast, the only approved treatment currently available for advanced prostate cancer is a form of chemotherapy, which extends survival by an average of only 2.4 months.

Rapid Quantitative Assay to Detect Interferon-Alpha Subtypes and Allotypic Variants

Different forms of interferon (IFN) mRNA transcripts and proteins are induced at different levels in response to a variety of physiological and pharmacological stimuli. The detection of the individual forms has utility not only in the research laboratory, but also potentially to monitor vaccine efficacy, autoimmune disease, chronic infections, or tumor therapy. Because the 12 human IFN-α genes share a high degree of sequence homology, their individual transcripts are extremely difficult to quantify using conventional methods. By overcoming this technological hurdle, this highly sensitive and specific quantitative real-time PCR assay provides a tool for better determining which IFN-α mRNAs responds to a particular treatment and to what extent, both in cell culture and in vivo, allowing to differentiate between several IFN-α transcripts in one single assay. A kit of primer/probe sets complementary to the coding sequence avoids spurious detection of degraded mRNA and enhances the correlation between the IFN-α subtype that is measured by the assay of the invention and the protein that is actually expressed.

Technology for the Detection of HIV

The 2008 Report on the global AIDS epidemic found that since 1981, HIV caused an estimated 25 million deaths worldwide. Despite the success of antiretroviral drugs to slow the rate of AIDS deaths, HIV still remains a challenging public health problem. As of 2007, about 33 million people in the world were living with AIDS. There is a strong need for improved diagnostics to provide more rapid and sensitive identification of the virus. New HIV infections occur faster than people can be treated. Recognizing the most recent infections at the individual level would allow for prevention programs to target those areas more effectively, and in turn, slow the HIV infection rate dramatically.

Dr. Bharat Parekh of the CDC has lead a team to develop unique tests that not only detect HIV-1, but also identify how recently a person has been infected with HIV-1; this allows for identification of HIV infection hot spots. Specifically, he developed novel peptides that can detect all HIV-1 strains for incidence estimation. Initially, the product used the BED peptide, a synthetic protein. However, synthetic production was difficult and prevented widespread use of the test. As a result, CDC scientists created a unique multi-subtype recombinant protein developed from HIV-1 that could identify all strains of HIV-1. Unlike the synthetic peptide, the new protein can be expressed and purified from E. coli, which greatly simplifies the production process while enabling production of substantially larger quantities of protein.

Dr. Parekh used invention reports to disclose his inventions to the CDC Technology Transfer Office. This resulted in licenses to companies in the United States, Ireland, India, and China. Dr. Parekh provided these companies with information and biological materials to replicate the tests. His laboratory members trained key scientists from the companies in a hands-on approach to ensure a successful transfer of technology. CDC staff worked closely with company personnel to ensure consistency of the test kits developed for all the testing assays.

Dr. Parekh's efforts led to ground breaking assessments of new infection rates in the United States and South Africa. His tests have been used in many countries including: Brazil, India, China, Thailand, Botswana, and more. Currently, he is transferring new technologies to the companies for newer improved test kits. The result of this technology transfer will lead to better detection and surveillance of HIV, thereby indicating where prevention programs should be implemented.

Therapeutic Antibodies for Respiratory Syncytial Virus (RSV) Infection

Respiratory syncytial virus (RSV) is the single most important cause of serious lower respiratory tract disease in the infant and young child. It is estimated that up to 125,000 hospitalizations occur each year in the United States associated with pneumonia or bronchiolitis from RSV infection in children less than 1 year of age. The importance of RSV as a cause of serious lower respiratory tract disease in children has made it a high priority for prevention and treatment. Efforts to develop an RSV vaccine have so far failed and no highly effective antiviral therapy has been found. The first candidate vaccine, formalin inactivated RSV, was associated with an increase in disease severity and several deaths when vaccinated children were later infected with RSV in the community. Multiple live virus vaccine candidates have been tried, but none has been found safe and effective. Because no vaccine is available, CDC scientists began to investigate the use of therapeutic antibodies for the prevention and treatment of RSV infection.

