



University Transportation Centers



Excellence and Innovation
in Transportation Research
and Education

The Safe, Accountable,
Flexible, Efficient
Transportation Equity Act

A Legacy for Users | June 2014



U.S. Department of Transportation
Office of the Assistant Secretary
for Research and Technology

Front cover photos are courtesy of: Dr. Eugene DeLoatch, Morgan State University; Dr. John J. Meyers, Missouri S&T; NEXTRANS Center; and the University of Massachusetts-Amherst.

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Introduction

This booklet highlights the activity and significant accomplishments of the 60 University Transportation Centers (UTCs) reauthorized under the 2005 Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU). SAFETEA-LU reauthorized the UTC Program, which is part of the U.S. Department of Transportation's (U.S. DOT) efforts to use cutting-edge technology and innovation to solve the nation's transportation challenges and to build a transportation workforce for the future. The UTC Program is administered by the U.S. DOT's Office of the Assistant Secretary for Research and Technology.

Background

The UTC Program was created in 1987 under the Surface Transportation and Uniform Relocation Assistance Act, which authorized the establishment and operation of UTCs in each of the 10 standard federal regions. The Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) reauthorized the UTCs for six additional years adding four national centers and six University Research Institutes (URIs). The mission of these UTCs was to advance U.S. expertise in transportation technology and technology transfer. In 1998, the Transportation Equity Act for the 21st Century (TEA-21) reauthorized the UTC Program for an additional six years and increased the number of UTCs to 33. TEA-21 also established education as one of the primary goals of the UTC Program. In 2005, SAFETEA-LU reauthorized the UTC Program establishing 60 university centers. In 2011, 22 UTCs were competitively awarded to continue a tradition of excellence. In 2012, President Obama signed the Moving Ahead for Progress in the 21st Century Act (MAP-21) which reauthorized the UTC Program to competitively award up to 35 UTCs. In fall 2013, 33 centers were awarded grants.

Vision

The UTC Program ensures that internationally recognized university transportation centers of excellence are fully integrated within universities and continue to serve the nation as a vital source of transportation research, professionals, and leaders to meet the Nation's need for the safe, efficient, and environmentally sound movement of people and goods.

Mission

The UTC Program advances U.S. technology and expertise in transportation through research, education, and technology transfer at university-based centers of excellence.

Goals

Each UTC is expected to accomplish the following goals:

1. Education: Provide a state-of-the-art, multidisciplinary program of coursework and experiential learning that reinforces the UTC's transportation theme.
2. Human Resources: Ensure that an increased number of students, faculty, and staff are attracted to and substantively involved in undergraduate, graduate, and professional UTC programs.

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3. Diversity: Ensure UTC students, faculty, and staff reflect the growing diversity of the U.S.
4. Research Selection: Conduct an objective process for selecting and reviewing research that balances the multiple objectives of the UTC Program.
5. Research Performance: Continue an ongoing program of basic and applied research, the products of which are judged through peer review or other experts in the field, to advance the body of knowledge and practice in transportation.
6. Technology Transfer: Ensure the availability of research results to all potential users in forms that can be directly implemented, utilized, or otherwise applied.

Research and Development

Each UTC represented here focuses its research on a specific transportation theme. Themes vary and span the spectrum of the transportation endeavor. UTCs often collaborate with each other on areas of shared interest, cultivating a community of knowledge and avoiding duplication of effort.

UTC research on cutting-edge innovations such as connected vehicles, enhancements to durable pavement mixtures, and non-destructive testing techniques and monitoring has contributed to advances in commercial applications through the facilitation of technology transfer to transportation experts in both government and industry.

Students who participate in UTC research projects represent an outstanding pool of expertise in the transportation profession by advancing their knowledge and experience. Maintaining a strong, diverse workforce of transportation professionals is vital for the U.S. to reach its transportation goals.

University Transportation Centers

As provided for in the 2005 SAFETEA-LU Authorization.

National UTCs

Marshall University
 Missouri University of Science and Technology
 Montana State University
 Northwestern University (see also Tier II UTC)
 Oklahoma State University
 Portland State University
 University of Alaska
 University of Minnesota
 University of Vermont
 University of Wisconsin

Regional UTCs

- I. Massachusetts Institute of Technology
- II. City University of New York
- III. Pennsylvania State University
- IV. University of Tennessee
- V. Purdue University
- VI. Texas A&M University
- VII. University of Nebraska
- VIII. North Dakota State University
- IX. University of California, Berkeley
- X. University of Washington

Tier I UTCs

Georgia Institute of Technology
 Iowa State University
 Rutgers University
 San Jose State University
 University of Florida
 University of Idaho
 University of Maryland, College Park
 University of Michigan
 University of South Florida
 University of Southern California and California State University, Long Beach

Tier II UTCs

California State University, San Bernardino
 Cleveland State University
 George Mason University
 Hampton University
 Kansas State University
 Louisiana State University
 Michigan Technological University
 North Carolina State University

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Northwestern University (see also National UTC)

University of Akron

University of Arkansas

University of California, Davis

University of Connecticut

University of Delaware in Newark

University of Detroit Mercy

University of Massachusetts, Amherst

University of Memphis

University of Nevada, Las Vegas

University of Rhode Island

University of Toledo

Utah State University

Youngstown State University

Title III UTCs

Jackson State University

Morgan State University

North Dakota State University—Small Urban
and Rural Transit Center

Texas A&M University—Texas
Transportation Institute

University of Alabama, Birmingham

University of Alabama, Tuscaloosa

University of Denver/Mississippi State University

University of Tennessee, Knoxville—Center for
Transportation Research

For More Information

More information about the UTC Program is available online through the UTC website at <http://utc.dot.gov>.

The website includes:

- A list of current UTCs and points of contact.
- A search engine for the individual UTC websites allowing users to find relevant site content using keywords and phrases.
- An archive of relevant UTC publications and newsletters.

Contact Information

Additional information on the UTC Program can be obtained by contacting Caesar Singh, Director, University Grants Programs at Caesar.Singh@dot.gov.

Other UTC Program staff include:

- Amy Stearns, University Grants Manager
- Robin Kline, University Grants Manager
- Lydia Elena Mercado, University Grants Manager
- Denise E. Dunn, University Grants Manager
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The following individuals were instrumental in producing this accomplishments booklet:

- Judy Yahoodik, Management and Program Analyst, Volpe National Transportation Systems Center
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Alaska University Transportation Center (AUTC)

University of Alaska–Fairbanks

The Alaska University Transportation Center (AUTC) improves cold region transportation through research, education, and technology transfer. In 2005, SAFTEA-LU funding supported a portfolio of AUTC work that yielded multiple advancements in cold region seismic bridge design, dust control, soil stabilization, and asset management.

Seismic Bridge Design

AUTC's research on structural capacity and seismic demand in frozen soils led to revisions of state and national design standards, including the American Association of State Highway and Transportation Officials (AASHTO) Seismic Bridge Design Guide. Through the first quantified evaluation of loads imposed on bridge foundations by a frozen crust with liquefaction and lateral spreading, this research showed a 50 percent variation in pile performance. Also, cyclic cold-weather testing of steel-reinforced concrete performance realized a 30 to 40 percent strength increase in concrete, and a 10 percent increase in steel. Similar work tested seismic design improvements for all-steel piers and steel pipe piles.

Dust Control

AUTC's dust-reduction research entails a seven-project program that has:

- Tested and compared dust palliatives across 65 regional sites;
- Developed cost-effective instruments and evaluation options for the Alaska Department of Transportation and Public Facilities (DOT&PF);
- Delivered solutions to reduce dust by between 65 and 99 percent with a life span of 1–2 years, and
- Implemented results into new state dust-reduction requirements and Federal Aviation Administration (FAA) airport bidding specifications.

Soil Stabilization

AUTC tested alternative soil stability methods to enable the use of local materials by combining geo-fibers and synthetic fluids to double and triple the strength of sandy and silty soils, off-setting imported gravel costs by \$200 per cubic yard.

Asset Management

AUTC worked with Alaska DOT&PF to increase the life of existing infrastructure, develop new technologies to reduce construction and maintenance costs, provide enhanced management tools, and adapt to climate change infrastructure impacts. Investigation topics included slope failures, light detection and ranging (LIDAR) technology, pavement preservation, remote bridge structural health monitoring, and infrastructure impacts of permafrost and glacial thaw due to climate change. As a result of this research, a draft framework was developed to address challenges related to Geotechnical Asset Management (GAM), resulting in specific planning recommendations across a broad spectrum of GAM assets owned by the DOT&PF. Additionally, guidelines were developed for DOT&PF to implement an Unstable Slope Management Program.



Pictured are researchers, contractors, and Alaska DOT&PF staff installing a fiber-optic remote structural health monitoring system on Alaska's Chulitna River Bridge. (Source: M. Fisher)

Center for Advanced Infrastructure and Transportation (CAIT)

Rutgers University

The Center for Advanced Infrastructure and Transportation (CAIT) at Rutgers, The State University of New Jersey, has been a University Transportation Center (UTC) since 1998. CAIT is located in the most densely populated and heavily traveled region in the United States. Taking advantage of its proximity to the nation's third largest port, busiest rail line, five international airports, and a massive roadway network, CAIT uses the area as a laboratory to test solutions for complex multimodal issues in high-volume transportation corridors.

Rutgers' CAIT has emerged as a national leader specializing in infrastructure research that aligns with three U.S. DOT strategic areas: state of good repair, efficient and economical asset management, and safety. Among CAIT's broad spectrum of programs, is its internationally recognized work in condition assessment and health monitoring of bridges, roads, and other infrastructure.

Since 2008, CAIT has led the Federal Highway Administration's (FHWA) Long-Term Bridge Performance (LTBP) program, the largest and most ambitious bridge research contract ever issued by U.S. DOT. CAIT has also led major projects funded by the FAA, U.S. military, National Institute of Standards and Technology (NIST), Federal Transit Administration (FTA), State DOTs, and many others. CAIT provides training and technical assistance to state and local agencies including public works departments, metropolitan planning organizations (MPOs), and

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RABIT™ is the first fully automated bridge deck assessment tool to combine multiple nondestructive evaluation technologies that gather a range of condition data and transmit it to a mobile command van in real time. The robot was created by Rutgers' CAIT in partnership with FHWA under the Long-Term Bridge Performance program. ©2013 Nenad Guncuski/Rutgers CAIT.

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police. It trains more than 7,500 professionals annually in more than 200 courses covering everything from crash data analysis and pavement engineering to work zone and pedestrian safety, intersection design, and disaster preparedness.

