

U.S. Department of Transportation

Technology Transfer Response to the

Presidential Memorandum on:
Accelerating Technology Transfer and Commercialization
of Federal Research in Support of High-Growth
Businesses

9/28/2012

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The U.S. Department of Transportation's Plan To Accelerate Technology Transfer and Commercialization of Federal Research in Support of High-Growth Businesses

Executive Summary

This plan responds to the presidential memorandum of October 28, 2011, directing federal agencies to improve the results of their technology transfer and commercialization activities. It presents the U.S. Department of Transportation's (USDOT) 5-year plan for accelerating technology transfer (T2) during 2013–2017. USDOT has three goals for accelerating T2 and commercialization of federal research:

1. increase the number of T2 partnerships with entities from academia, industry, commercial, nonprofit, government, and non-government,
2. increase the number of commercialization activities, and
3. improve the efficiency of USDOT T2 business processes.

The USDOT plan includes the means, strategies and metrics to achieve the stated T2 goals. The overarching aim of the plan is to encourage formation of T2 partnerships between USDOT and government and non-government entities, including private firms, research organizations, and nonprofit entities. Implementation of the plan also should improve the efficiency of USDOT's T2 program, allowing professional staff to increase their focus on marketing and partnership activities. This approach should increase the number of T2 partnerships.

Introduction

A presidential memorandum directing the acceleration of technology transfer and commercialization of federal research in support of high-growth entrepreneurship was issued by President Barack Obama on October 28, 2011.¹ The memo stated that,

“Innovation fuels economic growth, the creation of new industries, companies, jobs, products and services, and the global competitiveness of U.S. industries. One driver of successful innovation is technology transfer, in which the private sector adapts Federal research for use in the marketplace. One of the goals . . . is to foster innovation by increasing the rate of technology transfer and the economic and societal impact from Federal research and development (R&D) investments. This will be accomplished by committing each executive department and agency (agency) that conducts R&D to improve the results from its technology transfer and commercialization activities. The aim is to increase the successful outcomes of these activities significantly over the next 5 years.”

The memorandum mandated each federal agency to:

1. establish goals for technology transfer and develop appropriate measures to evaluate progress,
2. streamline the federal government’s technology transfer and commercialization process, and
3. facilitate commercialization through local and regional partnerships.

USDOT Technology Transfer Program: How technology transfer supports the USDOT mission

USDOT’s mission is to “*serve the United States by ensuring a fast, safe, efficient, accessible and convenient transportation system that meets our vital national interests and enhances the quality of life of the American people, today and into the future.*”² USDOT’s top priority is Safety. USDOT defines Safety as “working to improve public health and safety by reducing transportation related fatalities and injuries.”³

USDOT’s approach to T2 is diverse and unique to each mode of transportation. The department accomplishes its mission through multiple strategies that include research partnerships with academia, industry, commercial, nonprofit, non-government, and government agencies; development and advancement of sound and implementable national transportation policies, promotion of safe transportation behaviors, and the delivery of training in transportation safety and efficiency practices. USDOT’s T2 activities focus upon research collaboration, knowledge generation, transfer, and dissemination; grants, cooperative agreements, and contracts; and practical application of research. The USDOT Research, Development, and Technology (RD&T) programs conduct T2 through:

- each Operating Administration (OA)
- federal laboratories and
- grants, cooperative agreements, and cooperative research and development agreements (CRADAs),

¹White House. (2011, Oct 28). Accelerating technology transfer and commercialization of federal research in support of high growth businesses. Retrieved from <http://www.whitehouse.gov/the-press-office/2011/10/28/presidential-memorandum-accelerating-technology-transfer-and-commerciali>

² 49 USC 101.

³ USDOT Strategic Plan, FY 2012-2016.

USDOT's T2 program provides leadership and expertise to facilitate the timely exchange of knowledge and technologies for development and advancement of products and methodologies that improve transportation safety and efficiency. Through the T2 process, the federal investment in transportation research yields safety, efficiency, and economic benefits.

USDOT Plan for Accelerating Technology Transfer and Commercialization

The three principal goals of USDOT's T2 program are to:

1. increase the number of T2 partnerships with entities from academia, industry, commercial, nonprofit, government, and non-government,
2. increase the number of commercialization activities, and
3. improve the efficiency of USDOT T2 business processes.

The USDOT T2 plan approach expects to achieve the acceleration of the technology transfer and commercialization results by regular assessment and evaluation of the plan's objectives and activities through the use of metrics. During the plan's first year, USDOT will work to baseline USDOT activities results using collected data and analysis.

The USDOT 2013-2017 plan goals with associated objectives, activities, metrics, and timeline are outlined below.

Table 1 Goal 1: Increase the number of T2 partnerships with academia, industry, commercial, nonprofit, government, and non-government entities

No.	Objective	Activities	Metric	Timeline
1	Increase awareness about USDOT T2 program among government and non-government partners.	<ul style="list-style-type: none"> • Explore outreach activities (e.g., conferences, trade meetings, social media, and targeted marketing). • Explore collaboration with local and regional transportation safety-focused entities, including USDOT regional offices. 	<ul style="list-style-type: none"> • Number of executed T2 agreements with government partners. • Number of executed T2 agreements with non-government partners. • Number of teleconferences attended and presentations made. 	Baseline metrics for 2013. Target to be established in 2014.

Table 2 Goal 2: Increase the number of commercialization

No.	Objective	Activities	Metric	Timeline
1	Increase commercialization opportunities.	<ul style="list-style-type: none"> • Publicize T2 and available materials for licensing. • Publicize collaboration opportunities. • Disseminate T2 best practices that advance the development of technology evaluations leading to commercialization activities. 	<ul style="list-style-type: none"> • Number of license applications submitted. • Number of collaboration engagements. 	Baseline metrics for 2013. Target to be established in 2014.
2	Increase the knowledge of commercialization opportunities.	<ul style="list-style-type: none"> • Survey and evaluate transportation and economic indicators. • Coordinate opportunities with intermediaries to help streamline matching technologies and potential economic developers. 	<ul style="list-style-type: none"> • Total revenue generated by USDOT licensees. 	Baseline metrics for 2013. Target to be established in 2014.

Table 3 Goal 3: Improve the efficiency of USDOT T2 business processes

No.	Objective	Activities	Metric	Timeline
1	Evaluate and modify USDOT T2 policies and processes to be more effective and user-friendly while maintaining statutory requirements.	<ul style="list-style-type: none"> • Implement identified policy and process improvements. • Evaluate process for executing in partnerships agreements (grants, contracts, CRADAs, collaborative agreements, and others). • Streamline USDOT T2 partnership processes and procedures to maximize transfer effectiveness. 	<ul style="list-style-type: none"> • Number of policies revised and implemented. • Number of process changes identified. • Reduce the time required to establish CRADAs. 	Baseline metrics for 2013. Target to be established in 2014.

USDOT Research Centers and Intermediary and Local Partnerships

USDOT's Federal laboratories support the transfer of technology and are included as part of its overall laboratory evaluations. USDOT is represented in the Federal Laboratory Consortium for Technology Transfer and is an active participant in the Inter-agency Working Group on Technology Transfer. USDOT Federal laboratories will continue searching for more ways to enter into local and regional partnerships with academic institutions and partners from the aerospace, highways, automotive, rail, and waterborne industries. Current partnerships include Research and Innovative Technology Administration's (RITA) John A. Volpe National Transportation Center (Volpe Center) entering into a CRADA with Massachusetts Institute of Technology; and Volpe's laboratory strategic plan targets local research collaboration. Other labs include Federal Aviation Administration's (FAA) William J. Hughes Technical Center (WJHTC) collaborating through CRADAs, and various mechanisms to partner with industry, university consortia, economic development entities, and state and local governments. FAA collaborates with external partners through its Technical Partnerships and Information Exchange office, which facilitates CRADAs when applicable. The office develops and strengthens knowledge of aviation, extending and expanding Federal Laboratory capabilities by performing outreach activities at aviation-related conferences and events, and through partnerships with industry and university consortia, economic development entities, and state and local governments.

FAA facilitates aviation related licenses, patents, and employee activities, and establishes CRADAs in accordance with the Stevenson-Wydler Technology Innovation Act of 1980 and FAA Order, Technology Transfer Program, 9550.6. Recently, FAA entered into a Memorandum of Lease and Memorandum of Agreement with external partners to facilitate private development the Aviation Research and Technology Park near its Federal Laboratory in New Jersey, with the intent of furthering aviation related research, technology transfer and commercialization.

USDOT's Federal Railroad Administration's (FRA) laboratory is the Transportation Technology Center in Pueblo, Colorado. This facility is operated by a private firm, Transportation Technology Center, Inc. (TTCI), under a care, custody and control contract. This arrangement maximizes the technology transfer opportunities by providing the industry direct access to test facilities and specialized technical support services for the purposes of research and testing. The FRA sponsors cooperative research activities that utilize this facility. FRA does not own patents; however, many patents have resulted from FRA-sponsored research. These patents are held by private firms and are actively utilized for commercial purposes. FRA engages in research to develop technologies for FRA's stakeholders, which are geared around safety. FRA research is always conducted with industry partners, universities, and private industry.

These are a few examples of the local and regional partnerships USDOT laboratories participate in. USDOT will continue working to strengthen such partnerships. More detailed descriptions of agency specific technology transfer efforts may be found in the Appendices.

Appendices

USDOT Operating Administration agency-specific technology transfer plans.

Appendix 1: Federal Aviation Administration (FAA) FAA Plan for

Accelerating Technology Transfer and Commercialization of Federal Research in Support of High Growth Businesses

Introduction/Background

The FAA works with its federal and industry partners to develop a flexible aerospace system that fully responds to the changing needs of businesses and customers in the 21st Century. We strive to reach the next level of safety, efficiency, environmental responsibility, and global leadership, and are accountable to both the taxpayer and the flying public.

FAA federal laboratories perform research and development (R&D), test and evaluation (T&E), and provide operational support to ensure and enhance safety of the nation's civil aerospace system. Programs include National Airspace System (NAS) operations, development and sustainment, weather, environment and energy, human factors, aerospace medicine, aircraft safety, airports, commercial space technology, wake turbulence, and long-range development of aviation systems and concepts.

Objectives

The FAA Technology Transfer Program's (TTP's) objectives are to:

- Increase collaboration between FAA and the non-federal sector (private industry and organizations, state and local governments, and academia),
- Support technology transfer and commercialization (when applicable) of the FAA's R&D investments, and
- Use technology transfer activities and tools to leverage resources that advance the agency's mission, and benefit the competitiveness of United States industry.

The FAA Technology Transfer Program and how it supports the FAA Mission

The FAA's mission is to provide the safest, most efficient aerospace system in the world. The FAA accomplishes its mission through acquisitions, research, and outreach to other government and non-government communities.

The TTP facilitates application of new knowledge, furthers research, and streamlines partnerships to develop and commercialize inventions or intellectual property (IP). To learn more about the TTP, please visit <http://faa.gov/go/techtran>, or see the publicly available FAA Order, Technology Transfer Program, 9550.6 at http://www.faa.gov/regulations_policies/orders_notices/.

Effectiveness of the TTP depends on innovative and highly productive aviation scientists, researchers, engineers, and technology transfer professional staff working together. The TTP strives to promote efficient technology transfer via high quality disclosures, avoidance of unnecessary costs, and timely licensing of assets to the non-federal sector for commercialization when applicable.

Figure 1 illustrates the basic technology transfer process, which contains two essential components. The top portion of the figure illustrates an “innovation cycle”, through which ideas, inventions, and IP are developed and identified. Some outcomes of this cycle advance the fundamental understanding of aviation research, or lead to new strategies for satisfying programmatic needs. Other outcomes may lead more directly to products, processes, or information benefiting the flying public or non-federal sector. These outcomes, as identified and appropriate, feed into the bottom portion of the figure, known as the “collaboration phase”. Here, they can be further refined and potentially commercialized to become useful products or services.