Of the 11 viral proteins encoded by the RSV genome, only the F and G glycoproteins induce neutralizing antibodies and long-term protective immunity. Although RSV-F is most critical to cellular infectivity, RSV-G is more tightly linked to pathogenesis. CDC scientists identified and characterized a chemokine motif, CX3C, located in the conserved region of the G protein. This motif modulates the host response to RSV infection in animals and binds to the corresponding chemokine receptor, CX3CR1. Several monoclonal antibodies previously developed by CDC that bind to the G protein were also found to block binding to CX3CR1. Importantly, it was determined that these antibodies decreased RSV disease in animal models.

CDC scientists identified a CRADA partner, Trellis Bioscience, to collaborate on additional studies to prove the viability of the antibodies directed against the G protein as potential therapeutic antibodies against RSV. Together, scientists at CDC and Trellis identified high-affinity fully human antibodies that mimicked the mouse monoclonal antibodies in in vitro assays and mouse models. Based on the positive results obtained during the collaboration, Trellis obtained an exclusive patent license to take these RSV anti-G antibodies into human trials and bring a commercial product to the market that shows improved safety and efficacy over the currently available antibodies. These RSV anti-G antibodies have the potential to dramatically decrease the number of hospitalizations and deaths of infants, children, and elderly persons, due to respiratory tract disease caused by RSV infection.

National Aeronautics and Space Administration (NASA)

Mission Statement

Since its creation in 1958, NASA's mandate has included the broad dissemination of its research results for the public benefit. In FY 2011 a new Office of Chief Technologist was created to serve as the focal point for overall coordination of the agency's technology development efforts as well as managing a new Space Technology Program. The Innovative Partnerships Program was merged into this new Office. The technology transfer functions that were performed by the Innovative Partnerships Program are now the responsibility of the Innovative Partnerships Office (IPO) within the Office of Chief Technologist. In addition to its NASA Headquarters office, the Innovative Partnership Office has locations within each of NASA's ten centers, and is dedicated to fostering technology transfer and technology development partnerships with industry, academia, government agencies, and national laboratories. The IPO is responsible for facilitating intellectual property protection and transfer of NASA developed technology for commercial application and other public benefit. NASA continues to seek dual use technology development partnerships that advance agency mission goals and at the same time apply NASA technology for the benefit of commerce and the public good.

Each year, NASA documents examples of notable successes from its technology transfer efforts in its annual *Spinoff* magazine publication. The magazine is available online at http://wwww.sti.nasa.gov/tto, and hard copies are available on request. To date, over 1,700 examples of technology transfer successes have been documented in the publication, all of which are searchable through an online database available through www.sti.nasa.gov/spinoff/database. In addition, NASA has established a website called NASA Home and City, located at http://www.nasa.gov/city, which helps to make the public aware of NASA's contributions to the quality and safety of everyday life. NASA participates with several other federal agencies in highlighting technologies available for licensing for commercial and research application. Details on this and other initiatives are available on the Office of Chief Technologist web site: http://www.nasa.gov/offices/oct/home/index.html

2010 NASA Downstream Outcome Success Stories

NASA Provides Critical Support in Chilean Miner Rescue

Perhaps one of the most poignant examples of NASA technology transfer in 2010 took place not in the upper reaches of space, but over 2,000 feet deep within the San Jose mine, Chile. It was there on August 5, 2010 that 33 miners became trapped in a mine collapse. At the request of the Chilean government, a NASA team led by Dr. Michael Duncan, Deputy Chief Medical Officer, NASA Johnson Space Center, along with physician Dr. James Polk, psychologist Dr. Albert Holland, and engineer Clint Cragg, traveled to Chile to provide their expertise. NASA experience in spacecraft design and life support systems enabled the development of a rescue capsule that could fit within the narrow confines of a rescue shaft drilled into the safe haven area occupied by the miners. NASA experience in human factors both physiologically and psychologically provided guidance on what nourishment would safely sustain the miners, while at the same time helping these men cope with the extreme, potentially deadly environment they faced. In tandem with Chilean rescuers, the NASA team support was essential in safely bringing the 33 miners, one man at a time, to the surface from the collapsed mine on October 13, 2010.