CAIT is committed to applied research that solves real-world problems. It has a university-based asphalt laboratory accredited by the AASHTO. CAIT advances research implementation and state-of-the-art products such as a robotic bridge deck assessment tool that deploys multiple nondestructive evaluation technologies to gather and meld condition data into a comprehensive picture of the structure's health. The American Society of Civil Engineering Pankow Award-winning innovation collects data four times faster than traditional methods, reduces lane closures, and keeps inspectors and technicians safely away from traffic.

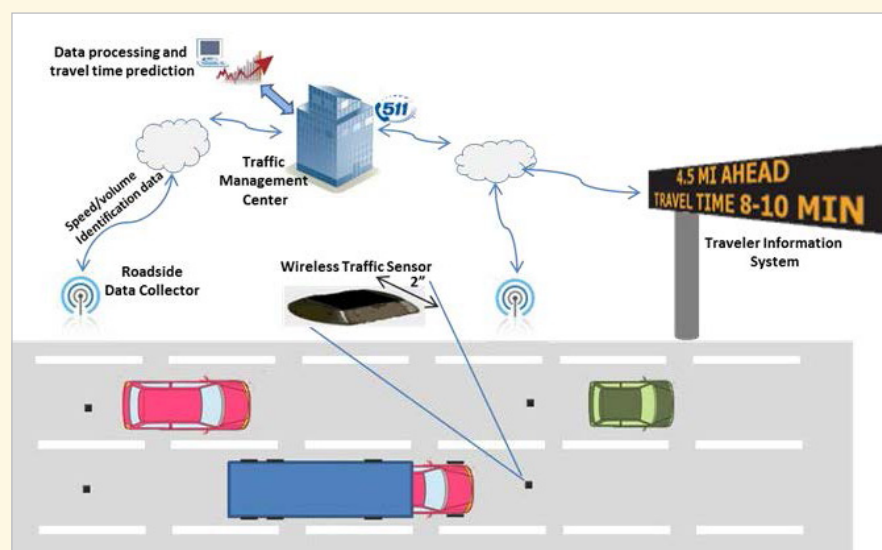
Along with government, industry, and countless academic partners, CAIT strives to keep our country's transportation systems in top condition while making them safer, more durable, and more efficient.

Center for Integrated Transportation Systems Management (CITSM)

University of Maryland

The Center for Integrated Transportation Systems Management (CITSM) at the University of Maryland was established in 2008. CITSM's theme was the *development of advanced technology, improved processes, and enhanced organizational structures for the integrated management and operation of transportation facilities and corridors*. The scope of projects supported by CITSM encompassed: transportation system data acquisition and monitoring, real-time system management and operations, transportation system safety, transportation systems planning, management and operations in extreme events, information dissemination to system users and operators, policy and institutional issues, and performance measurement. CITSM-sponsored projects focused on the development of tools, processes, and institutional relations that foster seamless management and operations of today's transportation infrastructure. During its four years of operation, 61 projects were completed by 21 participating faculty members, 76 undergraduates, and 130 graduate students resulting in 103 academic papers. CITSM organized 52 seminars given by nationally and internationally recognized speakers, and sponsored 377 short courses and distance learning classes attended by transportation professionals.

On April 6, 2011, CITSM organized a one-day demonstration/exhibition of prominent university transportation products in the U.S. DOT, which showcased two CITSM projects. A green wireless traffic detection technology was demonstrated which consisted of a scalable wireless sensor networking scheme that enhanced traffic data collection. The system was successfully deployed and tested on Maryland's Intercounty Connector. Using a modified platform, an automated truck parking information system was developed to promote safety and enhance performance at truck rest areas. As part of a second project, a system development process for integrating variable speed control and travel time information to minimize recurrent highway congestion was presented and demonstrated. This model uses embedded traffic flow relations to predict the evolution of congestion patterns over the projected time horizon and computes the optimal speed limit.



Wireless Traffic Sensor Network. (Source: CITSM Project Report)

Center for Intermodal Freight Transportation Studies (CIFTS)

University of Memphis

Potential Realized

Two words best summarize the University of Memphis (UM) UTC: **Potential Realized**.

It is no secret that Memphis moves freight. Often called America's Distribution Center, Memphis has five Class 1 railroads, the 4th largest inland port, and the nation's largest freight airport. Since RITA's (now the OST-R) investment in UM, the mid-south is realizing its freight-related potential.

The UM UTC designation established an administrative home that allows its researchers to seize available opportunities in one of the best working freight laboratories where they are able to conduct relevant research, education, and technology transfer activities. Below are several examples of potential areas for transportation research, as well as the innovative ways the Center for Intermodal Freight Transportation Studies (CIFTS) is meeting these needs.

Potential: Need to conduct research linking freight transportation performance and economic development.

Potential Realized: CIFTS performs local, regional, and national research with partners at universities across the United States. Because of CIFTS' breadth of experience, research is more freight-focused and directly linked to economic development benefits.

- A CIFTS project with Vanderbilt University looked at the four phases of emergency management—mitigation, preparedness, and recovery. The results reinforced, clarified, and resulted in closer cooperation among stakeholders responsible for freight safety and security.



Jared O'Dell epitomizes Potential Realized. In December 2013, Jared received his master's degree in civil engineering with a concentration in transportation. As an undergraduate, he participated in an internship program for first generation students from rural counties and worked at Canadian National (CN) Railway, a CIFTS partner. After his CN internship, Jared declared his love for transportation and worked as a graduate assistant supported by RITA (now OST-R) UTC funding. CIFTS not only provided financial support, we also connected a future industry professional with an amazing mentor; one of our faculty researchers.

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Potential: Students interested in exploring the transportation industry.

Potential Realized: CIFTS engages three full-time and one part-time professor who are molding minds through classwork and research. In addition, CIFTS consistently connects 10 or more graduate students to advanced transportation degrees and research opportunities.

- In June 2010, CIFTS partnered with CN Railway to conduct classroom and extensive hands-on training for emergency responders and stakeholders using a CN Railway training facility. More than 125 first responders and stakeholders received expert training.

Potential: 11 percent of the Memphis workforce is in the transportation industry; therefore, they are interested and invested in our work.

Potential Realized: CIFTS explores ways for the freight industry to maintain economic competitiveness by regularly distributing sought after tech transfer to the freight industry on a national level.

- Beginning with the First Annual Intermodal Conference in 2007, CIFTS expanded its role as host and expert facilitator to the freight and first responder community and stakeholders. Annual conferences, workshops, and training events allow for the sharing of information, techniques, research, and solutions to issues of interest.
-

Center for Multimodal Solutions for Congestion Mitigation (CMS)

University of Florida

The Center for Multimodal Solutions for Congestion Mitigation (CMS) supported the innovative development of solutions for mitigating congestion. This theme was selected because congestion mitigation is one of the top priorities of the U.S. DOT and the Florida Department of Transportation (FDOT), our Partner Agency. It was also chosen because addressing congestion via multimodal solutions considers the transportation system as a whole.



Pictured is a bird's-eye view of Interstate 4 in Orlando, Florida. (Source: Vipul Modi, former graduate student and employee at the University of Florida Transportation Institute)

CMS researchers produced various products that are in use by the transportation industry today. For example, CMS developed the Statewide Transportation Engineering Warehouse for Archived Regional Data (STEWARD), which serves as a repository for data generated by the SunGuide System in Florida, providing stakeholders with a rich supply of data from Florida's busiest roadways. These data are a useful resource for researchers and practitioners. Another set of CMS projects added several new features to CORSIM

(CORridor SIMulation), a microscopic traffic simulation software that is used worldwide. These CORSIM improvements included two-lane highways, toll plazas, high occupancy toll lanes, and adaptive cruise control. In a series of FDOT-funded projects, researchers developed tools for estimating travel time reliability on Florida's Strategic Intermodal System, which provides travel time reliability while considering incidents, work zones, and congestion occurrence.

These tools are currently used by FDOT in their mobility assessment efforts. In a project related to driving for aging baby boomers, University of Florida researchers developed a Fitness-to-Drive Screening Measure, which is currently being used by the AARP. In addition to these products, CMS researchers examined the trade-offs and costs of congestion in supply chains, and made significant advances in road pricing for congestion mitigation. Throughout the life of the project, CMS-affiliated researchers graduated 111 master's degree students and 31 PhD students, while holding 127 technology transfer events with a total of 3,065 participants.

Center for Transportation and Livable Systems (CTLS)

University of Connecticut

The Center for Transportation and Livable Systems (CTLS) at the University of Connecticut engages multidisciplinary engineering and planning activities that promote a sustainable transportation system and livable, connected communities. The mission of the CTLS is to support the six sustainability and livability principles jointly developed by the U.S. DOT, U.S. Environmental Protection Agency, and the U.S. Department of Housing and Urban Development. The following are some recent and ongoing examples of projects the CTLS has engaged in.

Research: t-HUB is a web application and database initiative to simplify both the data management and analytical processes for public transportation, and is led by Dr. Nicholas Lownes of the CTLS. t-HUB grew out of an expressed need for better tools for Title VI analysis by public transportation stakeholders. As part of the software development process, the CTLS team held two workshops in November 2012 and February 2013, engaging representatives from all public transportation stakeholder groups. Fifty-six individuals from 27 different organizations participated in the workshops. These efforts resulted in new partnerships and applications of t-HUB and its analytical tools at local, State, and regional levels.



Pictured are attendees of the CTLS Title VI and Transit Data Workshop held in November 2012. Photo is courtesy of Ashrafur Rahman.

Education: The Transportation Undergraduate Research Fellowship (TURF) program is a summer research fellowship initiative created to introduce undergraduate students to the full spectrum of the transportation research process, including proposal writing, scheduling, analysis, and communicating results. TURF partnered a total of 14 undergraduates with CTLS researchers

to conduct independent research projects complementary to ongoing CTLS research under SAFETEA-LU. Students propose a research project, conduct the research, and present their results at the end of the summer to an audience comprising peers, advisors, and other transportation professionals.

Outreach: CTLS researchers Norman Garrick and Peter Miniutti are assisting the city of New London, Connecticut to develop a vision to reconnect their downtown using sustainable transportation concepts and smart growth strategies. CTLS also partnered with the T2 Center (Connecticut's Local Technical Assistance Program (LTAP)) to support transportation workforce development and train the next generation of professionals entering the transportation workforce with regional and statewide partners across the transportation industry.

Center for Transportation and Materials Engineering (CTME)

Youngstown State University

Transportation: Mobility, Longevity, and Sustainability

The Center for Transportation and Materials Engineering (CTME) at Youngstown State University was established in late 2006 with funding from the U.S. DOT. The \$500,000 per year grant was part of the 2005 SAFETEA-LU legislation that authorized the U.S. DOT to fund 22 UTCs throughout the nation.