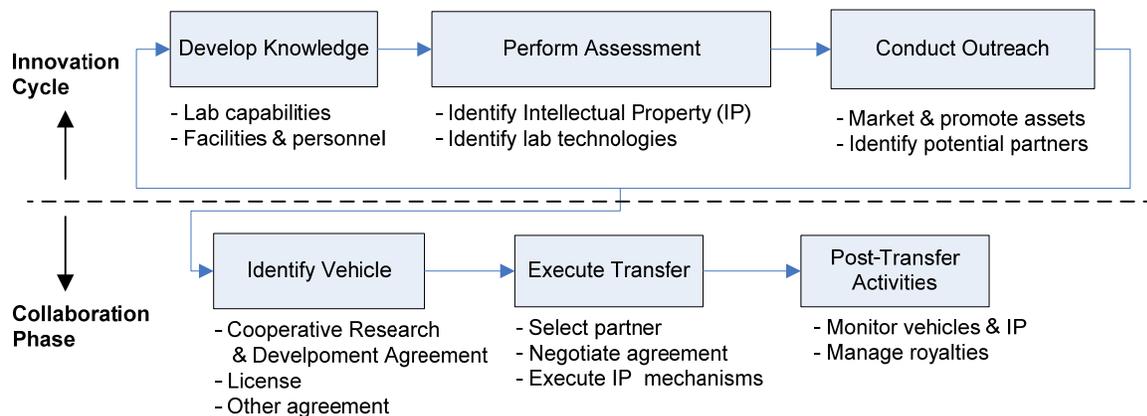


Figure 1 – Technology Transfer Process

The FAA’s Technology Transfer Program Office (TTPO) coordinates the technology transfer process with internal partner organizations at its federal laboratories, and external stakeholders as appropriate. These efforts are complementary activities that require significant coordination and cooperation. The TTPO manages internal technology transfer relationships, invention or intellectual property patenting and licensing, royalty payment processing and awards to inventors, and external collaboration and outreach activities. The following list highlights additional TTPO activities:

- Evaluate invention disclosures to obtain and protect patent rights as needed to promote development and commercialization
- Negotiate and execute license agreements to convey patent rights and unpatented materials to the private sector for research, development and commercialization
- Monitor license agreements for diligence and proper royalty payments
- Identify collaboration partners
- Negotiate agreements that enable access to laboratory materials, information and resources, and research and development projects to advance development and commercialization
- Monitor collaboration agreements, including Cooperative Research and Development Agreements (CRDAs), for diligence and change in research scope
- Manage the royalty payments from licensees that are paid to inventors and to the federal laboratories
- Deploy marketing strategies to direct appropriate technologies to those stakeholders that can best commercialize them

- Create an appropriate invention management strategy
- Evaluate the regulatory and policy environment to determine the implications for FAA technology transfer
- Develop an organized and robust data management system where information can be utilized, harvested easily, made transparent, and internal and external stakeholders have access to appropriate information
- Continuously evaluate and update technology transfer processes to ensure a high level of efficiency

Strategy and Plan

As shown previously by Figure 1, the transfer of publicly funded research and development (R&D) to the private sector is a process with discrete steps – only through the smooth transition between steps can commercialization result. Note that due to the coordination required, and the nature of business development, successful outcomes can take a significant amount of time to realize. Therefore, additional goals, actions, and measures are best derived and tracked over multiple years.

Scientists and technologists must recognize the value of their invention or intellectual property and the importance of reporting it. The processes shown by Figure 1, and resulting successful outcomes, can only be sustained through the agency’s support for people, policies, and funding to enable a technology transfer program and its processes. As much as possible, the TTPO reaches back to personnel and offices to communicate TTP activities, and promote TTP awareness.

The overarching aim of the TTP Plan (Plan) is to increase the number and pace of effective technology transfer and commercialization activities in partnership with the non-federal sector, including private firms, research organizations, and nonprofit entities. In accordance with the Plan, the TTPO continuously investigates specialized programs and resources to accelerate technology transfer. For example, the FAA’s WJHTC Federal Laboratory recently entered into land lease agreement with regional entities, which enables construction of an Aviation Research and Technology Park. The intent of the Park is to become an innovation center for furthering aviation related research, development, technology transfer, and ultimately commercialization while providing an excellent setting to bring together a diverse group of government, industry, academic, and regional stakeholders. The TTPO also focuses on improving its internal activities, such as automation of common high volume tasks, which recoup time for professionals to dedicate to partnership activities. The expectation is that expanding these types of approaches will meet Plan objectives without sacrificing quality and conformance to policy.

This Plan is a living document. The TTPO will periodically re-evaluate information and will adjust the Plan, and any TTP processes, procedures, and goals as necessary.

Goals and Metrics

Strategic goals of the TTP are to advocate commercialization of new technologies developed by agency personnel and industry partners, expansion of the United States technology base, maximize return on investment on federally funded research and development, and provide access to resources to develop and commercialize ideas, concepts, or mutually developed products. FAA reports annually to DOT, metrics

for these goals as codified at 15 USC 3710 (f). FAA also includes in its reports the following metrics and other information:

- number of Cooperative Research and Development Agreements (CRDAs)
- number of other types of collaborative research and development relationships
- significant downstream outcomes from technology transfer activities

The TTPO recently began cataloging other research agreements (primarily contracts, memorandums of agreement, and interagency agreements) on behalf of the FAA. A potential outcome of this effort is to leverage information from these agreements for TTP initiatives.

Over the years 2013-2017, the TTPO intends to evaluate and put into practice as applicable and possible the following goals and actions. In the first year, it will evaluate inclusion of new actions or measures in addition to those already captured by its existing annual report.

Goal 1: *Increase the number of effective technology transfer and commercialization activities in partnership with non-federal entities.*

Action 1: Develop effective outreach materials and methods

Action 2: Develop improved strategies for invention disclosure and scope of IP protection

Action 3: Expand use of Small Business Innovation Research (SBIR)/Small Business Technology Transfer (STTR)

Action 4: Increase awareness of and participation in the Program by non-federal partners by initiating or increasing new outreach activities, e.g., trade meetings, social media, targeted marketing

Goal 2: *Establish strong foundation for successful commercialization of inventions with policies and actions that encourage inventor-ship, outreach, and availability of technology.*

Action 1: Promote inclusion of technology transfer goals and measures in FAA programs and plans

Action 2: Encourage laboratory directors to consider transfer technology efforts positively in job descriptions, promotion policies, and job performance evaluations of laboratory scientists and engineers

Action 3: Develop processes to measure scientific article publications

Action 4: Develop appropriate software-related metrics

Goal 3: *Increase the pace of effective technology transfer and commercialization activities in partnership with non-federal entities, including private firms, research organizations, and non-profit entities.*

Action 1: Implement automated workflow systems for routine activities where applicable and practical

Action 2: Develop improved invention reporting process

Action 3: Streamline technology transfer partnership processes and procedures. Identify bottlenecks and devise approaches to eliminate or reduce them, and improve or simplify agreements to reduce resources and time spent on negotiation

Goal 4: *Develop Technology Transfer Knowledge of the FAA and Aviation Community.*

Action 1: Improve synergy, collaboration, and coordination among FAA technology transfer professionals

Action 2: Expand skill sets of FAA employee and technology transfer professionals

Evaluation Method and Outcome

The TTPO is available to guide FAA offices, as appropriate for their missions, in accomplishing technology transfer goals. The TTPO will evaluate each year relative to preceding year(s) and consider program modifications to enhance achievement of goals. Depending on the outcomes of tasks, other actions or metrics may need established to assess the impact on future objectives. The TTPO will continuously re-examine how it can better integrate technology transfer practices in its Government-wide efforts.

Streamlining

FAA reviews its TTP processes and practices in order to simplify and expedite processing times, administration, and dissemination of information. The following initiatives are currently underway:

- consideration of pay.gov to receive royalty payments
- enhancement as practical of agreement databases
- Enhance public access to information using internal and external websites, and other media outlets as appropriate

Facilitating Local and Regional Partnerships

FAA collaborates with the non-federal sector through its Technical Partnerships and Information Exchange office, which strengthens cooperative research, expands Federal Laboratory capabilities through outreach activities at aviation-related conferences and events, and develops partnerships with non-federal partners. The office bolstered its staffing with highly experienced engineering and science personnel having the technical depth and skill to recognize potential areas of collaboration at the earliest stages. Multiple joint university and academic outreach programs include cooperative efforts, and support of a broad set of industry and government research problems, such as radio frequency identification, magnetic resonance imaging, cognitive characteristics of air traffic control, and glass surface treatment.

In addition to the previously mentioned land lease agreement, FAA continuously pursues collaborations with non-federal partners through CRDAs and other agreement mechanisms.

Appendix 2: Federal Highway Administration (FHWA)

Research, Technology Transfer, and Education (RT&E) Program

The FHWA's RT&E program role is to provide leadership at conducting highway-related research, development, deployment, and training activities to address current and emerging needs facing our nation's transportation system. The program is responsible for developing and delivering the solutions needed to meet current challenges and foresee future needs, addressing them proactively and effectively. FHWA's Research and Development initiatives are focused on advancing the state of the art. Technology Transfer and Training and Education Initiatives focus on advancing the state of the practice through the deployment of new technology and innovations.

The new technologies and innovations that result from FHWA's RT&E program are typically non-proprietary, and effective technology transfer requires that State DOTs and municipalities, and the private-sector contractors that they hire, learn about and use these new technologies and innovations. FHWA's leadership role signifies a commitment to working collaboratively with its partners in defining the direction of and developing the FHWA roadmaps needed to achieve results, especially since these partners may at times be the ones implementing the technologies and innovations developed.

The success of new technologies and products developed through FHWA research ultimately depends on their acceptance by States, industry, and other stakeholders. Innovation delivery is another key step in the R&T life cycle. Through demonstration projects, education and training programs, manuals and other publications, and hands-on assistance, FHWA works to support the deployment of new, cost-effective, and high-performing technologies. Deployment efforts are coupled with assessment initiatives, which complete the R&T life cycle by evaluating the impact of new processes and technologies.

FHWA provides key support to the delivery of technologies and innovations. By bringing together the FHWA Resource Center, National Highway Institute (NHI), and Technology Partnerships Programs under one office, FHWA strengthened its ability to deliver vital services more strategically. The Resource Center and its Technical Service Teams facilitate technology deployment and technical assistance, NHI provides critical training opportunities, and the Technology Partnerships Programs offer education and local and tribal technology assistance.

The Technical Service Teams provide expertise and innovative technical assistance to help State and local agencies successfully adopt and deploy new technologies in such areas as construction and project management, finance services, operations, pavement and materials, safety and design, and structures. The work of the teams is bolstered by NHI, which offers more than 300 courses across 17 program areas to advance the performance of the transportation workforce. A growing number of courses are available online, meeting the need for training even as State and local agencies face tighter budgets. Partnerships are also key, as the Technology Partnerships Programs support the training, technical assistance, and technology deployment efforts of the Local Technical Assistance Program and Tribal Technical Assistance Program centers.

The three main components of the RT&E program are as follows:

The Highway Research and Development program (HRD)

The HRD program highlights FHWA's leadership in developing a comprehensive, nationally-coordinated FHWA highway research and technology program, engaging and cooperating with other highway research stakeholders. The HRD program performs research activities associated with safety, infrastructure preservation and improvements, environmental mitigation and streamlining, livability considerations, operations, and policy. The research conducted aims to collect information that ultimately provides transportation policymakers tools and products that allows them to make accurate decisions that improve the nation's quality of life. The HRD program includes FHWA's advanced and applied research, and facilitates national and international coordination and collaboration to leverage knowledge and develop solutions to address current and emerging highway transportation needs.

- **Safety.** Research and development activities support comprehensive and sustainable safety programs. Activities emphasize data-driven analysis of roadway-related safety considerations and specific improvement in four crash areas: roadway departure, intersection, pedestrian, and speeding. The program conducts rigorous evaluations to determine what safety improvements can be expected with the introduction of countermeasure designs or operations. All design or operational changes are assessed from a human factor perspective to eliminate or minimize unexpected consequences of change. FHWA works in cooperation with NHTSA and FMCSA to develop tools and technologies to reduce crashes and improve highway and intermodal transportation safety.
- **Infrastructure.** FHWA conducts problem-focused research, development, and communications outreach activities to preserve the existing investment in our Nation's highway infrastructure and to build for the future through the application of advanced technologies that improve infrastructure integrity. Infrastructure-related research focuses on three major areas: pavements, bridges and structures, and asset management. This work includes: a) development of metrics to assess the performance of infrastructure over the longer term; b) research and development of technologies and techniques to assure that the Nation's infrastructure is world class from a standpoint of longevity, safety, performance, climate-change mitigation, and sustainability; and c) leadership to ensure effective follow-up and deployment of the improvements developed, particularly those that will speed construction and reduce congestion caused by construction.
- **Planning and Environment.** Activities in this program area include carrying out short and long-term livability initiatives to improve project delivery and enhance communities that are impacted by surface transportation projects; developing comprehensive strategies to minimize the impact of transportation investment on the environment; adjust to changing climate conditions, advancing state of the practice for data collection, geographic information systems applications, and travel forecasting; and providing technical assistance and forums, best practices, and training to assist States, Metropolitan Planning Organizations, local public agencies and other partners and stakeholders in planning and delivering surface transportation projects.
- **Operations.** The Operations program conducts research on the application of cutting-edge technologies to move people and goods better, quicker, and safer. The primary focus of Operations activities is on congestion relief solutions. This work will mitigate the impacts of recurring congestion, as well as deal more effectively with non-recurring events that cause congestion, such as traffic incidents, work zones, adverse weather conditions and planned special events. Activities also include conducting applied research to develop the next generation of traffic management systems and models, and researching specific technologies that can improve

the performance of its services and support to the Intelligent Vehicle Initiative and the Cooperative Intersection Collision Avoidance Initiative. HRD Operations also pursues a broad range of activities designed to improve freight movement and reduce freight-related congestion throughout the transportation network.

