U.S. Department of Transportation
Office of the Secretary of Transportation

Assistant Secretary
for Research and Technology

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Washington, D.C. 20590

March 13, 2017

TO: Dr. Michael Walsh, Technology Partnerships Office
National Institute of Standards and Technology

FROM: Dr. Kevin Womack
Director, Office of Research, Development, and Technology

SUBJECT: U.S. DOT's Technology Transfer (T2) Report for FY2016

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 3710(g)(2); summarizing the implementation of technology transfer authorities established by the Technology Transfer Commercialization Act of 2000 (P.L. 106-404) and other legislation.

This report summarizes U.S. Department of Transportation's information for DOC's Fiscal Year 2016 Summary Report.

Please submit questions pertaining to this report to Santiago Navarro at Santiago.Navarro@dot.gov or 202-366-0849.

Attachment:

U.S. DOT Technology Transfer Report for FY2016

U.S. Department of Transportation

Technology Transfer – FY 2016

Office of the Assistant Secretary for Research and Technology

01/31/2017

Introduction

The U.S. Department of Transportation (DOT) is the federal steward of the nation's transportation system. DOT consists of multiple modal Operating Administrations (OA) that carry out mission-related Research, Development and Technology (RD&T) programs in support of their goals. The U.S. DOT Technology Transfer (T2) Program, housed in the Office of the Assistant Secretary for Research and Technology, is responsible for coordinating, documenting, and supporting T2 activities across the Department. This report summarizes the implementation of technology transfer authorities established by the Technology Transfer Commercialization Act of 2000 (Pub. L. 106-404) and other legislation.

DOT continues to increase coordination and collaboration efforts amongst its Operating Administrations (OA) as evidenced through the collection and submission of this T2 Annual Performance Report to DOT's budget examiner in the Office of Management and Budget. This report is also provided to the Department of Commerce's National Institute of Standards and Technology in support of the Commerce Secretary's Annual Summary Report to the President, the Congress, and to the U.S. Trade Representative on the status of Federal Laboratory technology transfer in accordance with 15 USC 3710(g)(2).

DOT defines technology transfer as the process of transferring and disseminating transportation-related scientific information to stakeholders who may apply it for public or private use. DOT's current approach to technology transfer is diverse and unique to each mode of transportation. Each modal Operating Administration conducts mission-specific deployment activities tailored to its mode and type of research. DOT's annual technology transfer report is available online at:

https://www.transportation.gov/research-and-technology/transportation-technology/tech-transfer-activities

Technology Transfer activities are executed by DOT agencies and their laboratories:

- Federal Aviation Administration (FAA): William J. Hughes Technical Center (Atlantic City, NJ).
- Federal Highway Administration (FHWA): Turner-Fairbank Highway Research Center (McLean, VA).
- Office of the Assistant Secretary for Research and Technology (OST-R): John A. Volpe National Transportation Systems Center (Volpe Center, Cambridge, MA).
- National Highway Traffic Safety Administration (NHTSA): Vehicle Research and Test Center (East Liberty, OH)

More information about DOT's technology transfer activities is available on the following websites:

- FAA: http://faa.gov/go/techtran
- FHWA: http://www.fhwa.dot.gov/everydaycounts and https://www.fhwa.dot.gov/goshrp2
- OST-R: https://www.volpe.dot.gov/work-with-us/technology-transfer

DOT Invention Disclosures, Patenting, Licensing and other measures

Table 1 Invention Disclosures and Patents

		FY12	FY13	FY14	FY15	FY16
	Invention Disclosure					
1	Number of new inventions disclosed	2	13	3	0	0
	Patents					
2	Number of patent applications filed	1	5	0	5	0
3	Number of patents received	4	1	1	1	1
4	Number of foreign patents filed	N/A	N/A	N/A	N/A	0
5	Number of foreign patents received	N/A	N/A	N/A	N/A	0
Enter “0” to report that the agency did not use this mechanism in the reported year. Enter "N/A" to report that data is not available at time of report. Add rows and interpretive notes as needed						