Bacteria Provide Cleanup of Oil Spills, Wastewater

This year, NASA technology aided in clean-up efforts after the catastrophic Deepwater Horizon oil rig explosion in the Gulf of Mexico. Through Small Business Innovation Research (SBIR) contracts with Marshall Space Flight Center, Micro-Bac International Inc., of Round Rock, Texas developed a phototrophic cell for water purification in space. Inside the cell were millions of photosynthetic bacteria. Micro-Bac proceeded to commercialize the bacterial formulation it developed for the SBIR project. The formulation is now used for the remediation of wastewater systems and waste from livestock farms and food manufacturers. Strains of the NASA-derived bacteria also feature in microbial solutions that treat environmentally damaging oil spills, such as the one in the Gulf.

Inflatable Antennas Support Emergency Communication

After the devastating 2010 earthquake in Haiti, emergency relief workers had access to Internet and telecommunications, thanks to NASA technology. Glenn Research Center awarded Small Business Innovation Research (SBIR) contracts to ManTech SRS Technologies, of Newport Beach, California, to develop thin film inflatable antennas for space communication. With additional funding, SRS modified the concepts for ground-based inflatable antennas. GATR (Ground Antenna Transmit and Receive) Technologies, of Huntsville, Alabama, licensed the technology and refined it to become the world's first inflatable antenna certified by the Federal Communications Commission. Capable of providing Internet access, voice over Internet protocol, e-mail, video teleconferencing, broadcast television, and other high-bandwidth communications, the systems have provided communication during the wildfires in California, and after Hurricane Katrina in Mississippi.

Signal Processing Methods Monitor Cranial Pressure

Innovative methods for transferring NASA technology came to the marketplace this year. Technologies licensed during the first successful auctioning of government-owned intellectual property now contribute to methods for assessing the flow of blood around the brain, and measurement useful for medical diagnosis and prediction of brain blood flow-related problems, such as stroke, dementia, and traumatic brain injury. Dr. Norden Huang of Goddard Space Flight Center invented a set of algorithms (called the Hilbert-Huang Transform, or HHT) for analyzing nonlinear and non-stationary signals that developed into a user-friendly signal

processing technology for analyzing time-varying processes. At an auction managed by Ocean Tomo Federal Services LLC, licenses of 10 U.S. patents and 1 domestic patent application related to HHT were sold to DynaDx Corporation, of Mountain View, California.

Miniature Cameras Promise Minimally Invasive Brain Surgery
An ongoing partnership between JPL and the Skull Base Institute (SBI) has resulted in the development of the "Multi-Angle and Rear Viewing Endoscopic tooL" (MARVEL), an auxiliary endoscope, that a surgeon would use in conjunction with a conventional endoscope to obtain additional perspective. The role of the MARVEL in endoscopic brain surgery would be similar to the role of a mouth mirror in dentistry. Such a tool is potentially useful for in-situ planetary geology applications for the close-up imaging of unexposed rock surfaces in cracks or those not in the direct line of sight. SBI has licensed the technology and has a Space Act Agreement in place for further development

Implantable Medical Devices Benefit Millions
A flexible, high strength, lightweight polymer, Langley Research Center's Soluble Imide was licensed by Medtronic Inc., of Minneapolis, Minnesota, for use as insulation on thin metal wires connected to its implantable cardiac resynchronization therapy devices for patients experiencing heart failure. The devices resynchronize the contractions of the heart's ventricles by sending tiny electrical impulses to the heart muscle, helping the heart pump blood throughout the body more efficiently. Each year, 6 million patients benefit from Medtronic's technology.

Department of Agriculture (USDA)

Mission Statement
This report covers technology transfer activities and metrics for the Agricultural Research Service (ARS), the Animal Plant Health Inspection Service's Wildlife Services (APHIS-WS), and the Forest Service (FS). This report includes tabular metrics of inventions, licenses, and Cooperative Research and Development Agreements for ARS, APHIS-WS, and FS.

For more information about USDA technology transfer, log onto the following URLs:

- ARS: http://www.ars.usda.gov/partnering
- APHIS-WS: http://www.aphis.usda.gov/wildlife_damage/nwrc/
- FS: http://www.fs.fed.us

Agricultural Research Service (ARS)
ARS conducts research to develop and transfer solutions to agricultural problems of high national priority and provides information access and dissemination to:

- Ensure high-quality, safe food, and other agricultural products;
- Assess the nutritional needs of Americans;
- Sustain a competitive agricultural economy;
- Enhance U.S. natural resources and the environment; and
- Provide economic opportunities for rural citizens, communities, and society as a whole.