- **Policy.** The Policy program analyzes emerging issues in the transportation community, including climate change, public-private partnerships, highway revenues, performance management, authorizing legislation, and a host of other issues. The program also supports data collection on motor fuels, motor vehicles, licensed drivers, roadway characteristics, pavement conditions, travel trends, and travel behavior. Policy data collection and forecasting efforts provide the foundation on which program administration, policy analysis and implementation, and legislative support all rely. The Policy area is responsible for the development of the Infrastructure Investment Needs Report, which promotes the ongoing development of engineering and economic analytical tools and related products to assess the current and future conditions and performance of the Nation's highways and bridges. Policy initiatives include the International Highway Transportation Outreach Program, which provides better knowledge of technology and best practices put in place in other countries that can improve the U.S. surface transportation system. The initiatives also support implementation of these innovations, leveraging resources to enable the U.S. to benefit from investments made by foreign counterparts, and creating business opportunities for the U.S. private sector. The Policy program also supports innovative program delivery solutions in areas such as Public-Private Partnerships and alternative funding mechanisms for highways.
- **Next Generation Research & Technology.** The Next Generation Research & Technology (R&T) program is responsible for leading the development and coordination of the FHWA components of a national highway research agenda to provide policy-makers and the research community information needed to address critical knowledge gaps, collaboration opportunities, and accelerate innovation and technology deployment to meet future highway transportation needs. The FHWA provides the unique national leadership and support required to accomplish this goal and meet the collective needs and national priorities recognized by highway research and technology stakeholders. FHWA has been working with these stakeholders to establish an on-going framework or process to identify national research needs that should be the focus of FHWA's program; improve coordination among researchers; and identify potential opportunities for synergy among research entities. Initial work on creating the framework for developing a highway research agenda is underway, and resources are needed to continue this effort to achieve the goal of an enhanced research agenda, based on a sustained, collaborative process, and reflective of our national needs and priorities. Next Generation R&T also encompasses the Exploratory Advanced Research (EAR) Program, which conducts longer-term, higher-risk research with the potential for dramatic breakthroughs in surface transportation. Key elements of the EAR program are to obtain information from the very large number of basic and advanced research and development activities outside of the highway R&D community for possible exploitation, adaptation and eventual application to the highway industry. Next Generation R&T also supports the operation of the Turner-Fairbank Highway Research Center (TFHRC), a Federally-owned and operated research facility in McLean, Virginia that provides State and local governments, FHWA, and the world highway community with advanced and targeted applied research and development related to new highway technologies. Research conducted at and managed by this facility focuses on providing solutions to complex technical problems through the development of more economical, safe, and environmentally sensitive designs; more efficient, quality controlled constructions practices; and more durable materials.

Technology & Innovation Deployment Program (TIDP)

After innovations and technologies have gone through an initial testing and evaluation process, and they are ready to be put through a more refined, conclusive testing, or they are ready to be deployed, these technologies are advanced into the TIDP program, where final analysis, marketing, communications, and promotional activities are conducted to accelerate its adoption by state DOTs and other government entities or beneficiaries. This aspect of the innovation lifecycle has in the past been insufficiently funded, which has resulted in a number of market-ready technologies that could be highly beneficial to the industry being under-utilized. Thus, FHWA is establishing a separate program area that will aim at advancing deployment-ready technologies resulting from the HRD program, or take market-ready technologies developed by other entities and support their accelerated implementation by State DOTs or other stakeholders.

The goal of the newly-created TIDP is to accelerate the delivery and deployment of innovation and technology. The program aims to concentrate on the growing need to significantly accelerate the adoption of proven, high-payoff, innovative practices and technologies that will significantly improve safety, efficiency, reliability and performance of the current highway transportation system. The TIDP will shorten project planning and delivery time, advance longer-lasting highway innovations and technologies to accomplish the fast construction of efficient and safe highways and bridges, improve safety during and after construction, reduce recurring and non-recurring congestion, improve freight movement and enhance the quality of the highway infrastructure. The TIDP will speed up the adoption of innovative technologies by the surface transportation community, providing creative programs, technical assistance, and resources to state and local transportation agencies to implement market-ready technologies. The TIDP will embrace stakeholder participation, monitoring, evaluation, documentation, and open dissemination of results. It will allow for the modification or upgrade of existing innovations and technologies to ensure widespread adoption and benefit by the highway community.

FHWA TIDP will also work with AASHTO, the States, the Transportation Research Board and others on the implementation of the Strategic Highway Research Program (SHRP 2) results. The purpose of SHRP 2 is to conduct concentrated, results-oriented applied research focusing on solving the top problems in the area of highway safety, reliability, capacity, and renewal. The research program has been carried out by the Transportation Research Board (TRB) in consultation with AASHTO and FHWA, and is now reaching the results implementation phase.

Finally, TIDP will provide a conduit to accelerate technology and innovation delivery through FHWA's recently launched second Every Day Counts initiative (EDC2). The Every Day Counts Initiative identifies under-utilized market-ready technologies with high pay-offs and accelerates their deployment and acceptance throughout the Nation.

Training and Education program (T&E).

T&E is responsible for training the current and future transportation workforce, transferring knowledge quickly and effectively to and among transportation professionals, and providing education solutions throughout the full innovation lifecycle. The T&E program provides a wide variety of services and products, including:

- The National Highway Institute provides training courses to present the latest technologies and best practices in highway construction.
- The Local Technical Assistance Program supports technology transfer centers in all 50 states, Puerto Rico, and regional centers serving Native American tribal governments.
- Training and Workforce Development Programs:
 - The Dwight David Eisenhower Transportation Fellowship Program provides opportunities for high performing students and faculty to research transportation topics.
 - The Garret A. Morgan Technology and Transportation Education Programs enhance science, technology, engineering, and mathematics at the elementary and secondary school level.
 - The Transportation Education Development Pilot Program develops new curricula and education programs to train individuals at all levels of the transportation workforce.

How do you know the program works?

FHWA's continued commitment to highway research and the implementation of ground-breaking technology is changing the way roads, bridges, and other facilities are planned, designed, built, and maintained across the country. This commitment ultimately delivers a safer, more reliable transportation system that is both effective and environmentally sustainable. The success of the RT&E program can be illustrated through the following examples of innovations that support DOT strategic goals:

- **Safety:**
 - The SafetyAnalyst software tool is widely used by State DOTs to support the implementation of the new Highway Safety Manual.
 - Through the Every Day Counts (EDC) initiative, the accelerated implementation of the Safety Edge, which shapes the edge of the pavement to 30 degrees, is saving lives by allowing drivers who stray off highways to return to the road safely, reducing highway crashes.
- **State of Good Repair:**
 - Research conducted at the FHWA's Turner-Fairbank Highway Research Center (TFHRC) Hydraulics Laboratory has advanced the understanding of the effects of flooding, scour, and coastal inundation on bridges, providing useful information to evaluate infrastructure damage after a hazardous event, and to develop improved bridge design standards.
 - Geosynthetic Reinforced Soil (GRS), another EDC technology targeted for accelerated deployment, provides for extremely durable bridges at reduced costs.
- **Economic Competitiveness:**
 - The EDC initiative is accelerating implementation of Adaptive Signal Control, a technology that adjusts traffic signal timing to traffic patterns, resulting in reduced traffic congestion and delays, and decreased fuel consumption and vehicle emissions.
 - Federal, State and local transportation agencies have available a passenger travel analysis framework model developed by FHWA to forecast Vehicle Miles Traveled and perform a

variety of scenario analysis, allowing for better transportation planning and assist in crucial transportation decisions.

- **Livability:**
 - FHWA developed a toolkit to help practitioners incorporate livability considerations into transportation planning. Regional livability workshops are being developed across the country.
 - New technology developed at FHWA's TFHRC can survey streets, sidewalks, and curb ramps with great precision, allowing for quick evaluation for Americans with Disabilities Act compliance, improving sidewalk access and the livable community experience for everyone.
- **Environmental Sustainability:**
 - FHWA has led research that has produced information on potential impacts of climate change on transportation systems and infrastructure.
 - FHWA has also developed a rating tool to help State DOTs and MPOs evaluate the sustainability of highway systems and projects.

What are the Performance Metrics?

Although conducting a solid Research and Development program creates technologies and innovations with the potential to improve the state of the practice, the ultimate measure of that success is through the effective implementation of those advances.

EDC is FHWA's flagship initiative to accelerate the implementation of new technologies and innovations. Performance goals and metrics were established for each of the initiatives in the first round of EDC, and similar performance goals and metrics are being developed for the launch of the second round of EDC. These goals include statements such as:

Goal Example A: FHWA will ensure that [x%] of States are trained in [a technology] by [date].

Goal Example B: [x%] of State DOTs will have adopted [certain practice or technology] on Federal-aid projects by [date].

Goal Example C: For States that adopt [certain practice or technology], [x%] of the Federal-aid projects initiated after [data] will utilize [that practice or technology].

Goal Example D: By [date], [x] State DOTs will have a specification and/or contractual language to allow [certain practice or technology] on Federal-aid projects.

Goal Example E: By [date], at least [x] State DOTs will have established and achieved [a target use level for a practice or technology].

Goal Example F: By [date], at least [x practices or technologies] will have been [designed or constructed] nationally.

Goal Example G: By [date], at least [x] State DOTs will have authorized use of at least [x practice or technology].

Examples of Successful Technology Transfer

Below are a few examples of FHWA's successful research and technology transfer efforts.

Designing Safer Intersections

FHWA continues to be at the forefront of research into the design and application of roundabouts, which are one-way, circular intersections where traffic flows around a center island. With intersection-related crashes accounting for 47 percent of all crashes in the United States and 21 percent of all traffic fatalities, improving intersection safety is an important priority for FHWA. The results from roundabouts in use to date are significant. A National Cooperative Highway Research Program (NCHRP) Report, *Roundabouts in the United States* (NCHRP Report No. 572), found that the installation of roundabouts led to a 35 percent reduction in total crashes and a 76 percent reduction in crashes causing injuries or fatalities. Other studies have also reported impressive safety benefits. To support the implementation of roundabouts across the country, FHWA published *Roundabouts: An Informational Guide* in 2000. When it was issued, fewer than 100 modern roundabouts existed in the United States. With about 2,000 roundabouts located throughout the country today, TRB released *Roundabouts: An Informational Guide, Second Edition* (NCHRP Report No. 672) in 2010. Jointly funded by FHWA, the report officially updates and supersedes the 2000 Guide. A newly launched FHWA Roundabouts Peer-to-Peer Program, meanwhile, is providing technical assistance to State DOTs and others as they implement the technology. California, Connecticut, Illinois, Massachusetts, and Missouri have received assistance to date. NHI also offers training on "Modern Roundabouts: Intersections Designed for Safety" (Course No. FHWA-NHI-380096).

Sidewalks That Don't Trip You Up

Pavement smoothness is not only vital to building better roadways but a key factor in ensuring that sidewalks and curb ramps are accessible to individuals with disabilities and meet the standards of the Americans with Disabilities Act (ADA). However, the traditional ADA survey process for assessing the condition of sidewalks and curb ramps is time-consuming and does not offer jurisdictions precise data. The Ultra-Light Inertial Profiler (ULIP), an instrumented Segway® developed by FHWA for pavement surface evaluation, offers an accurate and cost-effective solution. FHWA provided technical support as Bellevue, Washington, used the ULIP to conduct an ADA evaluation of existing physical barriers for persons with disabilities. Use of the technology: 1) cut Bellevue's costs from more than \$1 million down to \$285,000 and 2) resulted in more precise data on conditions such as pavement roughness and defects, helping the city to better prioritize its remediation efforts. The cities of San Marcos, Clovis, and San Carlos in California are also using the ULIP for ADA assessment in 2011.

Two Decades of Advancements in Pavement Design and Management

More than 20 years after data collection began for the Long-Term Pavement Performance (LTPP) program, the benefits and products generated by the program continue to change pavement design and management worldwide. The LTPP database has played a critical role in the development and evaluation

of every major pavement design methodology developed over the past 20 years. This includes the 1993 and 1998 AASHTO design procedures, the Superpave[®] mix design system, and the DARWin-ME[™] pavement design software. This software gives engineers improved tools for specifying the optimum mix, layer configuration, and thickness for new and rehabilitated pavements. DARWin-ME would not have been possible without LTPP data for many inputs. Calibrated nationally with LTPP test sections, DARWin-ME has shown significant reductions in the initial cost for heavily trafficked pavement designs, and its use is expected to generate annual savings of \$1 billion. Beyond overall design procedures, the LTPP data have supported and will continue to support model development and validation for a wide array of pavement performance predictors and indicators.

The program has monitored the performance of nearly 2,500 in-service pavement test sections throughout the United States and Canada, including 758 test sections that are still being monitored today. These test sections represent a range of climatic and soil conditions. The data collected now form the largest and most comprehensive pavement database in the world. LTPP data have been translated into an array of products and tools for pavement engineers, including data collection procedures, a new falling weight deflectometer (FWD) calibration system, an updated FWD calibration protocol, and equipment protocols for traffic data collection. The FWD calibration system provides a method to assure that data collected to assess the structural condition of pavements will be accurate and consistent. A nondestructive testing device, the FWD imparts a dynamic load to the pavement surface that is similar to that of a single heavy moving wheel load. The resulting pavement deflection can then be measured. This deflection data combined with the pavement layer thickness can be used to help analyze the remaining service life of a pavement. These and other advancements resulting from LTPP research are detailed in a new report, *Long-Term Pavement Performance Program: Accomplishments and Benefits 1989–2009* (Pub. No. FHWA-HRT-10-071).