CTME's theme aligns with the national strategy for surface transportation as defined in the U.S. DOT's Strategic Plan, as well as the U.S. DOT Research, Development, and Technology Plan. Activities at CTME address the goals of the UTC Program through research, education and workforce development, and technology-transfer activities.

CTME's efforts focused on four multidisciplinary areas:

Planning, workforce development, and outreach understands and anticipates the impact of multimodal transportation operations and management research and develops new education initiatives to enhance workforce development and outreach in the transportation workforce.

Infrastructure/construction technology applications plans for and implements new technology in infrastructure renewal and construction technology to focus on increasing the longevity of our nation's transportation infrastructure.

Sustainability of the environment involves understanding and implementing research applications to develop sustainable designs with minimal environmental and ecological impact.

Materials technology and applications consists of developing a research component, to identify new materials and new applications for materials manufacturing processes for use in all modes of transportation.

CTME has continued to refine its focus on applications of its programs and research outcomes in the areas of transportation. For example, CTME is focusing on applications that will increase the longevity of the nation's transportation infrastructure by developing lighter-weight, more fuel-efficient vehicles and by enhancing bridge safety and improving pavement-bridge interface.

Center for Transportation and the Environment (CTE)

North Carolina State University

The Center for Transportation and the Environment (CTE) was established in 1991 as a national center within the Institute for Transportation Research and Education at North Carolina State University. The CTE was funded by the RITA (now the Office of the Assistant Secretary for Research and Technology) and the U.S. DOT, with matching support from the North Carolina Department of Transportation (NCDOT). Since its creation, the CTE has carried out numerous projects with agencies at the local, state, and national level.



NCSU engineering students tour NCDOT rail facilities in April 2011, facilitated by CTE's Dr. David Robinson. Photo courtesy George List.

Several SAFETEA-LU-funded projects have also been CTE projects, which were supported by the National Cooperative Highway Research Program (NCHRP). A project titled, "NCHRP 25-25 Task 62: Improving Public Outreach for Transportation Projects by Use of Citizen Coalitions" was carried out in association with The Louis Berger Group, Inc. The project inventoried 85 coalitions involved in transportation policies, programs, and projects at various levels. The coalitions inventoried cover a range of topic areas,

including social equity, environmental protection, sustainable strategies, public health, air quality impacts, and historic and cultural preservation. Another project titled, "NCHRP 25-36: Impacts of Land Use Strategies on Travel Behavior in Small Communities and Rural Areas" addressed the impacts of land use strategies on travel behavior in small communities and rural areas.

Other initiatives have included a "Sustainability Blueprint" study for the NCDOT that helped institutionalize sustainable principles and practices. Another project carried out a statewide survey of bicycle and pedestrian issues. CTE has also maintained a close working relationship with the NCDOT in its ongoing research program. From 2010–2011, 13 projects were completed that addressed topics ranging from assessing ecological impacts, stormwater management, and bioenergy crop production along highway right-of-ways.

CTE's education program continues to focus on Context Sensitive Solutions (CSS) and features the completion of a new phase of the CSS National Dialog supported by the FHWA. The CTE/NCDOT partnership has generated significant research results in various environmental areas, including air quality, water quality, wetlands mitigation, vegetation management, wildlife management, highway construction materials, and new technologies. During 2010–2011, the CTE research program involved the active participation of more than 35 students and 19 university faculty representing many academic disciplines.

Center for Transportation Infrastructure and Safety (CTIS)

Missouri University of Science and Technology (Missouri S&T)

After seven years as a National University Transportation Center under SAFETEA-LU, the Center for Transportation Infrastructure and Safety (CTIS) at Missouri University of Science and Technology (Missouri S&T) has reached its goal of becoming a center of excellence in the areas of advanced materials, non-destructive testing technologies, and transition-state fuel vehicle infrastructure.

CTIS funding leverage has allowed its researchers to develop an expansive network of collaborators to comprehensively address issues facing our nation's transportation infrastructure. By undertaking projects with state DOTs (Missouri, Minnesota, Nebraska, and CalTrans), leading researchers at several universities like Nevada-Las Vegas, Iowa State, Nebraska-Lincoln, Minnesota, Arkansas, and Texas-Austin, as well as industry partners at General Motors, Core Slab, and Bell Helicopter, the CTIS has studied problems facing these agencies and proposed tangible solutions.



Missouri Bridge A7957 on Highway 50 near Jefferson City, Missouri during construction showing a high-strength self-consolidating concrete (HS-SCC) NU girder being erected with Data Acquisition System (DAS) attached. Photo courtesy of Dr. John J. Myers, Missouri S&T.

CTIS funded nearly 150 projects and graduated 55 master's degrees and 25 PhD students during the life of their SAFETEA-LU grant. Several CTIS projects have included field implementation, which present real-world solutions to transportation issues. A few of the noteworthy comprehensive research programs performed under this grant include Missouri S&T Hydrogen Transportation Test Bed Equipment & Construction, as well as Missouri DOT Transportation Geotechnical, Structures, and Pavement Preservation Research programs. The CTIS invested \$3M in specialized equipment needed to perform projects it funded.

CTIS has impacted the quality of available education for engineers and transportation professionals. In collaboration with Missouri DOT, CTIS has housed the Local Technical Assistance Program (LTAP) Center for the State. Over seven years, CTIS has provided support to the LTAP Center in the amount of \$1.2M, which has enabled the program to provide 630 workshops to practicing professionals. Over the life of the UTC grant, 251 undergraduate- and 249 graduate-level transportation-related courses have been offered at Missouri S&T in order to better equip students with the skills needed to be the next generation of transportation leaders.

Delaware Center for Transportation (UDUTC)

University of Delaware

The University of Delaware University Transportation Center (UDUTC) supports a multidisciplinary program of research focusing on four areas: Planning, Ecology and the Environment, Infrastructure Renewal, and Operations and Management. The example activities below were conducted as part of the SAFETEA-LU grant, and are two areas the UDUTC has been involved in that fit within the existing theme of *Resilience of Transportation Corridors*.

Curbside Bus Operations

The UDUTC took advantage of its central location in the Boston to Washington (BosWash) corridor to explore the impact of unprecedented growth of curbside intercity buses in the I-95 corridor, and the role of curbside buses in contributing to and degrading the resiliency of the corridor. The increase in popularity of curbside intercity bus services has been spurred by competitive prices; convenient online ticketing; the rise in “transit lifestyles;” and access to free, onboard Wi-Fi technology that caters to a younger demographic. The curbside intercity bus industry now represents the fastest growing mode of intercity travel in the United States—outpacing air and rail transportation. This growth in demand is accompanied by safety concerns and congestion at pick-up and drop-off points.

The Institute for Public Administration (IPA) at the University of Delaware was supported by the UDUTC to study these issues. Research included a literature review and field assessment of curbside operations, and a case study on a Chinatown bus based in Wilmington, Delaware, which was cited as an “imminent hazard” and shut down by the U.S. DOT. IPA also hosted the June 13, 2012 Curbside Intercity Bus Transportation Policy Forum to facilitate discussion on transportation policies related to the industry. The study recognized the demand for this type of service while exploring approaches to address safety concerns and externalities including permitting systems, idling laws, regulating curbside conditions, leasing or privatizing curb rights, and consolidating and/or centralizing bus operations in intermodal facilities.

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The UDUTC is exploring the impact of curbside intercity bus service on the resiliency of the I-95 corridor. Photo courtesy of Eileen Collins/Arthur Wicks.

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Climate Change

Climate change has the potential to impact the resiliency of transportation corridor performance. UDUTC projects on climate change have contributed original research to connect climate change to long-range transportation planning and pavement design. These projects have also provided opportunities for engaging larger climate change initiatives in Delaware, the introduction of climate change adaptation concepts in graduate and undergraduate classes, and discussion of future research activities.

During the life of this grant, graduate students Michelle Oswald and Weifeng Mao, and Professor David Ames served on the steering committee for the Wilmington Area Planning Council's (Wilmapco) regional sea-level rise (SLR) transportation vulnerability assessment from 2010 through 2011. Former UDUTC students also served on the steering committee. Michelle Oswald, an intern at Wilmapco, assisted with integrating climate change adaptation practice in long-range planning, as well as evaluation of climate change impacts.

Climate change adaptation concepts have been integrated into the undergraduate Transportation Engineering course and graduate courses in Urban Transportation Systems, and Civil Infrastructure Systems.

Research results were presented to the Climate Change and Energy division of Delaware Department of Natural Resources and Environmental Control (DNREC), Delaware Department of Transportation (DeIDOT) and DART (the transit agency in Delaware). DeIDOT supported a follow-on project to develop decision tools to evaluate strategies to address flooded roads.

The UDUTC has contributed original research to connect climate change to long-range transportation planning and pavement design. Photo courtesy of Sue McNeil.



Michigan Ohio University Transportation Center (MIOH UTC)

University of Detroit–Mercy

The Michigan Ohio University Transportation Center (MIOH UTC) was created to address issues of transportation systems, alternative fuels, and supply chain efficiencies yielding relevant improvements to the nation and region. During its six years, the MIOH UTC completed 28 research programs, many of which were a sequence of projects, plus four educational projects, and five K-12 outreach programs. Each research project resulted in presentations and/or publications (over 100 total) to disseminate its findings.

One very concrete example of MIOH's impact is the M-1 Rail, which will soon break ground on the modern streetcar system that was initially planned by project TS-19, "The Woodward Transit Catalyst Project." The report and presentation from TS-19 was directly employed to create the public-private partnership described by former Secretary LaHood, "This is going to be in the history books. No other city in America has had their business community come together and raise \$100 million." In the estimation of then FTA Administrator Peter Rogoff, "The M-1 Rail project will truly be a catalyst for bringing new jobs, employers, retailers, and attractions into downtown, midtown, and the New Center area along Woodward Avenue." FTA continues to assist M-1 and Detroit leaders in bringing this original vision into reality.

Following TS-19, MIOH researchers aided the understanding and planning of Transit Oriented Development (TOD) in Detroit, especially along the M-1 alignment, through two additional projects related to TOD for Detroit Rail and its environmental sustainability.

MIOH also developed a substantive K-12 program to attract, motivate, and educate future transit professionals, including summer camps and Saturday classes. After development, piloting, and assessing

these educational modules, they were provided to over 600 high schools across the nation and to all UTC's in attendance at the January 2010 CUTC meeting. These modules are available free of charge at http://eng-sci.udmercy.edu/pre-college/alt_fuel_curriculum.