Animal and Plant Health Inspection Service – Wildlife Services (APHIS-WS)
APHIS-WS provides Federal leadership and expertise to resolve wildlife conflicts and creates a balance that allows people and wildlife to coexist peacefully. Current program activities include threatened and endangered species conservation, the protection of public health and safety, wildlife disease surveillance and monitoring, a nationally coordinated research effort, and other activities and programs.

Forest Service (FS)
The mission of FS is to sustain the health, diversity, and productivity of the nation's forests and grasslands to meet the needs of present and future generations.

2010 USDA Downstream Outcome Success Stories

Developing, Implementing and Distributing an Improved Emergency Aid Food (ARS)
Over the last 50 years the Food-for-Peace program, through Title II of Public Law 480, has distributed food to people overseas at risk of hunger and malnutrition, providing nutritionally balanced meals in times of emergency. The USDA FSA administers the Food-for-Peace program, buying U.S. grown commodity products which are in-turn handed over to the United States Agency for International Development (USAID). USAID distributes the foods through Non-Governmental Organizations.

The meals have been supplied as uncooked fortified corn- or wheat- soy blends, with oil, vitamins and minerals. These uncooked Corn Soy Blend meals have had many problems ranging from off-flavors (products going stale due to rancid fats), segregation of particles which intensifies malnutrition (vitamins and mineral settling to the bottom of the bag), and off colors (as vitamins and iron react with starch, protein, and fat under high temperatures in tropical countries).

USDA researchers have collaborated to deliver an improved, novel emergency aid product for needy populations world-wide. The USDA team developed a fully-cooked Instant Corn Soy Blend product. In addition to a new product, the team developed new approach to purchase and distribute the product through the transfer of the process and product to AbilityOne, a company hiring the severely handicapped. This is first time the USDA Farm Service Agency (FSA) has issued a product request for a new emergency food. This technology transfer outcome was achieved through public release of information, and won an FLC Mid-Atlantic Region Technology Transfer Award. *Dairy and Functional Food Research Unit, Wyndmoor, Pennsylvania*

Diagnostic Tests for Rapid Response to H1n1 Pandemic Influenza (ARS)
When swine origin H1N1 influenza (pH1N1) was first identified, its importance in the infection of livestock and poultry, which can be infected with many influenza strains, was unknown.

This resulted in a critical need for a rapid and accurate diagnostic test for veterinary specimens by veterinary diagnostic laboratories that could quickly identify and differentiate the pH1N1from other influenza viruses. The H1N1 Pandemic Influenza Veterinary Diagnostic Test Development Team developed and validated a real-time polymerase chain reaction (RT-PCR) test for field application and transferred the protocols to the National Animal Health Laboratory Network and to a number of international laboratories. These tests are now in common use. This technology transfer outcome was achieved through use of Material Transfer Agreements, and won an ARS Superior Technology Transfer Award. *Southeast Poultry Research Laboratory, Athens, Georgia*

System for Delivering Poultry Litter below the Soil Surface (ARS)
Excessive nutrient losses cost producers substantial income, and severely degrade air and water quality in many watersheds with intensive poultry production. Research has shown that nutrient losses from poultry litter applied to farmland are minimized if the litter is incorporated by applying it in shallow trenches beneath the soil surface. Development of a single-shank, tractor-drawn implement has proven that the incorporation technique can be mechanized, but making this technology a practical option for producers requires a multiple-shank litter incorporator. An effective litter distribution system requires all of the shanks to simultaneously receive a steady supply of dry poultry litter particles small enough to flow easily through the shank portals. To meet this need, ARS invented an auger system that can pulverize dry poultry litter while transporting it from a bulk bin through rectangular openings whose size and location simulate shank portals. This system provides effective litter distribution and eliminates the need for pre-treating (grinding) the litter before loading, removing a major obstacle to adoption of the technology by producers. This technology was licensed to an industry partner in 2010. *Dale Bumpers Small Farms Research Center, Booneville, Arkansas, in cooperation with Pasture Systems and Watershed management Research Unit, University Park, Pennsylvania, and the National Soil Dynamics Laboratory, Auburn, Alabama*