The LTPP program's LTPP Computed Parameter: Dynamic Modulus study developed estimates of the dynamic modulus of hot-mix asphalt (HMA) layers on LTPP test sections following the models used in the *Mechanistic-Empirical Pavement Design Guide*. Adopted by AASHTO in 2008, the new guide enables transportation agencies to better predict pavement performance over time and make more informed decisions when designing pavements. Additionally, LTPP*, a user-friendly software, was developed to facilitate dynamic modulus computations. This will allow transportation agencies to more accurately characterize the strength and load resistance of their asphalt mixes, resulting in better and longer lasting pavements. Nearly 400 copies of the software have been distributed to State agencies and others. More information on the software and study findings can be found in the new TechBrief, *LTPP Computed Parameter: Dynamic Modulus* (Pub. No. FHWA-HRT-11-018).

LTPP advancements will also benefit future pavement professionals. Several universities have introduced curricula that include LTPP data, for example. To encourage use of the data, FHWA and the American Society of Civil Engineers (ASCE) sponsored an International Contest on LTPP Data Analysis in 2010. The contest included categories for both undergraduate and graduate students, partnerships, and curriculum. Looking to the future, additional products and tools could result from efforts to optimize pavement treatment selection, assess the impact of the environment on pavement performance, and compare the performance of new materials to conventional materials.

Optimizing Concrete Pavements with COMPASS

Many factors, including project time constraints, demand for longer pavement design lives, and environmental, social, and economic considerations, are leading the concrete paving industry to come up with new ways to proportion and optimize concrete mixtures. Additionally, many concrete material choices are available today that add complexity to the mixture proportioning process. With all of these changes, the industry needed a tool for concrete mixture optimization that could isolate properties of interest and simplify the approach to the mixture proportioning process based on site-specific conditions. In response to this need, FHWA developed the Concrete Mixture Performance Analysis System (COMPASS). With this Windows[®]-based application system, a user can optimize the performance of a concrete mixture in a particular environment by properly selecting material constituents, such as types of aggregates, cementitious materials, and admixtures, that will benefit properties identified as important to a particular environment or project type. The user can also determine the appropriate gradation and material constituent proportions that will enhance the performance of a mixture. These benefits will result in longer-life pavements.

CA4PRS: Get In, Get Out, Stay Out

As 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 making accelerated construction a reality. The software was developed under an FHWA pooled fund study by the Institute of Transportation Studies at the University of California at Berkeley. California, Minnesota, Texas, and Washington participated in the study. All States can now obtain the software and training at no charge.

CA4PRS can be used to identify optimal highway rehabilitation strategies that balance the construction schedule with 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). A growing number of States are using CA4PRS, including California, Utah, and Washington. Approximately 20 States have obtained the software. The California Department of Transportation (Caltrans), for example, used it in the design stage of a recently completed 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 cut construction and traffic control costs by 25 percent, saving \$6 million, and an additional \$2 million in road user costs. "A key benefit of using CA4PRS is that it allows us to get in and get out faster, reducing both the length of construction projects and traffic congestion," said Michael Samadian of Caltrans.

Enhanced Bridge Inspections Through Nondestructive Evaluation

Following the collapse of the I-35W Bridge in Minneapolis, Minnesota, in 2007, FHWA developed a Bridge Inspection Nondestructive Evaluation Showcase to give bridge owners, managers, and inspectors training in the latest nondestructive evaluation (NDE) tools and systems. NDE methods can be used to

assess existing conditions in highway bridges during routine inspections, supplementing visual inspections and improving the overall reliability of bridge evaluations. The showcase is now offered through NHI (Course No. FHWA-NHI-130099). FHWA is also conducting numerous other studies intended to advance NDE practice and help develop and deploy new tools and technologies that aid in assessing the condition of the Nation's physical infrastructure. Work underway includes researching NDE methods as well as developing resources for bridge owners and inspectors. A current research project is focusing on developing an advanced method of measuring corrosion and section loss in gusset plates, with an emphasis on multiple plates and areas that are not visible for inspection. An ongoing project is investigating using response-based analysis of in-service bridges to increase the accuracy of load ratings. One benefit of this increased accuracy is to minimize load restrictions for bridges. These research projects and other NDE methods that range from simple to highly advanced will be documented in FHWA's forthcoming *NDE Web Manual*. The manual, which will be hosted on the FHWA Web site, will feature information on NDE methods and link the methods with the inspection situations where they should be used.

RealCost Produces Real Savings

FHWA's RealCost software is a tool for performing life cycle cost analysis (LCCA) for pavement selection. The software can also be used for bridges and structures. LCCA provides a cost comparison between two or more competing design alternatives that produce equivalent benefits for the project being analyzed, evaluating agency and user costs over the life of the various alternatives. Because LCCA focuses on costs required over the life of an asset to maintain it above some minimum performance level, the lowest cost alternative is not necessarily the one with the lowest cost of initial construction. Using RealCost, agencies can analyze up to six design alternatives simultaneously. Up to four different traffic distributions, such as for a weekday or weekend, can also be defined and selected. Currently available in Version 2.5, which was released in 2010, the software calculates life cycle values for both agency and user costs associated with construction and rehabilitation. Numerous States have adopted RealCost for pavement LCCA and several, including California, Colorado, Florida, and Washington, have formally incorporated it into their pavement type selection policy or process. FHWA continues to enhance the RealCost software, incorporating user feedback and research findings. A new version of the software is expected to be released in 2012.

Making Highway Projects More Sustainable

As transportation agencies seek to build sustainable highways that meet development and economic growth needs, while reducing impacts on the environment and consumption of natural resources, tools are needed to help agencies quantify sustainability and support their decisions. Released in 2010, FHWA's Sustainable Highways Self-Evaluation Tool will provide valuable assistance to State DOTs and Metropolitan Planning Organizations (MPOs) as they work to make their highway projects more sustainable. With support from FHWA's flexible, cross-functional research funding, the tool was developed in cooperation with State and local transportation agencies and organizations such as AASHTO and ASCE. States and MPOs can use it to evaluate their projects and practices and rate them using a consistent set of evaluation criteria and scores.

This unique tool addresses the full life cycle of a highway project, from planning through construction to operations and maintenance. Sustainability is measured through goals and credits for sustainable highway practices, projects, and programs. Each credit describes a particular practice, provides methods for implementing it, and includes examples where it has been successfully applied. The self-evaluation tool includes 68 credits, organized into system planning, project development, and operations and maintenance. Some agencies may use the sustainability tool to learn about how others are addressing sustainability or to find out more about certain sustainability practices that can be applied to a project, while other agencies may use it to track the performance of projects over time. Available in a beta version online at www.sustainablehighways.org, the tool offers users maximum, hands-on flexibility. Through a pilot testing initiative, FHWA will continue to refine and improve it.

Recycling Solutions

Recycling asphalt pavement creates a cycle of reusing materials that optimizes the use of natural resources. Reclaimed asphalt pavement (RAP) reduces the need to use virgin aggregate, which is a scarce commodity in some areas of the United States, and cuts the energy and transportation costs needed to obtain the aggregate. It also reduces the amount of costly new asphalt binder required in the production of asphalt paving mixtures. The state of the practice for RAP use in the United States, as well as best practices for increasing the use of RAP in asphalt pavement mixtures while maintaining high-quality pavement infrastructure, is detailed in a new FHWA report, *Reclaimed Asphalt Pavement in Asphalt Mixtures: State of the Practice* (Pub. No. FHWA-HRT-11-021). The report provides useful information on RAP percentages and asphalt binder grade selection, mix design considerations, and performance of RAP asphalt mixtures.

From 2007 to 2009, about half of States reported increased use of RAP, with the average percentage of RAP used in HMA around 15 percent. Analyses by FHWA have shown that the performance and life of pavements containing up to 30 percent RAP is similar to virgin pavements containing no RAP. The ability to use 30 percent RAP in asphalt mixtures, compared to no RAP, can result in cost savings of more than \$5 per ton of asphalt. Research led by FHWA has also shown that up to 20 percent RAP can be used in an HMA mixture without having to make changes to the asphalt binder. Using 20 percent RAP compared to 15 percent RAP results in cost savings of at least \$1.25 per ton of asphalt. Based on the amount of HMA and warm mix asphalt (WMA) produced in 2010 and the amount of RAP used in HMA and WMA, this could result in savings of \$125 million annually.

A Foundation for Future Mobility

TFHRC's new multimodal Transportation Operations Laboratory contains test beds for developing data resources, transportation concepts and analysis, and cooperative vehicle-highway interfaces. Offering a foundation for the future, the lab's research will explore how innovative technologies can dramatically change and improve the performance of the Nation's transportation system. The lab's concepts and analysis test bed, for example, will be used to conduct "what-if" simulations to assess the impact of different technologies and policies. Research into vehicle-highway interfaces, meanwhile, will explore how traffic signals can "talk" to cars and mobile devices and cars can then "talk" to other cars and traffic

signals about where they are and how fast they are going. This research could lead to significant decreases in delays and a reduction in the number of crashes that occur during stop-and-go traffic.

Targeted Safety Messages Talk to Your Vehicle

Operations research that will use the Cooperative Vehicle-Highway Testbed (CVHT) in FHWA's new Transportation Operations Laboratory includes the Signal Phase and Timing (SPaT) Interface Definition and Prototype, which will define a common two-way interface between vehicle systems, mobile devices, and traffic signal controllers. This would enable applications such as warning drivers they are about to violate a red light and optimizing traffic flows through intersections, which can reduce emissions and fuel usage. The first two prototype controllers to use this new interface will be tested in the CVHT in late 2011 and early 2012.

FHWA is also supporting the procurement of roadside equipment that will enable wireless communications between vehicles and infrastructure for the Connected Vehicle Safety Pilot, which is being led by the Intelligent Transportation Systems (ITS) Joint Program Office of the U.S. Department of Transportation's (U.S. DOT) Research and Innovative Technology Administration. Beginning in 2011 and running through the first half of 2013, this major research initiative will test how drivers in real-world conditions will respond to wireless safety messages targeted to them based on their specific position, situation, or vehicle type. These messages could include warnings such as "Use Caution, Icy Roads Ahead" or "Stop! Red Light Ahead" and address crashes associated with driving too fast for the conditions or driver distraction.

Traffic Signal Triggers

FHWA researchers are using step-frequency ground-penetrating radar (SF-GPR) to develop a nondestructive method for detecting and assessing inductive loop sensors that are embedded in roadway surfaces. The SF-GPR technology offers advanced subsurface three-dimensional imaging capabilities. The sensors being assessed indicate the presence or movement of vehicles and provide information that supports such traffic management applications as signal control and freeway mainline roadway and ramp control. Malfunctioning sensors can prevent traffic signals from sensing the presence of vehicles, which can be both frustrating for drivers and delay or prevent the display of green signal indicators to motorcyclists and bicyclists. Since research began in 2006 under a Small Business Innovation Research project, FHWA has improved the GPR detection and resolution capability and made significant steps in advancing the technology to the point where it can be commercialized.

Exploring Next Generation Solutions

FHWA highway research is creating a better, safer driving experience for today, but it is also looking at the infrastructure that will define tomorrow. From cutting-edge technologies inconceivable a generation ago to "smart" pavements and bridges that are just around the corner, the next generation of transportation has already begun.

Developing the Next Generation of Bridges and Asset Management Tools

The Long-Term Bridge Performance (LTBP) program is leading the way toward a better future for bridge performance. The program will collect, maintain, and study high-quality, quantitative performance data for a representative sample of bridges nationwide. These bridges will feature many structural types and materials, as well as variations in geometry, age, traffic volume, truck loads, and climatic conditions. Data collected by the program will support a better understanding of how and why bridges deteriorate, how to best prevent or mitigate deterioration, and how to most effectively focus the development of the next generation of bridge management tools. Pilot studies to assess program protocols and data management systems are now being conducted at seven bridges across the country. Located in California, Florida, Minnesota, New Jersey, New York, Utah, and Virginia, the pilot bridges represent both a broad geographic distribution and a cross section of the bridges on which the LTBP program will focus. The program will concentrate on the types of bridges heavily represented in the U.S. bridge population, including highway and interchange overpasses and bridges over minor waterways. The pilot phase is currently underway and will be completed in 2011, with the longer-term data collection phase to follow. While the data collection will occur over an extended period of time, an immediate payoff from the program will be the ability to integrate data from nondestructive testing and monitor bridge deterioration.

A New World of Ultra-High Performance Concrete

As the Nation looks to build longer lasting bridges and more rapidly renew its highway infrastructure, the use of high-strength and high-performing materials is more important than ever. For more than 10 years, FHWA's structural concrete R&D program has worked to take concrete to new levels with the implementation of ultra-high performance concrete (UHPC). Exhibiting superior properties such as exceptional durability, high compressive strength, and long-term stability, UHPC components can facilitate accelerated construction and allow for the use of longer spans. States such as Iowa, New York, and Virginia are now beginning to use the new technology. In Buchanan County, Iowa, for example, the construction of the Jakway Park Bridge received a boost with the successful use of a new type of UHPC bridge girder developed through the FHWA R&T program. This was the first bridge in the country to be built using the UHPC technology, demonstrating the viability of the concept from design, through construction, and into everyday use.