Rendering of Woodward Transit Catalyst System from MIOH UTC Project Report—TS19, November 2007

Georgia Transportation Institute/ University Transportation Center (GTI/UTC)

Georgia Institute of Technology

From 2007 to 2011, the Georgia Transportation Institute/University Transportation Center (GTI/UTC) supported transportation research, education, and technology transfer in the areas of economic growth, system productivity, and innovative financing.

GTI/UTC research supported the U.S. DOT's mission by contributing to the body of knowledge geared toward ensuring a fast, safe, efficient, accessible, and convenient transportation system. Research focused on a variety of topics, including forecasting freeway travel time; identifying freight performance measures to assess truck movements; investigating the productivity of airports by exploring the relationship between airport costs and metropolitan development; examining the state of Georgia's commercial vehicle oversize and overweight enforcement program; maximizing port and transportation system productivity by exploring alternative port operation strategies; and analyzing alternate revenue sources for transportation planning.

GTI/UTC supported more than 40 transportation seminars, symposia, and training classes, and cosponsored the "Piedmont Atlantic Megaregion in the Global Economy" Forum; the FTA Regional IV Conference; the World Symposium on Transport & Land Use Research (WSTLUR); and a congressional forum called "Funding and Financing Solutions for Surface Transportation in the Coming Decade." These events delivered important information to transportation professionals in both the private and public sectors.

In addition, GTI/UTC supported a number of educational initiatives. For example, more than 150 students participated in GTI/UTC's research projects, and more than 75 students won awards from a variety of sponsors. GTI/UTC supported 12 student internships at the Metropolitan Atlanta Regional Transit Authority (MARTA). The GTI/UTC and Fulton County cosponsored the K-12 Building Engineering Achievement in Transportation (BEAT) program. This program began with 25 students and grew to include over 200 middle and high school students. GTI/UTC also supported high school students who participated in the *Rule the Air!* Summer Camp. In this setting, students competed against other would-be CEOs who were in charge of their own simulated airline. Activities included managing aircrafts, selecting routes, and scheduling flights.

Gulf Coast Research Center for Evacuation and Transportation Resiliency (GCCETR)

Louisiana State University

The Gulf Coast Research Center for Evacuation and Transportation Resiliency (GCCETR) is a collaborative effort between the Louisiana State University (LSU) Department of Civil and Environmental Engineering and the University of New Orleans' (UNO) Department of Planning and Urban Studies.

The theme of the LSU-UNO Center is focused on evacuation and transportation resiliency in an effort to address the multitude of issues that impact transportation processes under emergency conditions such as evacuation and other types of major events. This area of research also addresses the need to develop and maintain the ability of transportation systems to economically, efficiently, and safely respond to the changing demands that may be placed upon them.

Below are several examples of recent projects conducted at the GCCETR along with brief descriptions of the overall research objectives and significant findings.

- **Report No. 13-03; Title: A Dynamic Feedback-Control Toll Pricing Methodology: A Case Study On Interstate 95 Managed Lanes.** Congestion pricing emerged as a cost-effective and efficient strategy to mitigate congested freeways. This study develops a feedback-control based dynamic toll approach to formulate and solve for optimal tolls, and compares the performance of the proposed methodology to that of the current strategy deployed on Interstate 95 express lanes. There were two objectives: 1) to maximize the toll revenue, while maintaining a minimum level of service on the managed lanes; and 2) to maximize both revenue and throughput on the managed lanes, while keeping a minimum level of service. When compared to the currently adopted toll pricing strategy on I-95, the proposed strategy with both objectives produces steadier toll rate profiles, while keeping the speeds at 45 mph or more. The success of these strategies led to further evaluation and piloting.
- **Report No. 12-06; Title: Transit-Oriented Development: An Examination of America's Transit Precincts in 2000 and 2010.** This study creates a typology of all fixed transit precincts across the United States to categorize all stations as a Transit Oriented Development (TOD), Transit Adjacent Development (TAD), or hybrid. This typology is based on an index that accounts for density, land use diversity, and walkable design. This study also presents a separate non-typological, multilevel, multivariate analysis of transit commuting and the built environment, which is unique in that it is the first national study of transit station precincts of its kind to control both regional and neighborhood level variables. The findings lend support for the TOD concept in generating higher shares of transit commuting within station areas, with implications about how America can accommodate population growth by turning TADs and hybrids into TODs. This can result in more sustainable commuting patterns, a new growth market for housing and real estate in a post-recession economy and the potential decoupling of growth in the economy without the growth in carbon emissions. Much of this could be achievable without the need to necessarily make a major national investment in new infrastructure but in utilizing the existing infrastructure better by encouraging more TODs.

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- **Report No. 11-09; Title: Assessing the Long-Term Impact of Subsidence and Global Climate Change on Emergency Evacuation Routes in Coastal Louisiana.** Subsidence forecast models for coastal Louisiana were developed to estimate the change in surface elevations of evacuation routes for the years 2015, 2025, 2050, and 2100. Geophysical and anthropogenic subsidence estimates were derived from ongoing empirical studies published in contemporary scientific literature. Forecasted elevation changes were subtracted from road surface elevation surveys. Individual road segments estimated to have surfaces at or below 0m in elevation (NAVD-88) were quantified by road class and parish. Additionally, the threshold for climate change susceptibility was evaluated relative to storm surge models published by the National Weather Service, which were used to identify and quantify evacuation routes vulnerable to surge inundation. The results from this analysis are presented by parish and reveal the modeled subsidence risks for the forecast years. Findings from this research can provide transportation engineers and emergency managers with data previously unavailable, which are applicable to evacuation modeling, hazard mitigation, environmental sustainability research, costal restoration efforts, and more. These research results were published in GeoJournal, as well as in other relevant professional publications.
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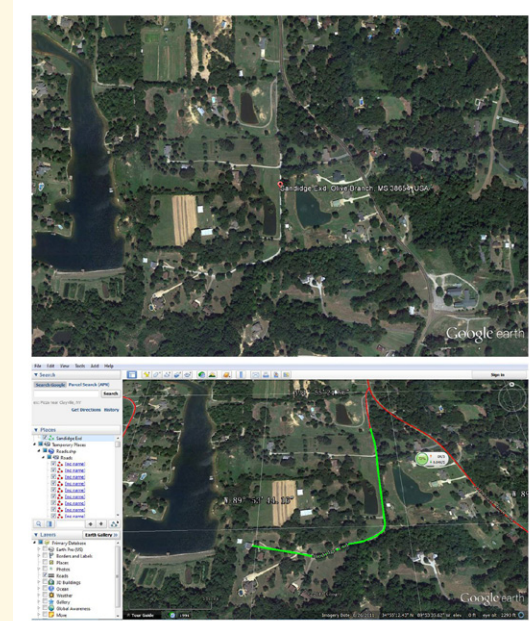
Institute for Multimodal Transportation (ImTrans)

Jackson State University

Established in 2006, the Institute for Multimodal Transportation (IMTrans) at Jackson State University (JSU) is one of 60 UTCs created under SAFETEA-LU. The theme of IMTrans is managing metropolitan mobility, with a long-term objective to establish a national resource for multidisciplinary research and education that integrates multiple modes of transportation. In the past few years, IMTrans has conducted several education, research, and transportation-related technology transfer projects to serve the community and the state of Mississippi.

In 2009, IMTrans funded the Summer Transportation Institute (STI) project, which recruited 20 minority high school students for a two-week summer camp program on JSU's campus. As part of the program, students experienced different transportation modes, transportation-related jobs and workplaces through numerous field trips, and attended rigorous lectures by JSU's Civil and Environmental Engineering faculty and transportation professionals from various industry and government agencies. Since 2011, Mississippi DOT (MDOT) has co-funded the STI project, and in 2013 JSU was officially selected by FHWA as the third institution in Mississippi to receive full STI funding from both MDOT and FHWA.

Every year, IMTrans is invited by MDOT to co-sponsor the state's annual public transportation summit. In 2012, IMTrans supported the local transit company Jatran, in a volunteer project which involved JSU students and faculty in developing GIS maps for bus routes. In the past two years, IMTrans has co-funded and conducted two research projects titled, "State-of-Practice Approaches and Technologies for Inventory Data Collection of Mississippi's Public Road System," and "Emergency Evacuation Study for the Greater Jackson Area." These projects have supported four graduate research assistants. Over the past two years, four TRB papers and three journal articles based on IMTrans research were coauthored by students and faculty, and accepted for publication.



Above: Aerial imagery data analyzed in inventory data collection study. Photo courtesy of Mina Zhou. Lower/left: Mississippi Summer Transportation Institute (MSTI) classroom. Photo courtesy of Imelda Simeon. Lower right: JSU's football stadium and connecting networks, which have been considered in an emergency evacuation study. Photo courtesy of Feng Wang.



Intelligent Transportation Systems (ITS) Institute

University of Minnesota

The Intelligent Transportation Systems (ITS) Institute is a national UTC that was funded through SAFETEA-LU. The ITS Institute plans and conducts activities that further the mission of the UTC program of the U.S. DOT and RITA (now the Office of the Assistant Secretary for Research and Technology (OST-R)). That mission is to advance U.S. technology and expertise in the many disciplines that make up transportation through education, research, and technology transfer activities at university-based centers of excellence.

The ITS Institute's activities are guided by its theme of enhancing the safety and mobility of road- and transit-based transportation by focusing on human-centered technology. To that end, it brings together technologists and those who study human behavior to ensure that ITS Institute-developed technologies become tools that optimize human capabilities.

This human-centered approach means that new developments in the core ITS technology areas of computing, sensing, communications, and control systems will be used to approach significant safety and mobility problems with a fresh perspective. Additionally, the ITS Institute addresses issues related to transportation in a northern climate, investigates technologies for improving the safety of travel in rural environments, and considers social and economic policy issues related to the deployment of core ITS technologies.



Left: In Alaska, driver-assist technology installed on snowplows helps operators clear Thompson Pass, often in whiteout conditions. Photo courtesy of Alaska Department of Transportation and Public Works. Right: An MVRTA driver views his lane position and other vehicles in the head-up display, part of the driver-assist system. Photo courtesy of Michael McCarthy (ITS Institute).

The ITS Institute is particularly active in the area of congestion mitigation and researching ways to improve traffic flow on signalized arterial roads. Below is one example of how the ITS Institute has contributed its expertise and knowledge to improving travel times and reducing delays due to congestion.

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The SMART Signal system, installed on France Avenue in Edina, Minnesota, collects signal-phase change events. Photo courtesy of Jonathan Chapman.

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SMART Signal, Smart Congestion Relief

A primary obstacle to improving the performance of signalized arterial streets has been the difficulty of gathering accurate and

reliable data to assess arterial traffic conditions. The need to manually collect the data and then calculate performance metrics for individual intersections or arterials has made assessing performance a time-consuming and expensive process for transportation agencies.