Table 2 Income Bearing Licenses

		FY12	FY13	FY14	FY15	FY16
	Licenses					
6	Total Active Licenses	2	3	1	2	2
7	Total New Licenses	0	1	0	1	2
	Income Bearing Licenses					
8	Total Active Income Bearing Licenses	2	3	1	2	2
9	New Income Bearing Licenses	0	1	0	0	0
10	Total Active Invention Licenses	2	3	1	2	0
11	New Invention Licenses	0	1	0	0	0
12	Exclusive licenses	0	0	1	0	0
13	Partially exclusive licenses	0	0	0	0	0

14	Non-exclusive licenses	2	3	0	2	2
FAA licenses are non-exclusive						
	Elapsed Amount time to Grant Licenses					
15	Average (months)	N/A	N/A	N/A	N/A	N/A
16	Minimum (months)	N/A	N/A	N/A	N/A	N/A
17	Minimum (months)	N/A	N/A	N/A	N/A	N/A
	License Income					
18	Total License Income	N/A	N/A	N/A	N/A	N/A
19	Total Invention License Income	N/A	N/A	N/A	N/A	N/A
Enter “0” to report that the agency did not use this mechanism in the reported year. Enter "N/A" to report that data is not available at time of report. Add rows and interpretive notes as needed						

Table 3 Licensing Income

		FY12	FY13	FY14	FY15	FY16
	Earned Royalty Income					
20	Earned Royalty Income from top 1% of licenses	N/A	N/A	N/A	N/A	N/A
21	Earned Royalty Income from top 5% of licenses	N/A	N/A	N/A	N/A	N/A
22	Earned Royalty Income from top 20% of licenses	N/A	N/A	N/A	N/A	N/A
23	Minimum Earned Royalty Income	N/A	N/A	N/A	N/A	N/A
24	Maximum Earned Royalty Income	N/A	N/A	N/A	N/A	N/A
25	Median Earned Royalty Income	N/A	N/A	N/A	N/A	N/A
	Disposition of Earned Royalty Income (thousands)					
26	Total amount of Earned Royalty Income received	$7.4	$8.8	$22.6	$11.8	$15.3
27	Percent of Earned Royalty Income distributed to inventors	45	42	32	42	32
28	Percent of Earned Royalty Income distributed to the agency or laboratory	N/A	N/A	N/A	58	68

29	Licenses terminated for cause	N/A	N/A	N/A	0	0
Enter “0” to report that the agency did not use this mechanism in the reported year. Enter "N/A" to report that data is not available at time of report. Add rows and interpretive notes as needed						

Table 4 Cooperative Research and Development Agreements

		FY12	FY13	FY14	FY15	FY16
	CRADAs					
30	Number of Active CRADAs	29	40	51	48	68
31	Number of newly executed CRADAs	12	8	10	9	22
32	Active CRADAs with small businesses involvement	12	8	10	11	12
33	Number of small businesses involved in active CRADAs	3	3	5	10	12
	Traditional CRADAs					
34	Active traditional CRADAs	3	3	7	48	62
35	Newly executed traditional CRADAs	0	0	2	9	22
	Non-traditional CRADAs					
36	Active non-traditional CRADAs	0	0	0	0	1
37	Newly executed non-traditional CRADAs	0	0	0	0	1
Enter “0” to report that the agency did not use this mechanism in the reported year. Enter "N/A" to report that data is not available at time of report. Add rows and interpretive notes as needed						

Table 5 Small Businesses, Startups, and Young Companies

		FY12	FY13	FY14	FY15	FY16
	Others					
38	Total Number of Small Businesses supported	14	26	30	35	65
39	Total Number of Startups and Young Companies supported	N/A	N/A	N/A	N/A	0
Enter “0” to report that the agency did not use this mechanism in the reported year. Enter						

"N/A" to report that data is not available at time of report. Add rows and interpretive notes as needed

Table 6 Other Performance Measures Deemed Important by the Agency

		FY12	FY13	FY14	FY15	FY16
	Agency specific agreements					
40	Collaborative Relationships	14	26	30	35	152*
41	University Transportation Centers	22	35	35	35	32
42	Technical Publications – Volpe Center	IP	IP	IP	IP	73*
Enter “0” to report that the agency did not use this mechanism in the reported year. Enter "N/A" to report that data is not available at time of report. Add rows and interpretive notes as needed						

Note 1 The increased number for items in fields 40-42 are from activities identified and deemed part of this reporting requirement. IP – entry currently in progress of obtaining.