UHPC research focal areas are advancing, including through a Transportation Pooled Fund project being conducted in partnership with the New York State Department of Transportation (NYSDOT) and the Iowa Department of Transportation. The project is evaluating the performance of novel field-cast UHPC connections linking prefabricated bridge girders to precast concrete bridge decks. While the use of modular bridge deck components can produce higher quality, more durable bridge decks, the required connections have often been lacking, diminishing the overall system performance. The new UHPC connection eliminates the conflict points between the deck reinforcing bars and the girder shear connectors, allowing for easy field assembly. NYSDOT hopes to use the concept in a highway interchange reconstruction project in 2011.

The story of UHPC and the unique solutions it offers is told in a new FHWA TechNote, *Ultra-High Performance Concrete* (Pub. No. FHWA-HRT-11-038).

Every Day Counts

Rapid deployment of proven technology and solutions to speed up project delivery are at the heart of FHWA's new Every Day Counts (EDC) initiative. The EDC initiative is designed to identify and deploy proven, ready-to-go innovation aimed at shortening project delivery, enhancing roadway safety, and protecting the environment. Teams from FHWA are working with State, local, and industry partners to implement the EDC technologies and to achieve better, faster, and smarter ways of doing business. Priority technologies include many developed or advanced through FHWA research, such as warm mix asphalt (WMA), prefabricated bridge elements and systems (PBES), Adaptive Signal Control Technology (ASCT), and the Geosynthetic Reinforced Soil Integrated Bridge System (GRS-IBS).

ASCT adjusts signal timing to account for the variability in traffic demand that conventional traffic signals cannot accommodate, thereby improving traffic congestion and safety. Locations that have used this technology include Anne Arundel County, Maryland; San Ramon, California; San Marcos, California; Los Angeles, California; Bellevue, Washington; and Ann Arbor, Michigan.

The Safety EdgeSM technology provides a simple but effective solution to reduce pavement edge-related crashes and help save lives. By shaping the edge of a pavement to 30 degrees, the Safety Edge helps mitigate the problem of vertical drop-off, enabling vehicles to return to the paved road smoothly and easily.

WMA encompasses a variety of technologies that allow asphalt to be produced and then placed on the road at lower temperatures than the conventional HMA method. The lower temperatures may result in cost savings and reduced greenhouse gas emissions because less fuel is required. WMA is a proven technology that improves compaction, which then improves pavement performance, reduces fuel and energy usage, and increases worker comfort by reducing exposure to high temperatures and odors. WMA also has the potential to extend the construction season, allowing projects to be delivered in a timelier manner. TFHRC staff conducted early experiments when WMA technologies emerged and have been active participants in subsequent research and the deployment of WMA across the Nation.

FHWA has also supported research on PBES, as well as deployment of the new technology. The prefabricated systems can be manufactured offsite at a prefabrication plant or adjacent to the project site by the contractor, under controlled conditions, and brought to the bridge location ready to install. The use of PBES, ranging from superstructures or substructures to totally prefabricated bridges, offers both faster and safer bridge construction and better quality. PBES can also reduce costs and the environmental impact of projects. FHWA's *Connection Details for Prefabricated Bridge Elements and Systems* manual (Pub. No. FHWA-IF-09-010) provides transportation agencies, contractors, and consultants with information on the state of the practice for accelerated bridge construction across the country.

In States such as Ohio and New York, GRS-IBS technology is revolutionizing bridge building by alternating layers of compacted local soil and sheets of geotextile fabric reinforcement to build abutments and provide support for the structure. Researchers at the U.S. Forest Service and the Colorado Department of Transportation (CDOT) pioneered the early development of the GRS technology. FHWA then worked with CDOT to further refine it. Today, FHWA is continuing to refine and broaden the applicability of the technology. The result is bridges that are both extremely durable and cost effective, with costs potentially reduced by 25 to 60 percent. The GRS-IBS method also blends the roadway into the superstructure to

create a jointless interface between the bridge and the approach roadways, alleviating the common “bump” caused by differential settlement between bridge abutments and approach roadways. GRS-IBS can be built with readily available materials, using common construction equipment, and without the need for highly skilled labor.

New FHWA publications continue to advance the deployment of the GRS-IBS technology, including the *Geosynthetic Reinforced Soil Integrated Bridge System Interim Implementation Guide* (Pub. No. FHWA-HRT-11-026) and the *Geosynthetic Reinforced Soil Integrated Bridge System Synthesis Report* (Pub. No. FHWA-HRT-11-027). The guide takes engineers through the site selection, design, and construction process for GRS-IBS, while the companion report substantiates the design method and presents case histories for GRS-IBS bridges built to date.

Appendix 3: Federal Motor Carrier Safety Administration (FMCSA)

FMCSA Input to the DOT response to White House’s 10/28/2011 Memorandum: Accelerating Technology Transfer and Commercialization of Federal Research in Support of High Growth Businesses

Introduction

The mission of the Federal Motor Carrier Safety Administration (FMCSA) is to reduce highway crashes involving large trucks and intercity buses. Through the Agency’s research, development, and technology program, it facilitates the accelerated transfer of innovative technologies and solutions to improve the safety of commercial motor vehicle (CMV) operations. FMCSA’s technology transfer activities produce data, analyses, technical performance specifications, final reports and briefings made available to industry stakeholders, truck and bus manufacturers, safety technology suppliers and developers, research institutions, and the general public to foster and encourage improving CMV safety.

Research to Support Rulemaking

FMCSA performs transformative research focusing on risk factors and safety technologies that inform FMCSA’s programs and priorities, and ultimately supports deployment of those technologies. The Agency accomplishes this by expanding research on CMV driver risk factors to support rulemaking and to promote a safety and wellness culture in the CMV industry. Research areas include CMV distracted driving, driver fatigue, inattention, and other driver conditions and impairments that support rulemaking and promote health, wellness, and safety culture in motor carriers.

No.	Milestone	Evaluation Method	Timeline
1	Initiate research activities to support rulemaking that addresses the application of technology to improve driver and vehicle safety.	Establish baseline for the number of studies initiated annually and measure trends over time.	Annual assessment of the number of published studies.

Improved Commercial Motor Vehicle Enforcement Capabilities

The development and adaptation of wireless communication technologies has the potential to increase the efficiency of roadside truck inspection processes and to reduce administrative burdens. Research in this area will facilitate the adoption of technologies that facilitate inspections and increase the effectiveness of enforcement efforts.

No.	Milestone	Evaluation Method	Timeline
2	Initiate research activities that facilitate the adoption of advanced CMV enforcement technology to improve driver and vehicle safety.	Establish baseline for the number of studies initiated annually and measure trends over time.	Annual assessment of the number of published studies.

Deployment of Safety Technologies by Fleets

FMCSA will accelerate the deployment of onboard safety technologies by promoting the benefits to fleets and insurance carriers through the testing and evaluation of next generation safety systems in partnership with technology providers and other USDOT agencies. Further, FMCSA will identify, test, and deploy smart roadside technologies in partnership with State CMV safety agencies and other Federal agencies.

No.	Milestone	Evaluation Method	Timeline
3	Deployment and adoption of advanced safety systems by commercial vehicle operators	Establish market penetration baseline and measure trends over time.	Annual assessment and monitoring of safety technology adoption.

Commercial Vehicle Information Systems and Networks (CVISN) as a Technology Transfer Tool

As authorized by MAP-21, the FMCSA provides CVISN deployment grant funds to advance technological capability and promote the deployment of intelligent transportation systems applications for commercial vehicle operations, including commercial vehicle, commercial driver, and carrier-specific information systems and networks. The CVISN grants to states support deployment and evaluation of advanced technologies in the following areas:

Safety Information Exchange - technologies to facilitate the collection, distribution, and retrieval of historical and real-time commercial vehicle information at the roadside.

Electronic Credential Administration - systems for electronic submission, processing, approval, invoicing, payment, and issuance of commercial vehicle credentials and special permits.

Electronic Screening – systems which allow transponder-equipped commercial vehicles that maintain good safety and legal status to bypass some roadside inspection and weigh stations.

No.	Milestone	Evaluation Method	Timeline
4	Electronic Screening Deployment of electronic screening equipment.	Measure trends over time using approved metrics and compare to baseline: 39 states	Annually assess status for remaining states.
5	Electronic Credential Administration Automated processing of license information and data exchange with clearinghouse.	Measure trends over time using approved metrics and compare to baseline: 35 states	Annually assess status for remaining states.
6	Safety Information Exchange Connectivity with Agency systems to share vehicle inspection data.	Measure trends over time using approved metrics and compare to baseline: 33 states	Annually assess status for remaining states.

Appendix 4: Federal Railroad Administration (FRA)

This document is in response to the Presidential Memorandum on October 28th, 2011, "Accelerating Technology Transfer and Commercialization of Federal Research in Support of High-Growth Businesses". In support of this memorandum, the Federal Railroad Administration will highlight its activities addressing technology transfer conducted through the Office of Research and Development. The FRA does not maintain or operate a Federal Laboratory as defined in the memorandum. The research from this Office is conducted through universities, support contractors, and small businesses being directed by FRA program managers that specialize in a specific area of research. This approach also involves early and appropriate partnerships with the railroads, railroad suppliers, technology providers, state and regional rail authorities and railroad researchers at selected Universities to enable maximum real-world impact at the earliest possible time. These partnerships bring in both the suppliers and the end users into the initial development of the technologies which promote research transition and implementation (i.e. technology transfer).

FRA research is transferred to the industry and suppliers through the following processes:

- Actively participate in Association of American Railroads, American Railway Engineering and Maintenance-of-Way Association, Transportation Research Board, American Public Transportation Association, and other railroad committees
- Coordinate joint research programs with industry partners
- Publish interim research results and formal reports
- Attend technical conferences to present research findings, scan for new technologies, and coordinate research activities
- Demonstrate technologies to railroads and suppliers
- Develop and make available to industry unique custom hardware and software for specific railroad applications
- Work with industry to apply for regulation waivers to encourage implementation of leading edge technology while maintaining safety

The FRA holds no patents and does not own any of the technologies developed under the research program. However, multiple patents have resulted from the sponsored research. These patents are held by private firms that were contracted to conduct the research. In addition, some of these companies are actively utilizing the patents for commercial purposes. The government has usage rights to these patents if needed.

Previous experience has demonstrated that from concept to product commercialization typically take seven to ten years to completion. This duration is controlled by changes in requirements and funding levels during the development. FRA Office of Research and Development focuses significant effort to assure that the ideas and technologies developed become useful tools for the industry.

The FRA utilizes a stakeholder subsidiary to hold a care, custody, and control contract on the Transportation Technology Center which is a DOT facility. This contract requires minimum yearly reinvestment by the contractor to maintain and upgrade the facility at no cost to the government. In return, the facility can be used for commercial activities related to the agencies missions. The

government has first priority on the use of the facility and controls the site modifications and upgrades. The research scientists and engineers housed at the facility are supported by the stakeholder subsidiary and not the FRA. The FRA does conduct research at the facility utilizing an IDIQ Task order contract to meet specific research objectives.

RESEARCH AND DEVELOPMENT METRICS

Selecting the appropriate evaluation metrics is the key to aligning the researcher's goals with those of the department. The wrong metrics are counterproductive and can lead to decisions and actions that are not beneficial to technology transfer activities. Success is measured by actual implementation of the ideas or technology by the industry. The industry providing funding and support to a program or project is a strong indication that the activity has significant merit and potential for complete technology transfer. This metric is a function of the stage of the program. The industry providing funding or in-kind services typically occurs during late stage programs.

Early stage projects no matter what the potential payout would not be funded by the railroads until there is a demonstrated potential for success. Early stage projects or programs are defined as basic research which attempts to understand the fundamentals of railroad science or technology. Mid or late stage projects are applying the technologies developed in the early stages toward prototypes that can be tested and evaluated. The FRA does not fund projects beyond the prototype and demonstration stage. Commercialization activities that turn the prototype into a product are done solely by the contractor or supplier usually supported by a railroad partner.

Below are the recommended metrics for early and late stage programs. The early stage programs utilize effort based metrics while the late stages are outcome based.

Metrics to be considered for early stage programs;

- Match to USDOT/FRA strategic objectives
- Number of reviewed technical papers and/or conference presentations
- Patents filed or issued through FRA funded R&D

Metrics to be considered for late stage programs;

- Values of normalized statistical derailment trends
- Funding levels or in-kind support provided by the Industry
- Number of purchased, rented/leased systems provided by supplier
- Number of new suppliers entering the market with similar technologies
- Number of companies that utilize government furnished equipment
- Number of track miles or employees covered by technology or approach

The effort based metrics data are internally generated and therefore can be easily collected. The outcome based metrics can be much more difficult to gather. It will require information provided by the railroads and suppliers which may not be readily available. Tight coordination with industry and possible rulemaking activities may be required. Further efforts will be directed towards the evaluation process which will better define measures for the level of success.

As mentioned earlier, FRA Office of Research and Development focuses significant effort to assure that the ideas and technologies developed become useful tools for the industry. Technology transfer and business development has previously been accomplished through the FRA research program and will continue to be part of our mission.