ITS Institute researchers developed a system that automatically collects data and assesses performance in real time. It then creates performance measures, including information on the times and locations of congestion on a given roadway. Because it can also refine the traffic signal parameters intelligently using archived data, the system has been dubbed “SMART Signal,” for Systematic Monitoring of Arterial Road Traffic Signals.

SMART Signal has been deployed at more than 70 intersections in Minnesota and 6 intersections in Pasadena, California. The SMART Signal system is intended to be installed at a series of intersections along an arterial road. A dedicated microprocessor module is installed in the signal control cabinet at each intersection, interfacing directly with the cabinet electronics without interfering with signal operations. SMART Signal collects event data that are then packaged and transmitted in real time to the server located at the University of Minnesota.

Institute researchers worked closely with Minnesota Department of Transportation (MnDOT) operations staff. The device is important for MnDOT because it takes all the data in the traffic signal cabinet and turns it into usable information—performance measures—for traffic engineers to use to assess how their signals are doing. The system has also benefitted the traveling public by providing the following: less congestion, less delay, and improved travel times throughout the corridor.



The TDSS uses a smartphone mounted on a vehicle's dashboard to give the driver real-time warnings about speeding and other unsafe behaviors. Photo courtesy of Steve Maturen.

In 2011, the University of Minnesota's Office of Technology Commercialization signed a licensing agreement with startup company SMART Signal Technologies Inc. to commercialize the system. This project, funded by RITA (now OST-R) under SAFETEA-LU, is one example of the ITS Institute's work that is focused on enhancing the safety and mobility of road- and transit-based transportation.

Mack-Blackwell Rural Transportation Center (MBTC)

University of Arkansas

The Mack-Blackwell Rural Transportation Center (MBTC) began participating in the U.S. DOT University Transportation Center Program in 1992. The MBTC has a strong history of working with the Arkansas State Highway and Transportation Department, other government agencies, and private industry to identify and



Pictured is the Mississippi River Bridge in Helena, Arkansas. Photo courtesy of the Arkansas State Highway and Transportation Department.

provide impactful solutions to transportation challenges. Under the SAFETEA-LU UTC grant, MBTC's theme is to improve local transportation systems and transcend rural needs by connecting the rural to the urban, the urban to the nation, and the nation to the world's transportation system through our research impacts, trained transportation professionals, and technology transfer activities. MBTC is a partner in the Department of Homeland Security National Transportation Security Center of Excellence, which is dedicated to solving critical scientific and technological issues related to multimodal transportation security at the national level.

The University of Arkansas builds on its geographic access to river, road, and rail corridors, and industry access to global logistics leaders (including Wal-Mart Stores, J.B. Hunt Transport, and ABF Freight Systems) to lead nationally relevant multimodal research to carry people and freight to their destinations efficiently and effectively. MBTC researchers are nationally known for their expertise in:

- Advanced pavement and structural materials
- Economic and operations analysis of inland waterways
- Emergency logistics planning
- Foundation/soil-structure interaction modeling and design
- Freight data analysis and modeling
- Multimodal network optimization
- Pavement design, construction, evaluation, and rehabilitation
- Seismic modeling and design
- Structural design, modeling, and health monitoring
- Transportation systems engineering

MBTC's future work in the UTC Program will be conducted through the Maritime Transportation Research and Education Center (MarTREC) to build economic competitiveness through efficient, resilient, and sustainable maritime and multimodal transportation systems.

Michigan Center for Advancing Safe Transportation throughout the Lifespan (M-CASTL)

University of Michigan

The Michigan Center for Advancing Safe Transportation throughout the Lifespan (M-CASTL), based at the University of Michigan's Transportation Research Institute, is devoted to "safety and mobility throughout the lifespan" with special emphasis on young people and older adults. M-CASTL strives to advance expertise and U.S. technology in the many disciplines comprising the safety and mobility of both young people and older adults. This is achieved through basic and applied research, and by fostering the application of transportation science and technology through education of new professionals and technology transfer to those in transportation-related fields.

Both young people and older adults present unique safety and mobility challenges. The University of Michigan established M-CASTL to increase understanding of and address—across the different dimensions of the roadway, vehicle, and driver—the risks related to the two ends of the age spectrum. Specific thrusts of M-CASTL focus on understanding and addressing the changing perceptual, cognitive, and psychomotor abilities of older drivers, the transportation needs of young people and older adults when they are unable or choose not to drive themselves, and the elevated crash risk of young drivers.

In June 2012, the International Conference on Aging, Mobility, and Quality of Life (AMQoL) was held in Ann Arbor, Michigan and hosted by M-CASTL. As part of M-CASTL's education and technology transfer mission, the AMQoL conference focused on the elements of transport and mobility that enable aging adults to access the various activities and services that maintain their health and well-being and also enhance their quality of life. The scope of the conference was interdisciplinary, and delegates included scholars, practitioners, and policymakers from around the world. A wide range of topics were addressed including exercise and health, tourism and leisure, transportation safety, urban planning and environmental design, and assistive technologies.

A symposium at the AMQoL conference showcased several SAFETEA-LU/M-CASTL presentations about the Candrive/Ozcandrive project, a prospective study of 1,300 older drivers in Canada, Australia, and New Zealand. As a result, a special issue of *Accident Analysis & Prevention* was developed to describe the study's methodology, as well as the cohort and findings related to older driver health and effects on driving (see: Marshall, S. C., et al. (2013). "The Candrive/Ozcandrive prospective older driver study: Methodology and early study findings." *Accident Analysis & Prevention*, 61: 233-235).



M-CASTL/University of Michigan: Pictured is a photo from the June 2012 AMQoL conference flyer which focused on mobility and services for aging adults. Photo courtesy of the University of Michigan.

Mid-America Transportation Center (MATC) Region VII

University of Nebraska–Lincoln

The Mid-America Transportation Center (MATC) was the U.S. DOT Region VII’s UTC. MATC’s mission is to improve safety and minimize risk associated with multimodal freight movement across the U.S. surface transportation system—objectives that parallel the key components of the U.S. DOT’s transportation priorities of safety, mobility, and efficiency as defined by SAFETEA-LU. MATC’s philosophy is that research, education, workforce development, and technology transfer activities should have substantive student involvement and address the key issues of private and public sector partners.

MATC faculty and students from 8 consortium universities conducted 78 transportation research projects in the areas of safety, efficiency, and mobility. These impactful projects spanned the fields of highway and rail safety, ITS, crash mitigation and countermeasures, and infrastructure reliability assessment and monitoring. In cooperation with university faculty researchers, 100 graduate and 56 undergraduate students participated in these projects, which underscores MATC’s commitment to developing the next generation of transportation professionals.

The innovation of MATC’s researchers extends well beyond the parameters of the university. By developing an array of education, workforce development, and technology transfer initiatives, MATC’s work impacts the region’s public and private sectors. For example, the 2nd Annual Scholars Program Conference—part of an ongoing MATC initiative to increase underrepresented and minority student enrollment in transportation degree-granting programs—was attended by 41 students from historically underrepresented populations. This conference took place in fall 2012. Conference presentations and video highlights are available via YouTube. Additionally, MATC’s K-12 STEM educational initiative, the “Roads, Rails, and Racecars” after school program has reached over 5,200 students at 12 program sites since 2010. Recently, the MATC team developed a series of free webinars to bring key research findings to practicing transportation professionals.



The photo collage represents the numerous research, technology transfer, and education activities the MATC has engaged in over the past several years. Photo courtesy of the MATC and the University of Nebraska, Lincoln.

Mineta Transportation Institute (MTI)

San Jose State University

The Mineta Transportation Institute (MTI) conducts research, education, and information and technology transfer with a focus on multimodal surface transportation policy and management issues. MTI includes three national research centers: the National Transportation Safety and Security Center, National Transportation Finance Center; and National High-Speed Rail Connectivity Center. MTI is a preeminent resource for surface transportation policy research. Research needs assessments are conducted each autumn with the U.S. DOT Western Resource Center, Caltrans, and the MTI Trustees. MTI research has earned several awards, resulting in a number of “points of pride,” as noted below.

The MTI education program offers the Master of Science in Transportation Management (MSTM), as well as three professional certificates: Transportation Management, Transportation Security Management, and High-Speed Rail Connectivity Management. Outreach programs include a continuously updated web site, electronic newsletters, social media, transportation policy summits, and a long list of media interviews and story placements.

MTI is a leading resource for policy research, education, and technology transfer as noted in the metrics below.

Key Metrics under SAFETEA-LU Research:

- 152 published research reports
- 312 research paper presentations

Education

- 284 MSTM enrollments
- 79 MSTM graduates

Technology Transfer

- 20.3 million web site visits
- 8.2 million document downloads
- 76 policy summits and forums
- 4,558 summit/forum attendance

MTI “Points of Pride” under SAFETEA-LU

- MTI’s research was awarded the 2011 Transportation Research Board’s Outstanding Research Paper in Public Transportation: “The Impact of Carsharing on Household Vehicle Holdings: Results from a North American Shared-Use Vehicle Survey.” (PIs: Elliot Martin, PhD and Susan Shaheen, PhD).

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- MTI's report titled, "Tribal Corridor Management Plan for California," is now the guiding procedure for Caltrans and other agencies when Native American artifacts are uncovered. (PIs: Joy Adams, PhD and Mary Scoggin, PhD).
 - "From Buses to BRT: Case Studies of Incremental BRT Projects in North America" has become the bus rapid transit guidebook for Caltrans. (PI: John Niles).
 - At the Transportation Research Board Annual Meeting in 2013, MTI presented a leadership summit addressing high-speed rail issues. Secretary of Transportation Ray LaHood delivered the keynote address.
 - MTI sponsors teams of middle school students for the Annual Garrett Morgan Sustainable Transportation Competition. Projects are presented in a national videoconference with the Secretary of Transportation (dating back to the Honorable Rodney Slater) and other mobility leaders addressing the teams. Cash awards, plaques, and signed certificates are given. More than 40 teams have participated.
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Mountain-Plains Consortium (MPC) Region VIII

North Dakota State University

The Mountain-Plains Consortium (MPC) theme is *Transportation Infrastructure and Operations to Support Sustainable Energy Development and the Safe Movement of People and Goods*. The focus of MPC is safe, mobile, and sustainable freight and passenger transportation, while addressing the challenges of a region characterized by a large area, climate extremes, and sparse population density punctuated by metropolitan hubs. Related to the U.S. DOT's "safety and security" objective, MPC has conducted projects on high-risk rural roads, transportation operations, safety management, low-cost safety improvements, work zone safety, and commercial vehicles. Examples of this work include a methodology developed in Wyoming to identify high-risk locations on Indian reservation roads and a driving simulator used in Utah to study driver behavior under various traffic control scenarios.