Immunocontraceptive Vaccine for Wildlife (APHIS-WS)
Deer populations have increased from only about 500,000 deer across the United States in the early 1900's to over 15 million today. Although this recovery is considered a wildlife management success story, deer are causing many problems, particularly in urban environments. Ornamental trees and shrubs in residential and commercial areas suffer damage as deer seek alternative food sources. High populations of deer result in numerous

deer/vehicle collisions and pose a serious threat to motorists. It is estimated that there are over 700,000 deer-vehicle collisions each year that result in more than 200 human fatalities and 29,000 injuries. In addition to vehicle accidents, deer have been implicated in the distribution and transmission of Lyme disease.

Over the past 14 years, scientists from the NWRC have worked to develop a new wildlife Immunocontraceptive (GonaCon™) to help reduce overabundant urban white-tailed deer and other overabundant wildlife populations. GonaCon is a vaccine that causes deer to remain infertile for up to 5 years following a single injection. This multiyear single-shot vaccine stimulates the production of antibodies that bind to gonadotropin-releasing hormone (GnRH)—a hormone necessary for production of estrogen, progesterone, and testosterone. By binding to GnRH, the antibodies reduce GnRH's ability to stimulate the release of these sex hormones. As long as a sufficient level of antibody activity is present in the bloodstream, sexual activity is decreased, and vaccinated animals remain infertile. In September 2009 Wildlife Service's NWRC obtained a registration for GonaCon with the U.S. Environmental Protection Agency (EPA) for use with female white-tailed deer 1 year of age or older. NWRC anticipates its use primarily in urban/suburban areas where other management tools cannot be used. Vaccinated animals show a decrease in sexual activity and breeding behavior. There is no known danger associated to humans or wildlife from eating deer that have been vaccinated with GonaCon. In addition to deer, GonaCon has proven effective for use with numerous other wildlife species, including California ground squirrels, prairie dogs, Norway rats, feral cats and dogs, wild horses, elk, and bison. Future research will be directed toward registering GonaCon for use with other wildlife species and for prevention of wildlife disease transmission.

Learning How Birds Perceive Aircraft (APHIS-WS)

Two-thirds of bird strikes resulting in serious aircraft damage occur between zero and 500 feet above ground level. However, a substantial number of strikes also occur between 501 and 3,500 above ground level. At that height, certain ground-level dispersal methods, like loud noises or bird-chasing dogs, are ineffective. National Wildlife Research Center researchers in Sandusky, Ohio, and their collaborators from Indiana State University, Purdue University, Precise Flight, Premises Control, and the Federal Aviation Administration (FAA) are learning more about how birds detect and respond to approaching aircraft. Specifically, researchers are investigating how birds detect and respond to object approach (such as aircraft), and whether changes to wavelengths and pulse frequencies of aircraft lighting can make aircraft more visible to birds. Vision is a primary sensory pathway in birds. While birds, like humans, see in color, they have different photoreceptors and can see beyond the range humans can. Research was conducted with captive Canada geese using a 10-ft wingspan, remote-controlled plane outfitted with the Precise Flight lighting system with geese with clipped wings were placed in a 56-foot diameter enclosure, surrounded by high-speed video cameras to capture the birds' response to the approaching plane. The plane made multiple approaches to each set of birds, some with the lights on and some with them off. Researchers are evaluating the video footage frame by frame to see if the lights improved the birds' detection and avoidance of the plane. In addition, via the Purdue laboratory, the researchers are quantifying the visual capabilities of Canada geese, particularly their sensitivity to color, contrast of the aircraft to surrounding light conditions, movement, and their ability to clearly resolve an approaching object at distance. The behavioral and physiological findings are promising and researchers are optimistic their efforts will result in new methods to help birds detect and avoid aircraft in the air. This will add another tool in the wildlife hazard mitigation toolbox and complement existing wildlife management on airports. This technology transfer outcome was achieved through public release of information.