Appendix 5: Federal Transit Administration (FTA)

FTA TECHNOLOGY TRANSFER

As a key agency in the U.S. Department of Transportation (DOT), the Federal Transit Administration (FTA) undertakes and funds nationally-significant research, development, demonstration, deployment, and evaluation projects to improve public transportation services throughout the United States. See Figure 1 for illustration. These activities are conducted in partnership with private industry, academia, public transportation systems, state and local governments, and non-profit and for-profit entities, among others.

A significant outcome of all FTA-funded research and demonstration projects is sharing the knowledge to ensure that research and scientific discoveries are distributed throughout the marketplace to benefit the economy and the nation. The dissemination of this knowledge—technology transfer—is central to FTA’s activities, with emphasis on getting the latest ideas and technologies into the hands of the transit industry as quickly as possible.

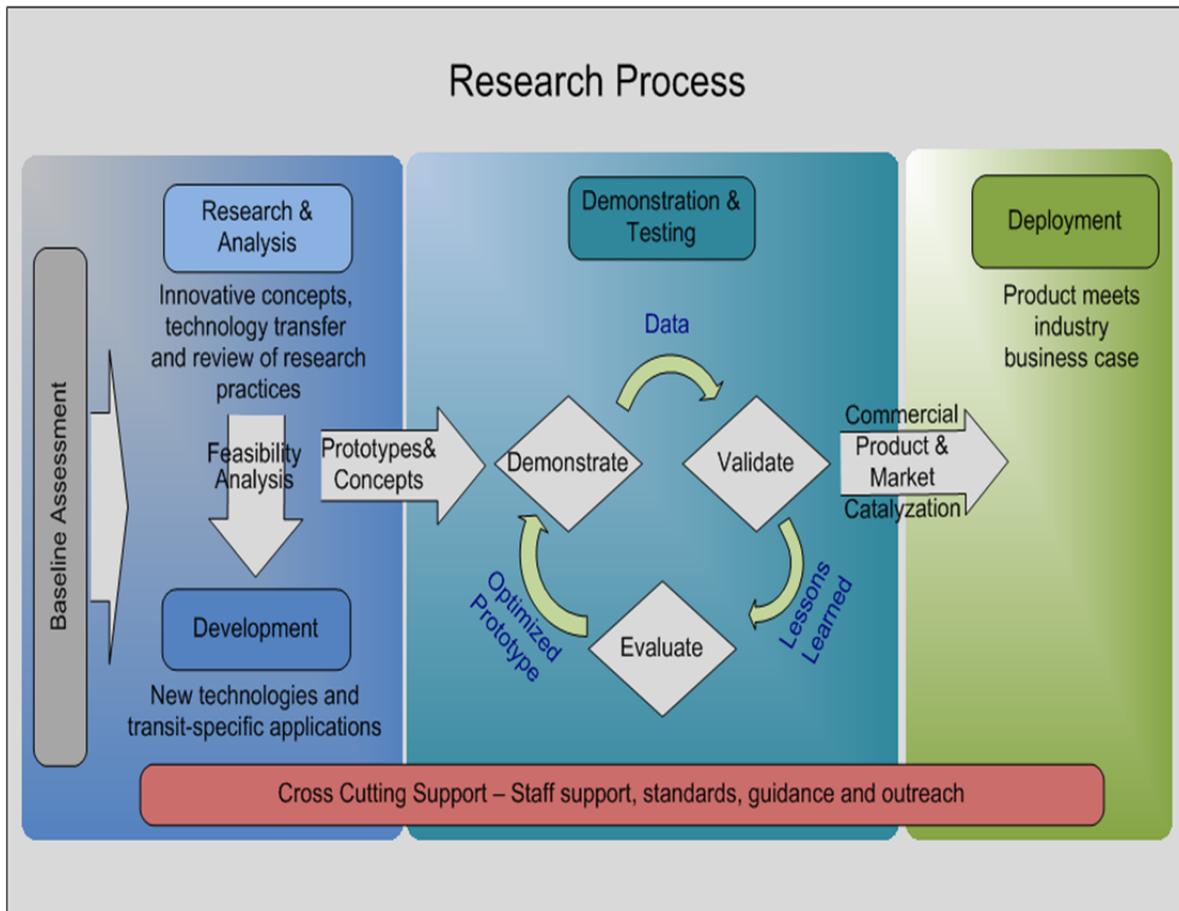


Figure 1 Illustration of technology transfer activities conducted at FTA.

Technology transfer plans and activities of selected FTA research and demonstration programs are presented below. These plans emphasize how the dissemination of results is critical to their success.

Low or No Emissions Vehicle Deployment Program (LONO)

U.S. DOT's new authorizing legislation, MAP-21, establishes a new Low or No Emissions Vehicle Deployment program that provides funding for acquiring low or no emissions transit vehicles and the infrastructure to support those vehicles. The program encourages projects that build on successful research, innovation, and development efforts, thus providing a pathway for promising advanced vehicle technologies from FTA research efforts to enter the market and get the volumes required for cost reductions.

Although primarily a capital program, the LONO program provides opportunities for technology transfer activities. As part of the new program, FTA will conduct comprehensive evaluations that can be used to better understand the pathways and obstacles to deploying zero and low emissions vehicle technologies. This information will be documented and used to inform the transit industry of the available technologies and their potential benefits and can also be used to structure future research efforts to maximize their deployment potential.

Intelligent Transportation Systems for Transit

Intelligent Transportation Systems (ITS) are techniques and methods for relieving congestion, improving road and transit safety, and increasing economic productivity. During the last few decades, there have been rapid advances in information and communications technology. Many transit agencies have employed a number of these different technologies to supplement or enhance the transportation services they offer to the public.

FTA's transit ITS research includes real-world operational testing of prototypes and technologies nearing commercialization. Working with transit agencies and manufacturers, FTA has conducted evaluations of ITS demonstration projects to assess the impacts and determine the costs and benefits of new technologies. FTA uses the engineering and applied research necessary to encourage the transit industry to adapt and integrate these new technologies into transit applications. Research is also conducted to identify risk factors and establish solutions.

FTA, under its efforts to promote ITS, identifies the state-of-the-practice from the technological, institutional, economic, industrial, and deployment perspective and, in close coordination with the transit industry, encourages standards and best practices to provide a consistent environment for eliminating incompatibility, streamlining procurement, ensuring safety, and reducing costs. Through FTA funding, transit ITS innovations are observed and evaluated by FTA researchers in large-scale field operational tests to identify best practices and lessons learned, which enables the transfer of knowledge to implementing agencies and forms the basis for new training. A vital outcome is the validation of

technologies through testing and the delivery of proposed specifications that allow vendors to produce consistent, high-quality products.

Technology transfer activities in transit ITS include technical assistance, peer-to-peer exchanges, professional development and training, information sharing, and industry dialogue, conducted to best relate lessons learned to achieve desired outcome goals. Standards development organizations (SDOs), which are generally familiar with similar ITS technologies in multiple industries, help in the process of adapting new technologies to take advantage of existing manufacturing capabilities and vendors. Industry groups also take a large role in information sharing and supporting further deployments.

Table 1 CURRENT ITS RESEARCH ACTIVITIES CONSIDERED FOR TECHNOLOGY TRANSFER

	<i>Milestone</i>	<i>Evaluation Methods</i>	<i>Timeline/Results</i>
1	Test and Evaluate Vehicle Assist and Automation (VAA) technology for system operations and improvements	Establish baseline and measure trends over time using approved metrics.	Establish baseline in 2012 using current operations data and measure progress during field test. Develop Commercialization Plan in 2013.
2	Test and Evaluate Integrated Corridor Management (ICM)	Establish baseline and measure trends over time using approved metrics.	Using the modeling results as a baseline, monitor field testing data in 2013 for use in the evaluation. Results will establish new Criteria for Corridor Management.
3	Test and Evaluate Connected Vehicle technologies for transit	Direct transit field test in coordination with RITA's Joint Program Office for data collection and evaluation	Field test through 2013 in preparation of possible Rulemaking by NHTSA.

Transit Investments for Greenhouse Gas and Energy Reduction (TIGGER)

FTA's TIGGER Program involves working directly with public transportation agencies to implement new strategies for reducing greenhouse gas (GHG) emissions and/or energy use within transit operations. These strategies can be implemented through operational or technological enhancements or innovations. To align the TIGGER Program with other strategic initiatives, FTA encourages project implementation through Regional Office oversight that will enhance operational efficiencies, demonstrate innovative vehicle propulsion strategies, and create an environment prioritizing public transportation through other technology approaches to achieve efficiency and sustainability goals.

The TIGGER Program was initiated within the American Recovery & Reinvestment Act (ARRA) of 2009 and continued with SAFETEA-LU funding in 2010 and 2011, Over the next several years, FTA will collect information and data on each TIGGER project to assess the success of the program and to validate GHG and energy savings claims made in project proposals. To aid in this task, FTA has entered into an intra-agency agreement with the National Renewable Energy Laboratory (NREL) to conduct independent evaluations of the program.

Proposed technology transfer activities include developing research briefs, case study analyses, and a report to Congress to increase awareness and use of innovative technologies and operational strategies within the transit industry for reducing energy use and GHG emissions. Proposed activities also include cooperation with non-federal partners within the program through trade meetings and webinars and developing effective outreach materials and methods.

National Fuel Cell Bus Program (NFCBP)

The National Fuel Cell Bus Program is a cooperative research development and demonstration effort established under the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) legislation to advance the commercialization of fuel cell buses. Fuel cells provide a zero-emissions alternative to diesel-powered buses without the issues associated with greenhouse gas and particulate emissions, high maintenance costs, and fuel price fluctuations of diesel buses. Fuel cell bus research can also directly benefit other vehicles, such as hybrid and battery-powered buses. The program is conducted in close partnership with industry, including manufacturers, suppliers, and transit agencies—the end users of the technology. Funded under 50-50 cost share agreements through non-profit regional research consortia, the program encourages successful public-private partnering by pulling together industry teams to conduct projects that target program goals and directly address barriers to commercialization of fuel cell buses.

Low and zero emissions technologies for transportation is an emerging market, with significant potential for U.S. leadership. Funding under the NFCBP provides resources to U.S. manufacturers and suppliers to aid them in developing technology to compete in the emerging market segment of fuel cell propulsion and supports a variety of technologies such as hybrid electric drive systems, hydrogen fuel storage and dispensing systems, and lightweight vehicle designs. The program also funds industry evaluations and market studies to better understand the pathway and barriers to commercialization of fuel cells for transit buses. Projects funded through the program will continue over the next several years.

All NFCBP development and demonstration projects are evaluated independently, and the results are shared broadly with the transit industry through publications and outreach efforts, providing valuable information to transit agencies that are considering the technology for their fleets. These results also provide data to manufacturers to help make their products more durable, reliable, and cost-competitive, a necessity for technology commercialization and effective deployment.

Technology transfer activities include engaging industry to help define technical targets for commercialization and developing and maintaining government-industry partnerships. Important outreach efforts are conducted that include the publishing of reports, maintaining a dedicated website to share information across projects, and the operation of national and international fuel cell bus working groups to share information on the technology progress and commercialization strategies. A yearly status report on the state of fuel cell bus technology is also produced.

New Model Bus Testing Program (“Altoona Testing”)

FTA's New Model Bus Testing Program (often referred to as "Altoona Testing" due to the location of the primary test facility) tests new transit bus models or existing bus models being produced with major changes for safety, structural integrity and durability, reliability, performance, braking, maintainability, fuel economy, noise, and emissions. Test results for bus models are compiled in reports, and FTA grantees must certify that they have received a copy of the test report prior to final acceptance of the first vehicle. The program provides a critical link between the transit bus manufacturing industry and transit researchers, functioning as a conduit for knowledge and technology transfer to the private sector.

By testing new bus models before they are purchased, grantees and manufacturers can often address problems before the fleet is built, potentially saving considerable money and time. The Bus Testing Program also serves to avoid inconveniencing passengers, enhances safety, and also protects the Federal taxpayers investment. Several manufacturers of numerous bus models have been able to enhance deficiencies in their products before committing to large-scale production and being exposed to large-scale liability. New legislation under MAP-21 introduces a pass-fail standard and accompanying test of new bus models.

Technology transfer activities include disseminating reports resulting from the New Model Bus Testing Program, which are available online through the Bus Testing Database. Online information can then be easily searched and filtered to facilitate comparisons between different bus models.

FTA Outreach

FTA conducts an information dissemination program in which reports and publications that present the results of its research are produced and published on FTA's public website at <http://www.fta.dot.gov/research>. The website creates awareness and understanding of the value of FTA's transit research, communicates the benefits of FTA research in ways that resonate with key stakeholders, affirms FTA's leadership role in transit research, and demonstrates the return on investment of FTA research programs. A transit research and industry news update, the quarterly *FTA Research Digest*, also is produced, which includes summaries of new publications, information on federal research in progress, and research news and resources. Subscribers to FTA's email updates receive notifications as soon as the *Digest* and new reports are published online.

Through these information dissemination efforts, FTA provides key audiences with easy access to transit research information results and findings to those who can benefit. These efforts also improve implementer ability to transform FTA research into system improvements, build awareness to support effective decision making around the deployment of new technology, and ensure that research peers have the most current information on trends, previous findings, and in-progress results.