Efforts to Streamline Technology Transfer Operations

The DOT T2 Program, housed within the Office of the Assistant Secretary for Research and Technology (OST-R), is responsible for coordinating, documenting, and supporting T2 activities across the Department. DOT's T2 activities focus on research collaboration, knowledge transfer, information dissemination and the practical application of research. Specific efforts include:

- Tracking the progress of technologies that have been adopted and implemented by internal and external stakeholders. Progress is often described through success stories.
- Developing T2 training materials to help research and development (R&D) personnel incorporate various technology transfer practices into their research programs e.g. A Transportation Tech Transfer Primer was created to help think about stakeholder maps and T2 plans that may foster adoption and implementation of research outputs. http://ntl.bts.gov/lib/57000/57400/57403/Transportation_TechTransfer_Primer.pdf
- Aligning DOT's Acquisition, Research, and Technology Transfer processes through an interagency working group charged with developing cross-functional T2 training materials for contracting officers and their technical representatives.
- Incorporating technology transfer into DOT's Research, Development, and Technology Strategic Plan, FY 2017-2021
- Coordinating the Department's response to Executive Orders and other T2 Administration mandates, such as *Accelerating Technology Transfer and Commercialization of Federal Research in Support of High-Growth Businesses,* October 2011.

Legislation Support and Programs that Streamline T2

The Fixing America's Surface Transportation (FAST) Act (Pub. L. 114-94) requires the Secretary of Transportation to develop a five-year Research, Development, and Technology (RD&T) Strategic Plan to outline its research priorities and RD&T activities for fiscal year 2017 through 2021. The RD&T strategic plan includes a section that describes strategies that each Operating Administration (OA) will use to facilitate the transfer of outputs from its R&D programs into the transportation system.

The FAST Act also authorized DOT to continue funding the University Transportation Center's (UTC) Program which aims to advance transportation technology and expertise through education, research and technology transfer at university-based centers of excellence. The Program was created by Section 314 of the Surface Transportation and Uniform Relocation Assistance Act of 1987. Under the Moving Ahead for Progress in the 21st Century (MAP-21) Act (Pub. L. 112-141), 35 centers were awarded grants. With the passage of the FAST Act, a new UTC competition was held during fiscal year 2016, through which 32 new grantees were selected. Grantees are recommended to establish T2 plans for their research activities.

DOT's Federal Highway Administration (FHWA) Provides Incentives to States

In February 2014, FHWA launched the Accelerated Innovation Deployment (AID) demonstration program to offset the cost risks associated for adopters during their deployment of an innovation. Through this program, funding was made available to states to support their implementation of innovations in any aspect of highway transportation including planning, financing, operation, structures, materials, pavements, environment, and construction on any project eligible for Federal assistance. The program seeks projects that include innovations that are proven in real-world application and not routinely used. Such innovations usually measure seven or higher on the Technology Readiness scale, as detailed in the site: https://www.fhwa.dot.gov/advancedresearch/trl_h.cfm

By the end of FY 2016, a total of 62 projects had received AID Demonstration awards totaling more than $44 million. One notable example is the $0.6 million award to the New York State Department of Transportation to employ 3D engineered models incorporating civil integrated management modeling on its complex Kew Garden interchange reconstruction project in Queens County, NY.

FHWA establishes "Moving Innovation" as a Key Business Process

FHWA has embraced a culture of innovation and actively supports it across FHWA. FHWA has woven innovation into its business practices, from the development of innovative technologies at its world class Turner-Fairbank Highway Research Center, to creating the Office of Innovative Program Delivery (OIPD) that works with FHWA partners to identify innovations ready for deployment. OIPD also works with FHWA's Office of Technical Services and its Division Offices to provide technical assistance to Federal, State and local partners, such as the National Park Service, who deploy the innovations to its Federal Lands Highway program. Innovation development and innovation deployment is a continuous cycle. Working with stakeholders, the agency sets goals to address the national gaps and opportunities. Research topics are prioritized to align with the agency's goals. Collaboration and coordination with partners and stakeholders occur during agenda setting, through research, to assessing the impact of new technologies.