New "Green" Adhesive for Wood Composites (FS)
Traditional plywood, particleboard, and other composite products made from petroleum-based adhesives release harmful formaldehyde vapors, a potential human carcinogen. Formaldehyde fumes from these materials can also cause short-term symptoms such as watery eyes, burning sensations in the eyes, nose and throat, and skin irritation, especially in sensitive people. Charles Frihart, Ph.D., a research chemist at the U.S. Forest Service's Forest Products Laboratory (FPL), led a joint research effort with FPL and Ashland Hercules Water Technologies to develop a new adhesive that contains soy flour, a special water-resistant additive, and other modifiers. Together these ingredients form a polymer glue used for interior wood products such as decorative plywood and engineered wood flooring. This new glue performs as well as the existing petroleum adhesives, but does not contain formaldehyde. New regulations on reducing formaldehyde emissions from wood composites and the need to meet green building standards are strong driving forces behind the research. Further development of soy adhesives is continuing under the partnership between FPL and Ashland Hercules. The team has one issued patent, several patents pending, and their joint efforts have received additional support in the form of grants from the United Soybean Board. This technology transfer outcome was achieved through CRADA and license.

Technology for Measuring Duff Moisture Content Improves Safety of Forest Fires (FS)
FS inventors developed a machine to quickly assess moisture content in the duff, or the surface of the forest floor. Their invention is a portable unit that can be carried to the forest and test the moisture of forest duff using electrical calculations and surface probes. This way, people in charge of containing a fire can determine in a few minutes, rather than days, the moisture levels in the duff and thereby provide better control of fires. This technology was licensed to a private sector partner.

Department of Veterans Affairs (VA)

The Department of Veterans Affairs (VA) operates, through the Veterans Health Administration (VHA), a substantial research program in connection with the research programs at many of the medical institutions with whom VA is affiliated. As a result, many of our researchers also hold academic appointments with our affiliates. Some of our best and most beneficial inventions have come out of this setting and VA wants to continue to promote this research environment and relationship, as it benefits our veterans and the public generally.

Although VA can assert an ownership right in inventions made by our employees under Executive Order 10096, and its implementing regulations, it cannot and does not do so to the exclusion of our university partners or the inventors. Since many of VA's researchers hold dual appointments with VA and a university, VA recognizes that the universities may have an interest in an invention made at a VA facility, leading to joint ownership.

To further enhance the unique relationship and the cooperation between the research affiliates and VA, and to facilitate the technology transfer process, the Office of Research and Development's (ORD) Technology Transfer Program (TTP) developed a Cooperative Technology Administration Agreement (CTAA). This agreement encompasses the obligations of the universities and the interests of VA while fostering the relationship between the two organizations. It further outlines relevant definitions, terms, and conditions for handling

intellectual property (IP) on behalf of both organizations. Using the CTAA allows ownership to remain with VA while providing the university unimpeded access and authority to patent and market the IP in question. Using CTAAs creates a mutually beneficial situation for VA and its academic affiliates while strengthening, and/or expanding existing partnerships to the advantage of both organizations. Currently VA has 59 active CTAAs with some of the leading research institutions. The agreements have been extremely efficient in handling jointly owned intellectual property and we have not encountered any substantive problems.

Mission Statement

The mission of the VA TTP is to serve the American public by translating the results of worthy discoveries made by VA researchers into clinical practice. To facilitate this effort, VA continues working with and establishing collaborations with our academic affiliates (University Medical Schools) using the CTAA. Use of the CTAA allows VA to access existing intellectual property expertise at the respective university negating the need to recreate the wheel. This results in a mutually beneficial situation for VA and its academic partners while strengthening existing collaborations.

VA has entered into more Cooperative Research and Development Agreements (CRADAs) and licenses over the past year and continues to actively work on more agreements for the future of VA's Technology Transfer program.

The overall goals of the VA program are to:

- Move VA innovations from "bench" to "bedside".
- Continue building internal/external IP capacity and expertise.
- Continue to maintain and improve IP database system.
- Refine system for acquiring patents and property rights.
- Continue negotiating CTAAs.
- Continue internal and external education program.
- Educate staff at all levels within VA about the current technology transfer policy.
- Retain ownership and internal licensing rights to ensure access by veterans to new technologies resulting from VA's research investment.
- Support high quality intramural research program and move discovery from the laboratory to clinical practice in a timely manner.
- Insure that inventors and their host VA medical centers receive optimal advice and support, so that they may realize equitable compensation and recognition.
- Continue to maintain and improve the TTP web page.
- Enhance and expand the partnership with academic affiliates in the area of technology transfer.
- Continue to fund cutting-edge research that leads to discoveries or inventions that advance medical science and benefit our veteran patients, investigators, the taxpayer, and the nation.