Even excellent research is of limited value if the results are not made available to as many parties as possible that might benefit from the findings. FTA's extensive technology transfer activities are a key indicator of its value to taxpayers and industry as it seeks to conduct nationally-significant research,

development, demonstrations, deployment, and evaluation projects to improve public transportation services throughout the United States.

**Appendix 6: National Highway Traffic Safety Administration (NHTSA)
Research & Development**

Technology Transfer Plan

FY 2013

Background

The National Highway Traffic Safety Administration's (NHTSA) mission is to save lives, prevent injuries, and reduce traffic related health care and other economic costs. The agency develops, promotes, and implements effective educational, engineering, and enforcement programs directed toward ending preventable tragedies and reducing safety related economic costs associated with vehicle use and highway travel.

Through the combined efforts of NHTSA, Congress, states, local law enforcement, public safety groups and industry, the nation has made major strides in reducing fatalities and injuries in motor vehicle crashes. Safety belt use has reached a record high national average of 80 percent. The fatality rate, per 100 million vehicle miles of travel, is declining. Motor vehicle manufacturers and their suppliers are developing advanced safety technologies and deploying them into the vehicle fleet. NHTSA's consumer information program provides valuable safety *information* that shoppers can use when deciding which vehicles to buy.

In addition to these programs, NHTSA issues and enforces Federal Motor Vehicle Safety Standards (FMVSS). These standards establish performance criteria that every new motor vehicle sold in the United States must meet. They range from those focused on crash avoidance features (such as brakes and lighting) to ensuring vehicle crashworthiness through testing occupant restraint systems (safety belts and airbags) and to protecting against fires (fuel integrity). These standards set forward test procedures and specific performance requirements. Vehicle manufacturers are required to certify that each new vehicle sold meets all of the standards applicable to it. NHTSA purchases vehicles on the open market and tests them. Should a vehicle fail any aspect of the standard, the manufacturer is required to recall the vehicle and fix the problem.

Priority Programs and Projects: As stated in the NHTSA's *Vehicle Safety and Fuel Economy Rulemaking and Research Priority Plan 2011-2013*, vehicle safety programs and projects that are in the following three categories: (1) large safety benefits; (2) vulnerable populations; and (3) high-occupancy vehicles are categories that the agency is putting a significant emphasis on. Programs and projects that are in Category 1, large benefits, have the potential for large safety benefits based upon factors such as: the size of the target population, the effectiveness of countermeasures and their potential to save lives and prevent injuries, the availability and practicability of these countermeasures, and the potential that countermeasures could be developed in the future that could be reasonably effective against a large target population.

Programs and projects in Category 2, vulnerable populations, affect children, older people, the vision-impaired or other populations that are considered vulnerable. Category 3, high-occupancy vehicles, involves buses or motor coaches and other high-occupancy vehicles.

Thus, research results in these three categories and that also have a significant technology aspect to them, will likely be where the most opportunities lie for technology transfer.

Summary of NHTSA Technology Transfer goals

In brief, NHTSA's goals for technology transfer are to:

1. IMPROVE HIGHWAY SAFETY – Reduce fatalities and motor vehicle crashes.
2. UNDERSTAND TECHNOLOGY – Improve understanding of emerging motor vehicle safety technologies in order to improve the effectiveness of research activities.
3. PROMOTE KNOWLEDGE OF VEHICLE SAFETY TECHNOLOGY – Generate and promote knowledge of vehicle safety technologies for use by high-growth businesses.

Technology Transfer

The Presidential memorandum of October 28, 2011 directed federal agencies to improve the results of their technology transfer and commercialization activities. NHTSA has not engaged in the 'Commercialization of Federal Research in Support of High-Growth Business' due to the inherent ethical conflicts of its regulatory role with such potential high-growth businesses. Consequently, NHTSA does not staff a Technology Transfer Office as do other federal agencies and their laboratories concerned with technology development, and it does not typically engage in patent license agreements, royalties, inventions, material transfer agreement (MTA's), proprietary license agreement (PLA's), etc.

In this consideration, the agency also believes that there are reasonable opportunities to facilitate technology transfer, and that there are reasonable first steps in response to the Presidential memorandum involving the 1) exploration of transfer goals, 2) metrics, 3) evaluation public access streamlining, 4) tracking, 5) grant review, 6) SBIR, and 7) partnerships engagement. The goal of these activities is to:

'Increase the number of effective technology transfer and commercialization activities in partnership with non-federal entities, including private firms, research organizations, and non-profit entities.'

Program Milestones

Milestone - Develop an improved web-based approach to disseminate transportation research findings to stakeholders.

Method – Evaluate current agency research content on agency's website and identify ways to improve content in 2013.

Timeline – Each year, evaluate the approach to web-based content in terms of how often the public accesses the site and consider methods to improve public access and usage rates to further enhance dissemination of research findings.

Appendix 7: Pipelines and Hazards Materials Federal Highway Safety (PHMSA)
Pipeline Safety Research & Development

Technology Transfer Plan

Introduction

With Congressional support, the Pipeline and Hazardous Materials Safety Administration (PHMSA) has developed and deployed a consensus-based, collaborative research, development and technology (RD&T) program that is bringing technology to market and is helping to strengthen pipeline integrity. This is in direct support of PHMSA’s safety, environmental and reliability mission with America’s pipeline infrastructure of more than 2.6M miles.

PHMSA’s Pipeline Safety RD&T Program was directed “to carry out a program of research, development, demonstration and standardization to ensure the integrity of pipeline facilities” by Congress in the Pipeline Safety Improvement Act of 2002 and in subsequent Acts.

Please visit <https://primis.phmsa.dot.gov/rd/index.htm> for more general information about the PHMSA program.

Technology Transfer Goals

The goals for transferring research results to the market are shown in Table 1 and based on the short-term deployment program focus directed by the Congress. These areas are formulated after conducting program and project level logic modeling that considered research inputs, outputs, impacts and stakeholders reached. The three areas in Table 1 were determined by the logic modeling as the most appropriate and attainable for the sustainable data gathering used to report the performance metrics described in this plan.

Developing Technology	Strengthening Consensus Standards	Promoting Knowledge
Fostering the development of new technologies so that pipeline operators can improve safety performance and more effectively address regulatory requirements.	Targeting and feeding new knowledge into the process of keeping standards relevant to their purpose.	Generating and promoting general knowledge to decision makers.

Table 1

Program Process and Technology Transfer

A five step process depicted in Figure 1 was developed after conducting the program logic modeling that systematically considers the transfer of research results to identified end users (who are regulators, pipeline operators, service providers, standards developing organizations and the general public). This process governs the program execution and factors tech transfer considerations (described later) in each step. PHMSA believes that systematic consideration of tech transfer raises the likelihood that each research project will transfer its results to the market or to identified end users.

More information on the overall process can be found on the program website (<https://primis.phmsa.dot.gov/rd/evaluation.htm>).

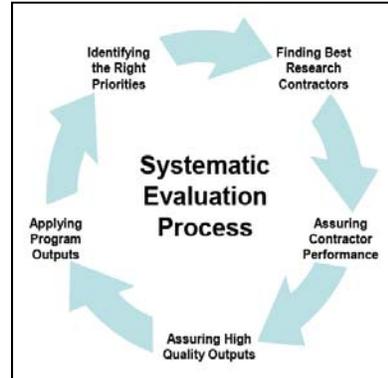


Figure 2

Research Performance Metrics

PHMSA's Pipeline Safety RD&T Program utilizes 17 different research performance metrics to illustrate program effectiveness and impact in support of the PHMSA pipeline mission. The process described in Figure 1 provided the bases for the following three technology transfer areas. Results of each area are listed below.

Fostering Development of New Technologies

- Number of projects developing new technology: 70
- Number of projects demonstrating new technologies: 33
- Number of U.S. Patent applications resulting from projects: 16
- Number of commercialized technology improvements: 14

Strengthening Regulatory Requirements and Consensus Standards

- Number of projects targeting Consensus Standards: 63
- Number of projects results used to revise Consensus Standards: 4
- Number of Consensus Standards affected by projects: 41
- Number of Consensus Standards revised by project results: 3
- Number of project results sent to committee for use in possible revision: 11
- Number of projects addressing PHMSA Regulations: 79
- Number of projects addressing NTSB Recommendations: 8

Promoting Knowledge for Decision Makers

- Number of projects promoting knowledge to decision makers: 128
- Number of final reports publicly available: 132
- Number of conference/journal papers presented: 79
- Number of stakeholders reached at public meetings: 3,300
- Number of program website visits since 2002: 16,696,270
- Number of program website downloads since 2008: 949,552

The program conducts real-time, annual and periodic data calls, as needed, to improve the level and quality of these performance metrics. The above information is reported as of August 2012 and since the program's modern inception in 2002. The data can be broken out into CY or FY reporting by request.

PHMSA reports retrospectively since there is no true way to predict technology transfer in the future. For example, PHMSA can report that a project developing a new technology is scheduled to conclude on a future date but cannot predict or guarantee that the technology under development will be commercialized on that date. Some projects require future phases of research work or in-field demonstrations to facilitate the technology transfer. In other cases additional time is necessary to resolve Intellectual Property requirements to facilitate the technology transfer. Reporting annual future targets may provide erroneous information because actual results may never match with targeted dates. To overcome this challenge, PHMSA annually re-visits research project team members to inquire whether the status has changed and that the solution is now in the market. This process supports the various metrics used.

Please visit <https://primis.phmsa.dot.gov/rd/performance.htm> for much more information within PHMSA's pipeline technology transfer goals and related investments.

Considerations for Technology Transfer Goals

PHMSA has many considerations for each goal area and utilizes its contractual authorities as much as possible within the process depicted in Figure 1 to maximize the likelihood that research results will transfer to the market. In addition and in general PHMSA believes following these three rules of thumb can improve the chances of success with transferring research results into the market.

Rule No. 1—Plan for technology transfer while identifying the right research priorities.

Rule No. 2—Involve end users (Examples are regulators, pipeline operators & service providers) into the research gap analysis and road mapping activities.

Rule No. 3—Utilize technology demonstrations in front of potential service providers and other end users to qualify/quantify technology readiness.

These three rules are applied where applicable within the tech transfer goals and throughout the program process execution.

Developing Technology

While fostering the development of new or improved technologies PHMSA utilizes technology demonstrations as a means of evaluating the merit of technologies that are reaching the prototype stage. Demonstrations expose the technologies to the environment where the technology must be operated successfully. Demonstrations also promote the deployment and utilization of new technologies through observations and participation by pipeline operators, equipment vendors, standards organizations, and pipeline safety officials. Demonstrations are just one stage in a technology transfer process but can be considered a major milestone for achieving an ultimate research goal.

Technology development for PHMSA occurs within a deployment mentality as directed by the Congress. PHMSA investment continues beyond proof of concept and concludes when the pre-commercial technology is effectively demonstrated in the intended operating environment. At that point, the Federal Government’s funding is stopped and industry funding continues developing and deploying the technology towards a commercialized technology Figure 2 depicts the readiness level for most technology development projects and factors several issues for consideration.

PHMSA Begins Investment		Technology Readiness Level (TRL)		PHMSA Concludes Investment	
Proof of Concept	Demonstrational Phase	7	Field Test	Pre-Commercialization Phase	Commercialization
		6	Test Bed		
		5	Test Rig		
	Laboratory Development & Testing Phase	4	Launchers		
		3	Communications & Software		
		2	Packaging or Housing		
		1	Sensor		

Figure 3

Strengthening Consensus Standards

Many regulators, including PHMSA, incorporate consensus standards into the Code of Federal Regulations (CFR). The goals of incorporation are to strengthen and streamline the code, be less prescriptive, be consistent with federal guidance and promote performance to drive how regulations are met. National consensus standards carry the weight of law when incorporated by reference into the CFR. Consensus Standards constantly need new scientific information and knowledge to be effective and relevant. They are continually reviewed and upgraded by committees of engineers and other technical experts. The intent is to ensure standards support the safe design, construction, operation, maintenance and repair of pipelines.

Research targeting consensus standards provides new knowledge needed to keep standards current and relevant to their intended purposes. The PHMSA program is funding research to strengthen consensus standards and expand their applicability. Significant time and resources are spent reaching agreement on a research strategy at R&D Forums and other public events. It’s imperative that knowledge from the research is transferred to Standards Developing Organizations. PHMSA is working to transfer the research benefit of projects addressing standards while providing knowledge transfer to the standards-development process.

To ensure success with this research program objective, PHMSA and the Pipeline Standards-Developing Organizations Coordinating Council executed a Memorandum of Agreement (MOA). The MOA is improving cooperation and coordination between the Parties to simplify a more effective and efficient integration of pipeline safety research and development results into the development and revision of

voluntary consensus technical standards. The systematic process described in the MOA is critical to ensure knowledge from pipeline safety research is transferred to end users.

Generating and Promoting New Knowledge

Research can generate an enormous amount of knowledge. The challenge is putting this knowledge into the hands of decision makers who can use it. Knowledge not transferred is wasteful, and can set back progress toward overcoming challenges.

PHMSA provides general knowledge to decision makers. PHMSA categorizes general knowledge as research focused on the feasibility of an emerging issue, parametric studies to pull known knowledge into a single comprehensive report and work addressing issues tied to no known industry consensus standards.