Since 2009, FHWA's efforts toward innovation have centered on the Every Day Counts (EDC) partnership with States and other public and private stakeholders to encourage widespread use of proven, market-ready solutions. Through this collaboration, FHWA is advancing innovations that speed project delivery and deploying technologies that save time, money, and--most important--lives. In FY 2016, the FAST Act included EDC by name, directing FHWA to continue cooperating with stakeholders to deploy new practices and technologies and create a culture of innovation in the highway community. Designed to complement other initiatives focusing on technological advances, EDC plays an important role in helping transportation agencies harness innovation to deliver the best value for every taxpayer dollar. The EDC partnership has had a positive impact on the highway community's adoption of new technologies and processes. Every State has used 10 or more of the 32 innovations promoted during the first three rounds of the initiative, and some have adopted more than 20. Several innovations are now mainstream practices in many States, enhancing the highway system and benefiting travelers that include advances such as time- and money-saving methods of accelerated bridge

construction, energy-saving warm-mix asphalt, and the Safety Edge[SM] paving technique to prevent roadway departure crashes.

Accelerating Implementation and Deployment of Pavement Technologies (AID-PT)

The AID-PT program was established in 2012 under MAP-21 and continued under the FAST Act, with funding available through fiscal year 2020. Through strategic partnerships with highway agencies and others across the paving community, FHWA is leveraging Federal investments to maximize the impact of the program, effectively amplifying the benefits to the traveling public. The AID-PT program focuses on promoting, implementing, and deploying proven technologies and demonstrated practices to improve paving materials and deliver guidance to help highway agencies design and construct both asphalt and concrete pavements more effectively. Specifically, the program encourages highway agencies to adopt and implement new technologies that have been shown to save money, enhance safety, improve performance, increase efficiency, and reduce delay. The use of reclaimed asphalt pavement, recycled asphalt shingles, and ground tire rubber in new pavements saves an estimated $2.1 billion annually. These efforts support an overarching focus on sustainability and reduce the impact of pavements on the environment.

U.S. DOT Research Leads to Adoption of Voluntary Standards

1. From Prototypes and Pilots to a New Voluntary Standard: Safeguarding Vulnerable Road Users in Large Vehicle Crashes

Side guards save lives. When trucks with high ground clearances strike vulnerable road users, such as bicyclists, pedestrians, or work crews, these people can fall into the exposed space between the front and rear wheels and suffer fatal crushing injuries. Side guards cover that open space. In 2016, the Volpe Center and the U.S. DOT's Office of the Assistant Secretary for Research and Technology (OST-R) published the first national voluntary side guard standard, providing consistent specifications for use by cities, manufacturers, and fleets. The Volpe Center's research has led to side guards being included as safety strategies in the Portland, Oregon Vision Zero Action Plan and the Seattle, Washington Freight Master Plan.

New York City (NYC) enacted a law requiring side guards on 10,000 city-owned and regulated trucks by 2024, as well as the nation's first incentive program for early voluntary adoption. Because NYC has a rate of several fatalities each year involving their 2,500 truck sanitation fleet, the trucks that have been retrofitted from that fleet alone should start saving about one life and preventing about 10 serious injuries per year. In addition, the District of Columbia enacted the first state-level side guard law in 2016, incorporating the Volpe/OST-R voluntary standard, and requiring all registered trucks to implement side guards by 2019.

Based on the Volpe Center's recommendations, San Francisco began to phase in side guards on all city-owned trucks in 2016. The Volpe Center is also supporting San Francisco by working with the National Institute of Standards and Technology to build a broad supplier base for side guards that will meet the Volpe Center's technical criteria on the West Coast.
https://ntl.bts.gov/lib/60000/60000/60063/Truck_Side_Guard_Specifications.pdf

2. Recommendations from FMCSA Study Adopted into National Fire Protection Association (NFPA) 52, Vehicular Natural Gas Fuel Systems Code

The Federal Motor Carrier Safety Administration (FMCSA) is the modal agency in DOT responsible for regulating the safety of heavy-duty trucks and buses, in particular, the safe operations and maintenance of drivers, motor carriers (owner/operators), and vehicles. The fuel system is one of 14 safety-critical parts of a heavy-duty vehicle; a defect (such as leaking fuel) found in any of the safety-critical parts of a heavy-duty vehicle can be the grounds for an inspector to place the vehicle Out-Of-Service.