Rural road safety audits, following a blueprint developed in North Dakota, identify low-cost/high-value safety improvements for rural roads. Signage, sight-line impediments, pavement markings, and missing or damaged safety equipment are among the items considered. (Photo courtesy of Mountain-Plains Consortium)

Research shows that rural roads are more dangerous than urban streets and highways, but that may be changing as MPC research provides techniques and technologies for improving rural road safety. Under SAFETEA-LU, the MPC published more than 75 research documents, many focusing on improving rural road safety. Projects in North Dakota, South Dakota, and Wyoming improved safety assessment techniques, increased the implementation of low-cost safety improvements, and led to the development of county and tribal safety management programs for paved and unpaved roads. The Wyoming rural road safety program (which stemmed from MPC projects) resulted in the installation of advanced warning devices, improved horizontal and vertical alignments, shoulder widening, and the relocation of roadside hazards on many road segments with high percentages of truck traffic.

The South Dakota GIS Highway Safety Review tool (developed for an MPC project) provides a data-driven visual approach to identifying high-risk locations and has been used on county and tribal roads. By examining roadway safety spatially, multiple high-risk locations within longer road segments can be accounted for. A traffic safety evaluation process developed in North Dakota serves as a blueprint for county, municipal, and tribal road safety audits, which identifies low-cost/high-value improvements and promotes awareness of safe design and maintenance. This process is particularly relevant in the booming oil producing counties of the Bakken Formation.

MPC meteorological and GIS technology deployed in Colorado identified where truck traffic is vulnerable to strong winds so that crash prevention strategies can be implemented. In addition, arrays of vertical rods of bamboo, fiberglass, and other materials were tested as low-cost traffic barriers to provide crash resistance while absorbing kinetic energy. In other work, seat belt use in North Dakota was studied to identify combinations of enforcement, education, and techniques that could improve rural seat belt use.

National Center for Freight and Infrastructure Research and Education (CFIRE)

University of Wisconsin–Madison



CFIRE led a 10-State regional, multimodal freight study to identify significant transportation corridors and provide state DOTs with the tools to implement MAP-21 provisions. Photo source Army Corps of Engineers Spatial Data, FAA ACAIS CY2011, 2010 Rail Density-NTAD 2013.

The theme of the National Center for Freight and Infrastructure Research and Education (CFIRE) consortium is *Making Multimodal Freight Systems Work for Economic Recovery and Quality of Life*. Below are several examples of current and ongoing projects that highlight the work of CFIRE and its partners in the areas of transportation management and multimodal freight movement.

Project title: MAFC Regional Freight Study

UTC/U.S. DOT mission: Applied multimodal freight research, multi-state collaboration, and technology transfer connecting freight transportation to economic activity.

Project summary: The 10-state, CFIRE-led Mid-America Freight Coalition (MAFC) is completing a study of regional, multimodal freight movement. This study identifies and characterizes the region's most significant

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freight corridors and provides state DOTs with tools and information for working with MAP-21 freight provisions, making freight connections across state lines, and collaborating on multi-state freight initiatives. Each corridor profile includes the following:

- An economic profile
- National connectors
- Overall vehicle and truck traffic
- Operational and organizational efficiencies and ITS infrastructure
- Greenhouse gas emissions
- Fuel and truck parking
- The infrastructure condition
- An in-depth inventory of multimodal freight facilities along the corridor

Project title: Great Lakes Maritime Transportation Teacher Institute

UTC/U.S. DOT mission: STEM-related educational opportunities connected to national and state content standards, while enhancing middle and high school students' awareness of careers in transportation, thus achieving transportation workforce development goals.

Project summary: CFIRE supports the annual Great Lakes Maritime Transportation Teacher Institute. Teachers learn about Great Lakes maritime transportation and how to integrate transportation-related material into their STEM curricula. School teachers also tour ship yards used for building yachts, U.S. Coast Guard vessels, and Great Lakes freighters.

Project Title: Annual Inter-University Student Symposium on Freight (AISSOF)

UTC/U.S. DOT mission: Workforce development that builds a cohort of freight transportation leaders of the future.

Project summary: The AISSOF convenes students to present and discuss their freight research and new ideas, develop professional leadership skills, and form a cohort of life-long peers, while networking with freight industry leaders.

National Center for Intermodal Transportation (NCIT)

University of Denver and Mississippi State University

The National Center for Intermodal Transportation (NCIT) is a partnership between the University of Denver and Mississippi State University. NCIT has undertaken a number of projects consistent with U.S. DOT strategic goals of improving the safety, efficiency, and economic competitiveness of the U.S. transportation system through technology transfer and workforce development. These projects developed an Intermodal Cargo Tracking device, a leadership competency model for transportation managers, and training modules and planning tools for intermodal systems that may be used for emergency actions.

The Intermodal Cargo and Container Tracking project demonstrated the feasibility of tracking and monitoring radio-frequency identification (RFID)-tagged cargo during intermodal transport to provide online information for cargo owners and supply chain partners. The technology permits tracking the location and condition of the container and its palletized contents on an hourly basis from an integrated GPS and Global System for Mobile Communications (GSM) cellular-based device (AMU) attached to the container. The project was designed to monitor and track freight cargo shipping containers and their contents to assist in logistics planning, efficient freight movement, and detection of tampering related to possible terrorist acts.



Cell phone, asset monitoring unit, battery, electronic seal, RFID tag, and satellite transmitter used for the Intermodal Cargo and Container Tracking project. Photo source: GlobalTrack, a subsidiary of Orbcomm, Inc.

NCIT also developed a Leadership Competency Model and Assessment Tool for transportation managers and emerging leaders. Based on extensive discussions with incumbent managers in a large state DOT, a competency model was crafted and an online assessment tool developed. The online assessment tool produces reports which can assist managers in their technical, leadership, and career development.

In addition, Intermodal Planning for Disasters training tools were developed and demonstrated. These tools addressed the need to consider various aspects of the intermodal transportation system when dealing with natural disasters or other unplanned emergency situations that can destroy or incapacitate parts of the system. Virtual modeling of system rerouting of traffic and freight were generated by optimization software. Training seminars with local government first responders and emergency services planners were also conducted.

National Center for Transit Research (NCTR)

University of South Florida

The National Center for Transit Research (NCTR) is located at the Center for Urban Transportation Research (CUTR) at the University of South Florida (USF). NCTR's purpose is to make public transportation and alternative forms of transportation, including managed lanes, safe, effective, efficient, desirable, and secure. The goals of NCTR are to:

- Minimize traffic congestion
- Maximize mobility options
- Promote safety and security
- Improve the environment
- Enhance community sustainability

These goals are accomplished by conducting applied and advanced research, energetically disseminating the results, and expanding the workforce of transportation professionals through education and training to address the challenges and opportunities of the future. Some examples of significant impacts of past research and programs funded through the UTC Program at USF are offered below. NCTR consortium members have contributed to research that has resulted in new technology applications and patents. Other NCTR research has changed practice and informed policy decisions throughout the country. A few examples are provided below:

- The Travel Assistance Device (TAD) mobile application, developed by NCTR researchers and tested by the Hillsborough Area Regional Transit Authority and other Florida agencies, uses GPS technology inside cell phones to prompt cognitively disabled riders to exit a bus. The device helps disabled riders navigate public transportation and gain more independence. The transit rider or travel trainer can plan personalized trips using the TAD website. Once the trip is planned, it is automatically downloaded to their cell phone. The mobile app then gives the transit rider two alerts when they are traveling on the bus. The first alert, a verbal announcement saying "Get ready," occurs a few stops before the rider's destination. When it is time for the rider to pull the "stop request" cord, they receive the second prompt to "Pull the cord now." The phone also vibrates to accommodate both the seeing and hearing-impaired. TAD improves the quality of life of cognitively disabled transit riders by supporting independent travel, and provides tremendous relief to caregivers who would otherwise be responsible for transporting them and/or the transit system that would provide support via paratransit. This project and other location-aware projects funded through NCTR have resulted in the issuance of eight U.S. patents, with nine more pending. This type of application can ultimately help not only cognitively disabled people, but seniors with memory issues, tourists who are unfamiliar with the area they are traveling in, or those who just might fall asleep or be deep in thought while riding transit and forget about their location.
- NCTR recently developed the TRIMMS© (Trip Reduction Impacts for Mobility Management Strategies) model. TRIMMS© is a visual basic application spreadsheet model that estimates the impacts of a broad range of transportation demand management (TDM) initiatives and provides program cost effectiveness measures, such as net program benefits and benefit-to-cost ratio analysis. An increasing number of

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state, regional, and local agencies are attempting to measure the benefits of TDM initiatives to conform with Congestion Mitigation and Air Quality (CMAQ) Improvement guidelines issued by the FHWA. The program calls for quantitative analysis of benefits and disbenefits (i.e., emission increases) resulting from emission reduction strategies for project selection of congestion and emission reduction initiatives. TRIMMS® allows regional customization of default benefit and cost parameters for 85 metropolitan statistical areas, provides documentation to help professionals use the model, and offers guidance on how to incorporate area-specific input data they have at their disposal. The model includes a sensitivity analysis component that is not present in any other currently available spreadsheet application of this kind. Sensitivity analysis can help practitioners estimate the probability that program benefit-to-cost ratios will at least be greater than some predetermined benchmarking value. This feature allows conducting TDM evaluation to meet the FHWA CMAQ Improvement Program requirements for program effectiveness assessment and benchmarking. This improves the ability of TDM practitioners to identify and put in place programs that produce the highest estimated social benefits. This tool is now being used by numerous agencies including the Environmental Protection Agency, San Joaquin Council of Governments, Washington State DOT, and the Montgomery County Department of Planning in Maryland.

- With Florida DOT support, NCTR developed the Transit Boardings Estimation and Simulation Tool (TBEST), a comprehensive GIS-based program for forecasting transit ridership at the stop level using precise geographic data that captures the walk-scale environment around transit stops. The model enables planners to evaluate transit services as well as land-use development scenarios with sensitivity to the walkable market areas that are critical to transit use. This model is currently the standard used by Florida transit agencies in transit development planning, and has also been used in Los Angeles, New York, and Oregon. It was recently adapted to use parcel level land use data to further enhance its sensitivity to the built environment in proximity to a transit stop.

National Institute for Advanced Transportation Technology (NIATT)

University of Idaho

The theme of the National Institute for Advanced Transportation Technology (NIATT) is *Advanced Technology for Sustainable Transportation*. NIATT develops technology to reduce congestion and improve safety on arterials, improve the quality and economic viability of biofuels, and reduce the environmental impacts of motorized vehicles. NIATT is nationally known for advances in engineering pedagogy and transportation curriculum development.