Agreement is reached at collaborative events such as R&D Forums about what general knowledge research is required. Diverse merit review panels review proposed research and recommend projects for award.

Through funding agreements, PHMSA mandates several actions that the researcher must take to promote project results. This is our approach for all PHMSA R&D awards (technology / standards / general knowledge). The following are examples of how all awarded research is promoted to decision makers.

- Requirement to submit results to a public conference / forum / symposium / workshop or trade journal;
- Requirement to report any application for a U.S. Patent;
- Requirement for an output or final meeting via a webinar or in person with invited decision makers and stakeholders;
- Collaborative public events such as R&D Forums and Workshops where ongoing work or results are presented; and
- Annual R&D Peer Reviews where knowledge of the research is reviewed and promoted
- PHMSA's Pipeline Safety R&D Website where project progress and results are posted.

It should be noted that PHMSA participates in the Department's Small Business and Innovative Research (SBIR) Program (<http://osdbuweb.dot.gov/Procurement/sbir.cfm>). All SBIR Phase I efforts are classified as general knowledge by the PHMSA program even though these efforts address technology development. It is only within a Phase II or III effort that PHMSA would categorize the investment as developing technology. PHMSA's participation in the SBIR program has identified several Small Business research teams who later compete in PHMSA's Broad Agency Announcements. This action resulted in the Small Business research team successfully commercializing new technologies.

Appendix 8: Research and Innovative Technology Administration (RITA)

Technology Transfer

The Norman Y. Mineta Research and Special Programs Improvement Act (P.L. 108-426, 118 Stat. 243, November 30, 2004) specifically grants powers and duties to the Research and Innovative Technology Administration (RITA), powers and duties as prescribed by the Secretary for “coordination, facilitation and review of the Department’s research and development programs and activities;” [The Mineta Act, § 4(a) (2), Powers and Duties of the Administrator]. Part of RITA’s mission is to coordinate and foster research activities across all DOT modes, thus the modes are inherently RITA’s internal stakeholders. These stakeholders play major roles in the diverse areas of the Department’s research.

RITA coordinates technology transfer efforts with DOT Operating Administrations in response to the Technology Transfer Commercialization Act of 2000⁴, and the Stevenson-Wydler Technology Innovation Act of 1980⁵. RITA’s mission is to help identify and facilitate solutions to the challenges and opportunities facing America’s transportation system through coordinating, facilitating, and reviewing USDOT’s research and development programs.

RITA is involved with other departmental technology transfer activities, some examples include: DOT representation in the Federal Laboratory Consortium for Technology Transfer and active participation in the Inter-agency Working Group on Technology Transfer chaired by the Department of Commerce. Also, RITA is finding ways to leverage technology transfer practices from other Federal agencies to the Department.

University Transportation Centers

The University Transportation Centers (UTC) Program is managed by RITA in a new competitive environment for the purpose of conducting multi-modal and multi-disciplinary research, education and technology transfer activities in support of Departmental priorities. Universities publish their research projects on various public websites (Transportation Research Board, UTC websites, and others) and submit electronic copies to various stakeholders. Universities are also required to report on technology transfer and intellectual property activities, such as invention disclosures and patent application filings. They must also report on the impacts technologies of their technologies, whether it be an invention, best practice, or other conceivable benefit. Any transfer of results to the government or industry and instances where the research led to the initiation of a start-up company will now be reported. RITA is looking to hire a patented bar attorney to support DOT’s role in intellectual property related activities.

Research HUB

RITA’s new Research Hub is a web-based, searchable database of the Department’s latest research, development, and technology projects, showcasing its research portfolio at the project level for the first time. The database pulls information from over 20 different data sources into a central repository of active and recently completed projects from ten Operating Administrations. The database has been developed in response to OMB and GAO’s request for a “*DOT-wide database of all of DOT’s RD&T projects that will support RITA’s coordination, facilitation, and review efforts*”⁶. Before the Research Hub was available, any requests for project-level information on DOT’s research portfolio from external stakeholders or

⁴ 42 U.S.C. 7261c

⁵ 15 U.S.C. 3701 et seq.

⁶ United States Government Accountability Office. (2006). TRANSPORTATION RESEARCH. *Opportunities for Improving the Oversight of DOT’s Research Programs and User Satisfaction with Transportation Statistics*. GAO-06-917.

members of the public would have to be addressed through time-consuming “data call” exercises that pulled DOT staff from around the Department away from their normal responsibilities.

Work on the current initiative began in 2010, a proof-of-concept project verified the feasibility of the multi-data source approach and this initial project’s success led to an early 2011 decision to establish the database as a permanent DOT resource and expand its content to DOT’s Operating Administrations. It was also decided to include research products and outputs in the database and to document “real-world” project impacts to demonstrate the value of DOT’s research investment. The Research Hub was released as a beta version to the public in January 2012, receiving positive feedback from DOT staff, external stakeholders, and the transportation research community. Plans are underway to release an upgraded 1.0 version in 2013.

Discussions have been held with staff from the White House Office of Science and Technology Policy to use the Research Hub to represent DOT in the STAR Metrics Initiative, which seeks to establish a Federal-wide database of RD&T projects, products, and outcomes. It is expected that the Research Hub will join this initiative in late 2012.

DOT programs in various Operating Administration RD&T offices, along with the UTC grants program, and tools such as the Research Hub, are examples of how DOT engages in enhancing its technology transfer program and create avenues for commercialization opportunities.

Annual Performance Report on Technology Transfer

Every year, the Department of Commerce (DOC) submits a Federal Laboratory T2 Fiscal Year Summary Report to the President and the Congress in accordance with 15 USC Sec 3710(g)(2) summarizing the implementation of technology transfer authorities established by the Technology Transfer Commercialization Act of 2000 (P.L. 106-404) and similar legislation. RITA prepares and submits the report for DOT agencies.

Transportation Safety Institute

The Transportation Safety Institute (TSI) provides knowledge transfer, a form of technology transfer, through training, products, and services to the transportation community through innovative methods and industry standards. TSI incorporates the latest research and science into its curriculum to transfer timely and relevant information to each student. TSI staff members are national experts in their fields of study and have proven skills in the science of accident and crash investigation. Each year, approximately 25,000 transportation professionals receive the most up-to-date DOT safety training available, and TSI creates learning environment geared to speed the application of training back to the job.

For more than 40 years, TSI has been improving the safety of our transportation system by teaching cutting-edge technologies and techniques to transportation safety practitioners around the world. Read more about how TSI transfers knowledge and technology every day in the [2011 Significant Accomplishments report](#).

John Volpe Transportation Research Center

The Volpe Center, located in Cambridge, Massachusetts, has been helping the transportation community navigate the most challenging problems for more than 40 years. As the National Transportation Systems Center, our mission is to improve transportation by anticipating and addressing emerging issues and advancing technical, operational, and institutional innovations across all modes.

Part of the U.S. Department of Transportation's Research and Innovative Technology Administration, Volpe is a unique Federal agency that is 100 percent funded by sponsor projects. As a result, technology transfer activities are influenced by research sponsors, who have a controlling interest in managing the intellectual property that results from sponsored activities. We partner with public and private organizations to assess the needs of the transportation community, evaluate research and development endeavors, assist in the deployment of state-of-the-art transportation technologies, and inform decision- and policy-making through our comprehensive analyses.

Home to renowned multidisciplinary expertise in all modes of transportation, Volpe serves its sponsor agencies with advanced technologies, research, and programs to ensure a fast, safe, efficient, accessible, and convenient transportation system that meets vital national and international interests and enhances the quality of life for the traveling public, today and into the future.

As a federal laboratory, the Volpe Center actively seeks technology transfer opportunities through a variety of means, including Cooperative Research and Development Agreements, research reports, technical presentations at conferences and workshops, and webinars on topics of national interest among transportation decision makers. Patent and copyright protection is used as appropriate; however, to the extent possible, access to innovations that serve the public good are provided at minimal or no cost to users. Currently, the Maritime Safety and Security Information System (MSSIS) and the Aviation Environmental Design Tool (AEDT) exemplify how the Volpe Center works closely with its sponsors to transfer innovative concepts into practice.

Initially developed for the Navy, MSSIS is a freely-shared, unclassified, near real-time vessel data collection and distribution network. Participating countries share data from Automatic Identification Systems (AIS) and other maritime-related systems. MSSIS enables collaboration and data-sharing among international participants, with a primary goal of increasing maritime security and safety. Volpe's Transview (TV32) client software for MSSIS, serves as a common system interface and vessel tracking display for users. TV32 offers standalone display features and functions as a gateway for users to access and contribute to the aggregated, global dataset. MSSIS received an Innovation in American Government Award from the Harvard University Ash Institute in 2008 and a Federal Laboratory Consortium Excellence in Technology Transfer Award in 2010. As of September 2012, 72 nations around the globe participate in the MSSIS network –as the wave of innovation continues under the ongoing sponsorship by the Department of Defense.

The Aviation Environmental Design Tool (AEDT) was developed in cooperation with the Federal Aviation Administration (FAA) Office of Environment and Energy and released in early 2012. AEDT is a software system that dynamically models aircraft performance in space and time to produce and consider the interdependencies between fuel burn, emissions and noise. AEDT is licensed by the FAA at \$1,000 for a single site license, with lower per site costs for multiple site licenses. Revenue is used to offset the costs of ongoing AEDT maintenance and support. Since April 2012, AEDT has been transferred to several dozen organizations and interest continues to grow domestic and international regulatory bodies, air traffic service providers, airports, consultants, academia, environmental organizations, industry organizations, as well as airframe and engine manufacturers.

Appendix 9: Small Business Innovation Research Program

Small Business Innovation Research Program

Congress established the Small Business Innovation Research (SBIR) Program to stimulate technological

SBIR 2.0 In June, 2010 the U.S. Small Business Administration (SBA) led an initiative called SBIR 2.0. This initiative was aimed at making the SBIR Program more efficient and entrepreneur friendly. DOT SBIR 2.0 initiatives are:

- Streamlining and simplification, to reduce time from selection to award. Beginning in Fiscal Year 2011 (FY 2011), the SBA required all federal SBIR Programs to meet and report annually on contract and grant award times as part of their agency submission of the SBIR Program annual report.
- Bridge financing: The Phase II B Bridge Financing Program provides select DOT Phase II awardees a one-time financial bridge award to accelerate the commercialization of the innovation to the marketplace. DOT Phase II awardees seeking Phase II B SBIR funding are encouraged to also seek private sector matching funds and/or in-kind investment.
- Technology Transfer. This Technology Transfer Pilot Program is modeled after a highly successful NIST SBIR Technology Transfer Program with the intent of using the SBIR Program to complete intramural research that requires further research and development for the innovation to move successfully to the marketplace.

innovation, utilize small business to meet federal research and development needs, encourage participation by minority and disadvantaged businesses in technological innovation, and increase private sector commercialization of innovations derived from federal R&D. The Volpe National Transportation Systems Center administers the US DOT SBIR program on behalf of the US DOT modal agencies. The modal agencies provide the topic areas for SBIR solicitations.

Since 2010, the DOT has worked to improve Program efficiency, streamline processes while also establishing opportunities to enhance commercialization outputs and accelerate contract award times.

The DOT SBIR Program publishes SBIR success stories quarterly on the Program website (<http://www.volpe.dot.gov/sbir/about.html>) and SBA www.sbir.gov website. These success stories describe the path from research to commercialization and highlight the partnerships that aided in moving the innovation from the lab to the marketplace.

The implementation of the recently passed SBIR Reauthorization⁷ will require additional program enhancements as well as performance metrics (Table 4) to further expedite commercialization outputs, obtain greater participation of minority groups and underrepresented areas, and introduce further efficiencies aimed at improving contract award processes. These activities will be implemented to align with the requirements contained in the statute, the SBIR Program Policy Directive and the new Rule on Size and Eligibility.

⁷ PL 112-81, National Defense Authorization Act for Fiscal Year 2012, Division E, December 31, 2011.

Table 4 Potential SBIR objectives and metrics (subject to change)

	Objective	Metric(s)	Timeline
1	Increase outreach to minority-owned small businesses and underrepresented areas	DOT will submit a Plan to SBA that establishes activities to increase participation of these groups in the Program	Effective October 1, 2012.
2	Streamline the SBIR award process	DOT will submit a Plan to SBA that establishes activities to further streamline process and accelerate contract awards to small businesses	Effective October 1, 2012
3	Increase follow-on work leading to deployment (Phase I to Phase II to Phase III)	DOT will be required to establish a Phase I to II transition rate effective Jan. 1, 2013 and a Phase II to III Commercialization Benchmark Rate, effective October 1, 2013.	Baselines will be established for implementation on January 1, 2013 and October 1, 2013 as defined in the statute, Policy Directive, and Size and Eligibility Rule
4	Track Commercialization Outputs	DOT will be required to collect and input data on various commercialization metrics as defined in statute and Policy Directive. Data will include: patents, inventions and licenses, jobs created, private sector investment.	SBA must build the necessary infrastructure (databases) for this to be implemented. Initial roll-out of some of the capability is scheduled for January 1, 2013