Over the last few years, FMCSA's Technology Division represented DOT at the National Fire Protection Association (NFPA), assisting in the development of the code NFPA 52. In March 2013, FMCSA published "Natural Gas Systems: Suggested Changes to Truck and Motorcoach Regulations and Inspection Procedures." In a 2016 update to NFPA 52, the group introduced and adopted more than 90 percent of the recommendations made in a published FMCSA study. On April 26, 2016 NFPA published the revised code, which superseded all previous editions of NFPA 52, and was approved as an American National Standard. Twenty states have voluntarily adopted NFPA 52.
https://ntl.bts.gov/lib/51000/51300/51333/Natural-Gas-Systems-Report-508.pdf

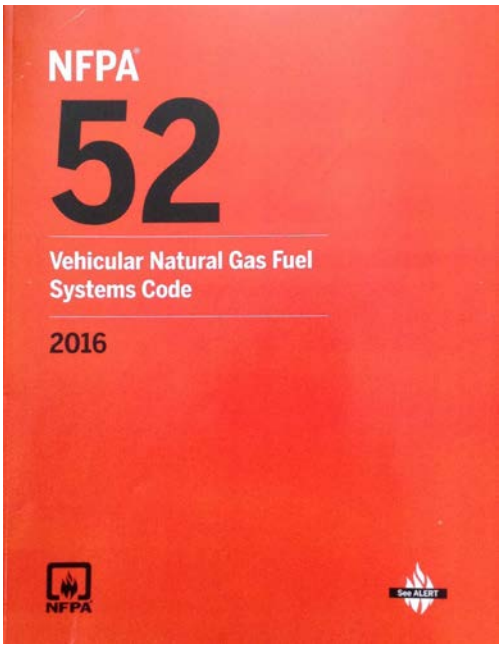

Figure 1 NFPA 2016 Edition

Success Stories Resulting from Collaborative Engagements

3. Fire Testing Next Generation Engineered Material Arresting System (EMAS)[1,2]

A Federal and industry partnership grows and continues investigating ways to improve runway safety areas at commercial service airports. Federal Aviation Administration's (FAA) Cooperative and Research Development Agreement (CRADA) between Airport Safety Research & Development and Zodiac ESCO Inc., enabled fire testing of the next generation EMASMAX Engineered Material Arresting System (EMAS). The tests evaluated how two prototype EMAS blocks burned in the presence of a fuel fire, assessed fire propagation through the material, and what type of Airport Rescue Fire Fighting (ARFF) response will be needed to extinguish this type of fire.

Figure 2 FAA Airport Safety Firefighter extinguishing fire during evaluation per Advisory Circular requirements

4. New Collaborative Partnership Supports Continued Advancement of Innovation

On May 25, 2016, FHWA's Office of Center for Accelerating Innovation (CAI) and the American Association of State Highway Transportation Officials (AASHTO), through their Innovation Initiative (AII) executed a Memorandum of Understanding to provide a framework for the advancement of innovation deployment activities and to foster a culture of innovation within the highway community. The MOU will foster the EDC pipeline by evaluating innovations and identifying market-ready technologies for potential deployment in future EDC cycles. FHWA awarded a Cooperative Agreement with AASHTO in September 2016 to further achieve these goals.

[1] "Technical Center Highlights and News", March 24, 2016, Page 1
[2] https://www.faa.gov/news/fact_sheets/news_story.cfm?newsId=13754

5. Leveraging Shore-Side, Building Energy Simulation Tools for Use in the Shipboard Environment

DOT's Maritime Administration (MARAD) is collaborating with the U.S. Department of Energy's National Renewable Energy Laboratory and the Naval Surface Warfare Center (Carderock and Philadelphia Divisions) on ongoing research. They have developed a physics-based modeling engine to evaluate non-propulsive ship energy consumption under different operational scenarios and technology applications, to enhance the U.S. Navy's ability to optimize ship operational reach and tactical performance.

The research teams evaluated the accuracy of the modified version of EnergyPlus by comparing results to direct measurements taken over a six-week period onboard MARAD's Training Ship (TS) Kennedy. EnergyPlus behaved well with respect to solar loading and convective heat transfer to seawater while the ship was under way. Data were collected during the TS Kennedy's annual six-week winter cruise, which took place from January 10 – February 17, 2016.