NIATT's research projects not only meet critical transportation needs, they also provide opportunities to immerse students in practical, learning-centered engineering or science environments. NIATT does not simply hire research scientists; it creates teams of undergraduate students who work directly with graduate students and are mentored by expert faculty.

NIATT had four goals under SAFETEA-LU. Two of the goals defined its research areas, and two defined how NIATT would accomplish these tasks:

- Goal 1: Reduce congestion and improve safety by developing arterial traffic management tools.
- Goal 2: Improve the quality of biofuels and reduce the environmental impacts of motorized vehicles.
- Goal 3: Increase the number of faculty and students in NIATT's research and education programs to enhance the transportation workforce.
- Goal 4: Transfer the results of NIATT's research program to practicing professionals in forms that are useful in order to improve the quality and performance of the workforce.



Pictured is NIATT's Controller Interface Device, which is used to test traffic control strategies. Photo courtesy of NIATT/University of Idaho.



NIATT's Clean Snowmobile Team developed a cleaner, more efficient snowmobile. Photo courtesy of MTU/KRC.

NIATT's theme supports U.S. DOT's strategic research and technology development plans by working with several surface transportation modes including transit, pedestrians (including the vision-impaired), highways, and recreational vehicles. This work also supports the goals of reducing congestion and supporting environmental stewardship.

NIATT has developed useful products and knowledge that continue to have national impact. Two examples include:

- 1) An advanced traffic simulation system, based on NIATT's Controller Interface Device, which has been licensed by roughly 140 universities and is used to test traffic control strategies.
- 2) NIATT's Clean Snowmobile Team developed a direct-injected two-stroke engine that reduced pollution by 95–98 percent, and doubled fuel economy. The team won First Place in the Society of Automotive Engineers Clean Snowmobile Challenge in 2007 with this engine.

National Transportation Center (NTC)

Morgan State University

The theme of the National Transportation Center (NTC) at Morgan State University is *Transportation: A Key to Human and Economic Development*. This theme emphasizes the human impacts of and interactions with multi-modal surface transportation systems, particularly the socioeconomic, efficiency, environmental, and safety aspects. Complementing the theme is the goal of increasing the number of minorities and women entering transportation careers.

NTC has supported research on traffic models to improve mobility and accessibility. NTC's completed research includes simulated vehicle infrastructure integration impact on incident management, congestion and disaster evacuation, and trip generation impacts of town center and senior housing developments. Recently completed projects focused on life cycle costing, optimization analyses of traffic flows, highway infrastructure, freight, and urban transit systems. NTC has also supported research on transportation infrastructure impacts on aquatic ecology and other environmental systems.

NTC has conducted research on driver behavior, impairment, and engineering features effects on vehicle crashes and safety. Research has included understanding effects of social networks on alcohol-impaired drivers and road engineering influences on motorcycle crashes. In addition, NTC research has focused on causes and effects and developing interventions to improve safety.

In collaboration with Maryland DOT, NTC has managed two signature internship programs. More than 175 students have participated in these internship programs over the 25 years of the program. One program is the MDOT/Morgan State academic year graduate internship, which has been in existence for over 25 years. The other is the undergraduate summer internship at Maryland State Highway Administration. The MDOT internship is for graduate students working as part-time analysts and planners at modal administrations. During the SAFETEA-LU UTC grant, 38 students participated in the MDOT/Morgan State intern program.

On October 11, 2011, NTC conducted a symposium on transportation in the state of Maryland. The intent of the symposium was to: (1) discuss the importance of transportation to the state's economy; (2) provide useful, factual information regarding transportation; (3) explain alternatives for funding transportation

infrastructure; and (4) engage leaders in a dialogue regarding the future of transportation funding. More than 100 transportation advocates, planners, students, policy makers, and community leaders attended the symposium. The symposium disseminated information on the future of Maryland infrastructure and financing modules.

An NTC project titled "Evaluating the Effectiveness of Dynamic Speed Display Signs" investigated whether such signs slow drivers. In October 2010, Dr. Jeihani (at left holding cables) and her research assistants installed tubes and counting devices near the university to track speed of passing vehicles. Photo by Dr. Eugene DeLoatch, Dean, School of Engineering.



NEXTRANS Center Region V

Purdue University

The NEXTRANS Center's integrated, innovative, and sustainable approach to transportation challenges meets regional and national needs for safe, efficient, and environmentally sound transportation systems, cultivating a highly qualified transportation workforce. NEXTRANS' holistic paradigm fosters principles of integration and sustainability in developing solutions from concept to deployment for multiple stakeholders. It accomplishes this by emphasizing the role of technology, efficiency, the behavior of travelers and other stakeholders, and linkages to energy security, the environment, and economic development.

NEXTRANS provides leadership in the Midwest by responding to transportation needs arising from the region's agricultural and manufacturing characteristics. This includes a safe and efficient multimodal transportation system, biofuels and alternative sustainable solutions for transportation, collaborative and intermodal transportation paradigms for supply chains and global trade, and infrastructure leveraging, renewal, and addition.



Student Dong Yoon Song operating the NEXTRANS Center's driving simulator at Purdue University. Photo courtesy of the NEXTRANS Center.

One NEXTRANS project in particular addressed the transportation implications of developing a cellulose ethanol industry for Indiana to better plan freight logistics, compare transportation modes and routes, and explore a range of infrastructure questions. This research has held significant relevance for regional agriculture, national energy priorities, and rural development. NEXTRANS research resulted from the 2007 Energy Independence and Security Act which called for the U.S. to produce 36 billion gallons of biofuel by

the year 2022. Scenarios were developed showing the impacts on Region V transportation, production, and storage of biofuels as well as the economic benefits to the area.

The NEXTRANS Center further addresses research, education, and technology transfer goals by leveraging "living laboratories" that use real-world environments to test concepts, deploy solutions, and obtain data. These labs located on the campuses of consortia members allow NEXTRANS to conduct valuable research in a variety of areas by sharing resources. The Driving Simulator Lab at Purdue University analyzes traveler behavior in different problem contexts. The Campus Transit Lab at The Ohio State University addresses transit operations and service planning aspects by using the campus as a sensor-installed living lab.

(continued on page 35)



How will biofuels affect transportation in Region V? Photo source Gettyimages/photos.com.

(continued from page 34)

Researchers at the lab use Automatic Passenger Counter (APC) and Automated Vehicle Location (AVL) data provided by the Central Ohio Transit Agency and the Los Angeles County Metropolitan Transportation Authority to improve vehicle flows and service improvement. This collaborative effort has proven valuable to the Campus Area Bus Service (CABS) in scheduling bus routes on campus. Stop-to-stop travel times derived from AVL data were used to piece together a schedule for the routes, taking into account the variability in travel times. Schedules were determined to minimize

passengers' waiting times while recognizing operational costs and needs. Interactions among routes were considered and efficient schedules produced under several scenarios.

This collaborative effort has also proven valuable to CABS and Campus Transit Lab (CTL). For example, when CABS staff asked CTL researchers for assistance in scheduling bus routes on campus, stop-to-stop travel times derived from AVL data were used to piece together a schedule for the routes, taking into account the variability in travel times. Schedules were determined to minimize passengers' waiting times while recognizing operational costs and needs. Interactions among routes were considered and efficient schedules produced under several scenarios. Results such as these prove instrumental for CABS in making final service provision decisions. The exposure to practical issues the researchers attained led to valuable practice-based grounding necessary for formulating research questions and developing new methods sensitive to the needs of the practicing transit community.

The Sustainable Transportation Lab at the University of Michigan studies individual decisions in the short-, medium-, and long-term related to sustainable transportation. Each of these living laboratories provides experiential learning opportunities for students across different age groups, performs outreach to practitioners, and offers mechanisms for a variety of partnerships across the public and private sectors.

NEXTRANS universities instruct and train students at all levels. Highlights include competitive undergraduate and high school internships, graduate studies, distance-based learning for professionals, essay contests, and collaborations with Crawfordsville (IN) High School students and their award-winning work with Amtrak.

Technology transfer through seminars, workshops, published papers, publications, websites, and regional and national conferences foster opportunities for application and commercialization. NEXTRANS organized two major thematic conferences, one on efficient and secure border trade with Canada and another on integrated solutions for multiple stakeholders. SAFETEA-LU research results and accomplishments were disseminated to a wide audience. The NEXTRANS Seminar Series brought high-level professionals and academics to consortium universities to discuss topics that include climate change, global food security, risk assessment methods, and managing cross-modal conflicts on multimodal transport networks.

Ohio Transportation Consortium (OTC)

University of Akron

The Ohio Transportation Center's (OTC) theme of *Transportation Mobility and Infrastructure Management* has been promoted through activities focused on safety, efficiency, convenience, and sustainability. OTC's mission is to promote transportation systems research and education by pooling the excellence of knowledge and expertise that currently exists in member universities throughout Ohio. OTC's work focuses on conducting applied research, providing quality education to future transportation professionals, and disseminating state-of-the-art knowledge and technology for implementation in the real world. Brief summaries of OTC's work in the areas of signalized intersections, driving simulators, and Intelligent Transportation System (ITS) measures are provided below.

Student research at OTC has focused on intersection safety and efficiency enhancements. Utilizing simulation tests, safety was improved by designating time intervals for pedestrians crossing in split two-phase intersections. Accurate vehicle trajectory data was extracted, resulting in reduced dilemma zones and improved design and implementation of signalized intersections when applying ITS measures.

Using driving simulators, researchers determined the most effective design for dynamic speed signs (DSS). Results improve DSS use on interstates and highways, improving service and safety. Additionally, field studies examined the retro-reflectivity of various sheeting material used on traffic-control drums, proving that diamond-grade sheeting provides a safer work zone when driver behavior is measured.

A STEM education program for students in grades 9-11 was enhanced through the use of equipment facilitating GPS objectives in the already present physics and mathematics curriculum. Director Ping Yi worked closely with the Council of University Transportation Centers to broaden membership and encourage collaboration between international and American universities on transportation education and research.



Dr. Ping Yi demonstrates the Automatic Turning Movement Identification System (ATMIS). ATMIS was developed by OTC to obtain vehicle turning movement information at all signalized intersections. The resulting algorithm more reliably calculates intersection delay for real-time applications. (Photo credit: OTC).

OTC cosponsored several ASCE and ITE chapter meetings, allowing students to present their research to transportation engineering professionals. OTC's annual student paper competitions publicized graduate and undergraduate transportation research. A technology transfer highlight was the 2010 OTC-hosted Ohio UTC Student Research Conference in collaboration with UTCs at Youngstown State and the University of Toledo, where students shared their research and competed for "Best in Conference" awards.