VA Technology Transfer Success Stories

Success in technology transfer does not necessarily come from licensing technologies that meet large market needs. Sometimes success comes from meeting the need of a unique patient population. VA is focused on the often unique needs of veterans, so VA has a strong interest in innovations that help veterans with disabilities.

Recently, in partnership with the University of Pittsburgh, VA and Pitt licensed two technologies aimed at increasing mobility among wheelchair using veterans. One invention was for a hybrid electric wheelchair and power scooter. The invention offers greater mobility and potentially lower cost. The other, licensed to Accessible Design, Inc., was for an invention ideally suited for younger athletic disabled veterans. It covers the design of a highly adjustable chair for use in athletic events such as shot put, discus and javelin. It offers lower cost compared to custom chairs, and ease of adjustment for each individual and each athletic event.

Additionally, an invention titled "Preservation of the Properties of Mesenchymal Stem Cells During the Expansion on a Three-Dimensional Extracellular Matrix Made by Bone Marrow Stromal Cells", developed at the Little Rock, AR VA Medical Center and the University of Arkansas, Little Rock, has been licensed to StemBioSys, LLC. StemBioSys manufactures and develops novel, proprietary stem cells. This invention will help the company facilitate its goals to become a leading supplier of Mesenchymal stem cells.

Lastly, an invention titled "Fused Stem Cells for the Treatment of Diabetes and Methods Thereof", developed at the Salt Lake City VA Medical Center and the University of Utah, has been licensed to Insugen, LLC. Insugen and is focused on the development of stem cell-based methods for the treatment of diabetes.

More information is available on the VA's Technology Transfer Program website:
http://www.research.va.gov/programs/tech_transfer/default.cfm

CONCLUSION

Technology transfer is an active and essential mission of Federal laboratories. By leveraging our nation's innovative assets and investing in science and technology, we strengthen our economy and American competitiveness in world markets. This report details the results of technology partnering activities cultivated in the Federal sector.

The statistical data provided in this report indicate that over the five-year span from 2006 through 2010 show a very mature and robust program. Generally, the trends for the various outputs are relatively flat, indicating little change over the reporting period.

Collaborations at Federal labs using CRADAs are trending upward for both active and new CRADAs although there is a slight decline in new CRADAs. This decline is very small but the overall trend for active CRADAs indicates that CRADAs are lasting longer. With over 8,000 active CRADAs, and the use of other tools available for laboratories to collaborate beyond a formal CRADA, such as NASA Space Act Agreements or DOE Work for Others, it is easy to see that Federal laboratories are reaching out to collaborate with other organizations.

Although the number of new inventions reported demonstrates a declining trend over the five year window, the number has increased over the past three years. However, the numbers still show a fairly flat trend. The new patent applications and issued patents over the same time period agree with this flat trend. The number of "other" licenses shows an upward trend in contrast to standard invention licensing which is consistent with the flat trend seen in the invention disclosure and patenting tables. License income also reflects this consistency, although it has declined since FY2008.

These numbers, however, do not tell the whole story. Technology transfer is far more than patenting and licensing of disclosed inventions arising out of mission-driven research. Federal laboratories transfer many technologies through a variety of mechanisms not reflected by numbers and charts. Other important, but often overlooked, mechanisms include post-doctoral fellowships and the subsequent return of these talented individuals to the private sector or to academia, and student fellowships from high school through graduate level. A number of studies and workgroups are underway to evaluate technology transfer and appropriate metrics in order to accurately describe and measure the role of Federal research in supporting our over-all economic well-being.

The success stories in this report provide examples of how society benefits from technology transfer activities across the Federal laboratories. As technology advances and the needs of the economy change, Federal laboratories will continue to play a vital role in keeping America in the forefront of innovation. Federal research supports our economic and international competitiveness by successfully transferring and facilitating commercialization of Federally created technologies.

This page intentionally left blank

NIST
National Institute of
Standards and Technology
U.S. Department of Commerce

100 Bureau Drive, Gaithersburg, MD 20899-2200 | http://www.nist.gov