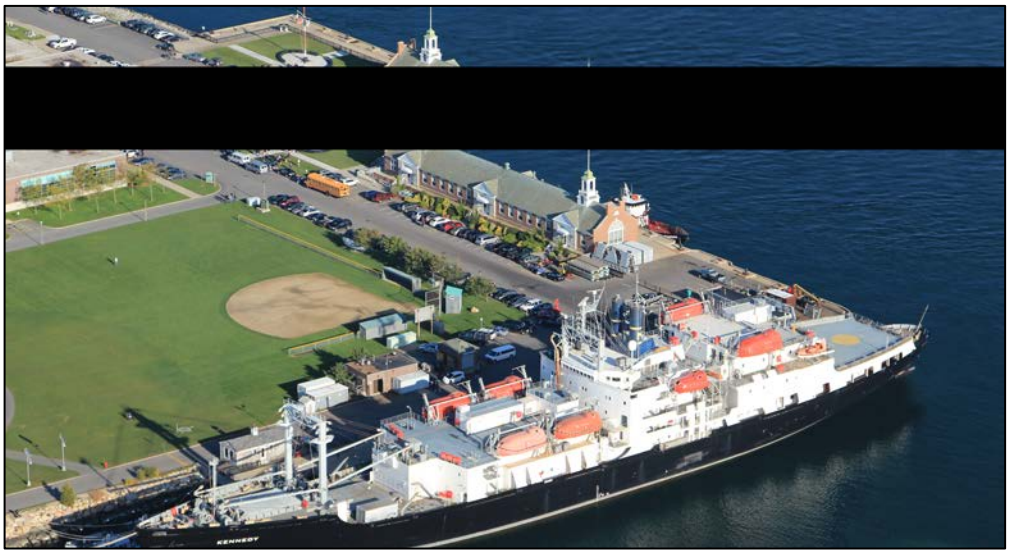

Figure 3 DOT's Maritime Training Ship – Kennedy

6. FHWA Incentivizes State-Based Innovation Deployment

U.S. DOT's Federal Highway Administration launched the State Transportation Innovation Council (STIC) in 2013. The STIC represents an established group of representatives from various levels of the highway community in each State tasked with comprehensively and strategically considering the implementation of innovations. The STIC places the States in the "driver's seat" to select innovations that best meet unique program needs and quickly implement them.

Technology transfer involves groups of people collaborating and using available resources to realize implementation progress, and tracking that progress requires time. One project was realized three years later. In 2016, STIC enabled the Department of Public Works & Transportation in Prince Georges County, MD, to complete, adopt, and institutionalize standard drawings for low-cost bridge structures. The drawings include beam details for bridges spanning from 40 to 80 feet. This led to benefits in saving construction time and enabling bridges to be traffic ready almost immediately after the bridge was erected.

Details included in the standards are the typical cross section, beam camber diagrams, beam reinforcing and prestressing strand details, and others. Dimensions are presented in an easy to use table format for the various span lengths. FHWA continues to explore opportunities to share information and provide tools that encourage the STICs to further institutionalize their efforts. For more examples of STIC Incentive projects, visit: http://www.fhwa.dot.gov/stic/.

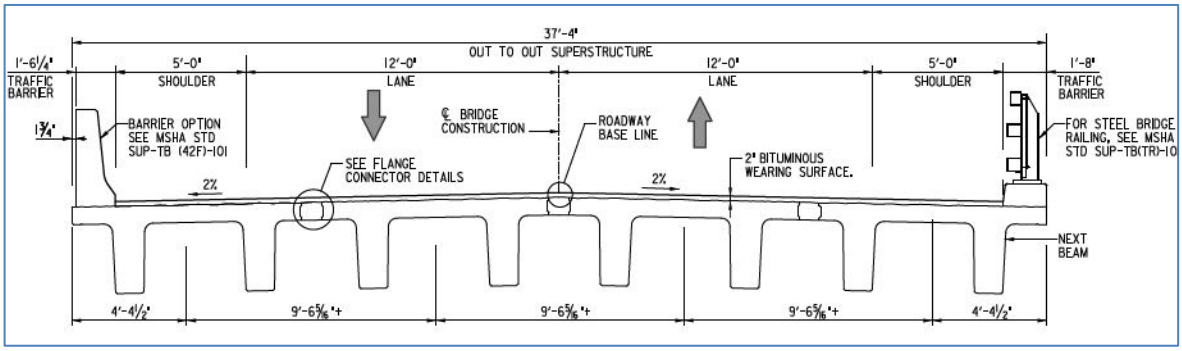

Figure 4 Low-Cost Bridge Standard Drawings available to any state and county that is interested in using it

7. EAR Program's Spin-off Acquired by Facebook

FHWA's Exploratory Advanced Research (EAR) Program funded Carnegie Mellon University (CMU) to develop an application for detecting emotion on human faces. Dr. Fernando De La Torre, an associate research professor at CMU, founder of FacioMetrics, researched this face masking technology for use on naturalistic driving study video data and Facebook acquired it.

Research and development funding was aimed toward developing an automated, complete, and irreversible identity-masking system for processing low-resolution video of drivers that will preserve head pose, eye and mouth movement, facial features, and eye gaze information while protecting personal identity. The Strategic Highway Research Program (SHRP2) safety naturalistic driving study resulted in collection of over one million hours of video. Effective masking to protect the privacy of the drivers will allow researchers greater access and use of the driver videos. A related benefit of the government-funded identity masking research was improved methods for detecting emotions.

Figure 5 Video data of drivers from researchers

8. ASCT Improves the Traffic Flow at Intersections

Conventional traffic signal systems use preprogrammed timing schedules that do not adjust to traffic conditions and can contribute to traffic congestion and delay. FHWA's ASCT research program supported both development and deployment of adaptive signal control technology (ASCT) which improves these systems by adjusting signal timing parameters that control the duration of red and green intervals to accommodate variability in traffic.

Topeka, Kansas installed ASCT on its 21st Street corridor and the technology is estimated to save drivers 123,000 gallons of gasoline and 191,000 pounds of CO_2 per year. Crashes also dropped nearly 30 percent along the corridor during the system's first year of operation. Since 2009, over 176 ASCT systems have been implemented, and many other agencies are considering the technology. Through FHWA's ASCT deployment efforts of providing the knowledge, training and support to the owner agencies, it influenced technology firms to continue the development of ASCT systems. There are eight ASCTs vendors and more are forming.

Figure 6 From conventional to adaptive traffic control signals

9. Simple Method for Simple Bridges

In DOT's FY13 report, we included as story about a "bridge of the future" initiative. FHWA's Geosynthetic Reinforced Soil–Integrated Bridge System (GRS–IBS) is an innovation to help reduce bridge construction time and cost. GRS-IBS was first applied by the U.S. Forest Service in the 1970s to build walls for roads in steep mountain terrain. FHWA has worked to evolve the technology into a fast, cost-effective method of bridge support that blends the roadway into the superstructure. Constructing a GRS-IBS bridge can cost 25 to 60 percent less than one built with conventional methods, depending on the standard of construction and the method of contracting. Since 2010, over 200 bridges in 44 states, Puerto Rico and the District of Columbia have been selected for construction using GRS-IBS.

Figure 7 A bridge built using the GRS-IBS methodology

10. FHWA's Traffic Incident Management Training Expands

The FHWA-sponsored Border Technology Exchange Program, coordinated by the Office of International Programs, collaborated with the Strategic Highway Research Program 2 (SHRP2) and stakeholders (AZ and TX DOTs) to train nearly one thousand fire, law-enforcement, emergency-management and transportation officials from local Mexican entities in Traffic Incident Management, which is critical to standardizing procedures of effective and safe cross-border transportation movements. Collaboratively, they have conducted nearly a dozen of the modified versions of the "National Traffic Incident Management Responder Training" in various cities in Mexico. SHRP 2's modified training sessions have featured a Spanish version of the popular video "Manage to Survive" developed by the International Association of Chiefs of Police in cooperation with FHWA.

Since it first launched in 2013, the training has been very well received and has gathered wide coverage from local media. A better trained emergency management force saves lives, money, and time, and given the volume of cross-border activity between the U.S. and Mexico, this standardized approach to Traffic Incident Management directly impacts the safety of U.S. citizens and businesses.

Figure 8 National Traffic Incident Management Responder Training in Ciudad Juarez, Chihuahua, Mexico