Oklahoma Transportation Center (OkTC)

Oklahoma State University

The theme of the Oklahoma Transportation Center (OkTC) is *Economic Enhancement through Infrastructure Stewardship*. Using technology transfer, OkTC has successfully implemented projects related to the efficient construction of structures and promoted sustainability through materials understanding, freight logistics, and intelligent transportation systems.

Every OkTC project involves strong partnerships between universities, private industry, and state DOTs. Several successful projects resulted in the creation of new patents, specifications, and best practices for transportation officials that improved the economy and the sustainability, usability, and durability of transportation infrastructure. OkTC researchers developed precast bridge deck sections, which are a cost-effective solution that will significantly reduce bridge construction time. Results of this study were used by the Texas DOT for building bridges using precast sections. The Intelligent Asphalt Compaction Analyzer technology developed by OkTC has been patented and licensed to Volvo Construction Equipment. Demonstrations of this technology took place in Oklahoma, New York, and Louisiana. Refinement and field demonstrations began in 2007 and demonstrations continued into 2012.

The OkTC emphasizes diversity, human resources, internships, and education activities, which have led to the hiring of women and minorities in academia, government service, and the private sector. The OkTC built a strong internship program in conjunction with the Oklahoma DOT, Oklahoma Turnpike Authority, and the private sector. It also collaborated with far-reaching programs such as the Local Technical Assistance Program and Tribal Technical Assistance Program with local and tribal government entities. Each OkTC research project was required to have at least a 10 percent funding commitment to encourage diversity participants and activities. This funding is specifically used to solicit diversity participation through the use of marketing materials and outreach to universities and community colleges, and minority, tribal, and Hispanic entities. Biannual symposiums were held in collaboration with the Oklahoma DOT and private industry to disseminate OkTC's work. To encourage interaction beyond the state of Oklahoma, the OkTC sponsored the Heartland Transportation Consortium Student Completion with student presenters from seven neighboring states.



The figure is a composite of four images. Upper left is an Oklahoma Highway Patrol trooper using high resolution GPS data from the OkTC project to populate the location fields of an electronic citation (speeding ticket). Upper right is a cantilevered bridge deck constructed using precast panels. Lower left shows three Stillwater Oklahoma high school students working on a freight logistics problem. Lower right shows a researcher on the pavement performing the macrostructure measurements. Photo courtesy of OkTC and the University of Oklahoma.

Oregon Transportation Research and Education Consortium (OTREC)

Portland State University

Founded in 2006, the Oregon Transportation Research and Education Consortium (OTREC) is focused on advancing technology, integrating transportation and land use, and building healthy communities. OTREC's mission is to inform the transportation decision-making process through timely and useful primary research, as well as building the capacity of the transportation workforce. Reflecting the U.S. DOT's mission, OTREC promotes choices that make the nation's transportation system safe, resilient, and adaptable. OTREC provides access to travel options that promote healthy communities and a sustainable environment, which lead to a stronger nation.

OTREC's programs lay the groundwork for livable communities through innovative education and technology transfer efforts that wed research and practice. Advanced technology projects have shown the effect of traffic-signal timing on pedestrians' exposure to pollution and helped a state DOT place sensors to best estimate travel times for the least cost. OTREC's healthy community projects have shaped national guidelines for bike boxes and improved safety at intersections using flashing-yellow-arrow traffic signals. Projects under the theme of integration of transportation and land use have shown how agencies can retrofit suburban land uses for active transportation and helped adjust Institute of Transportation Engineers trip-generations rates for dense, multimodal sites.

OTREC's educational approach emphasizes engaged learning and service to the community. The Sustainable City Year Program's experiential learning model—putting university-wide resources to work on a partner city's sustainability goals—has been replicated in 12 states. Now in its fifth year, the annual Oregon Transportation Summit has become the region's premier transportation conference, linking transportation professionals with the top researchers in their fields. OTREC's weekly transportation seminars bring professional knowledge into the classroom and streaming over the Internet, further bridging the gap between academia and practice.

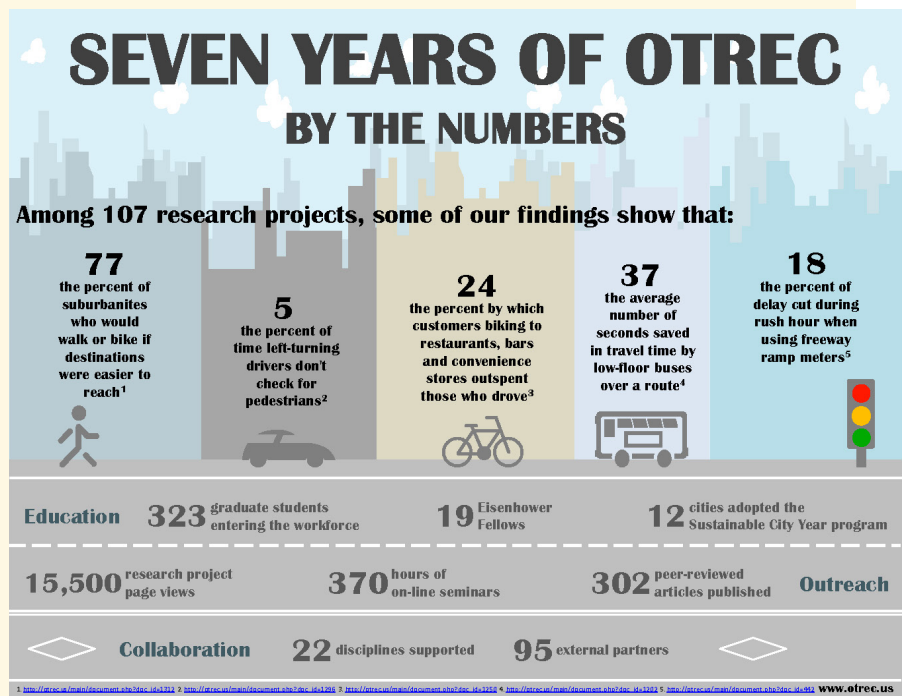


Figure is courtesy of OTREC.

Southeastern Transportation Center (STC) Region IV

University of Tennessee–Knoxville

The Southeastern Transportation Center (STC) is a consortium of universities located in U.S. DOT Region 4. Established by Congress as one of the original 10 regional UTCs, it has been headquartered at the University of Tennessee, Knoxville since 1995. STC has built its reputation as a national leader in transportation safety research, education, and workforce development. STC recruits talented people into the profession and sponsors outstanding individuals to pursue graduate and undergraduate degrees in transportation-related disciplines. Over the life of the SAFETEA-LU grant, STC has provided educational funding to over 1,500 students in the region. STC has sponsored major research projects related to improving intersection safety with comprehensive solutions; the effect of speed control, enforcement and regulations; and assessing railway corridors' transportation safety, security, and capacity.

Journal of Transportation Safety & Security

Leveraging Research Partnerships Worldwide

Addresses safety and security topics in the areas of

- Highway
- Transit
- Ridesharing
- Pedestrian & Bicycle
- Rail
- Water
- Aviation

Editorial board of renowned experts from

- China
- Australia
- Hong Kong
- Canada
- USA

Across the globe, commerce, economic development, and the security of nations depend on safe and secure transportation systems. Until recently, there were limited outlets for publishing research in transportation safety or transportation security. In 2009 the Southeastern Transportation Center launched the *Journal of Transportation Safety & Security*. JTSS fills that gap by publishing original research emphasizing multimodal transportation safety issues.

JTSS is the product of a winning international partnership between the Southeastern Transportation Center, Beijing Jiaotong Transportation University, University of Tennessee and international academic publisher Taylor & Francis LLC.

JTSS meets a critical need in published transportation safety research. It is relevant and timely for educators, researchers, practitioners, and policymakers.

Authors represent

- Arab Emirates
- China
- Denmark
- Egypt
- France
- Italy
- Israel
- Russia
- Spain
- UK
- USA

JTSS publishes Special Issues in conjunction with conferences such as the National Evacuation Conference.

JTSS Timeline

2006 2007 2008 2009 2010–2011 2012...

STC's theme is *Comprehensive Transportation Safety*, which encompasses virtually all disciplines and integrates conventional knowledge with advanced and emerging technologies. This theme emphasizes STC's mission of education, research, and technology transfer. It also supports the U.S. DOT's mission of serving the United States by ensuring a safe, sustainable, and accessible transportation system that enhances the quality of life of the American people.

Of the many notable projects STC created and continues to manage, the *Journal of Transportation Safety & Security* (JTSS) stands first among them. JTSS is a quarterly, peer-reviewed, academic journal that addresses multimodal transportation safety issues such as highway, transit, ridesharing, pedestrian, and bicycle modes as well as rail, water, and aviation. Now in its sixth volume, JTSS is recognized as a

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JTSS poster designed by Lissa Gay, 2012.

Source: University of Tennessee Center for Transportation Research

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top-tier academic resource. It is the product of an international partnership among STC, the University of Tennessee, Beijing Jiaotong Transportation University, and Taylor & Francis Group, LLC.

In support of its theme and for the duration of this grant, STC funded faculty and graduate students who participated in the Federal Motor Carrier Safety Administration's Wireless Roadside Inspection Program, which was designed to increase the number of commercial motor vehicle safety inspections across the nation.

Wireless Roadside Inspection Program.

Photo credit: Lawson Bordley, 2011.

*Source: University of Tennessee,
Department of Civil & Environmental Engineering.*



Southwest Region University Transportation Center (SWUTC) Region VI

Texas A&M University

The Southwest Region University Transportation Center (SWUTC) is the Region 6 UTC and is led by the Texas A&M Transportation Institute (TTI), a part of the Texas A&M University System. SWUTC also includes the University of Texas, Austin; Texas Southern University (TSU); Louisiana State University; and the University of New Orleans. SWUTC's theme is *Sustainable Transportation Solutions to Enhance Economic Prosperity and the Quality of Life*.

SWUTC has a diverse research program that addresses the needs of Region 6 and the nation. Research topics include emergency evacuation, commodity trade through the Panama Canal and across the Gulf of Mexico, trans-border freight issues, Gulf Coast megaregion planning and forecasting, road surface durability and longevity, highway financing strategies, transportation associated environmental and safety issues, and transportation solutions supporting improved quality of life.

A SWUTC study conducted in 2011 on driver reaction time while driving and texting was the first of its kind to place subjects in an actual vehicle over a closed course to create a real-world environment. This study produced alarming results, determining that a driver's reaction time is doubled when distracted by reading or sending a text message. In fact, the study results emphasized that texting impairment is even greater than many experts previously believed, and demonstrates how texting drivers are 11 times more likely to miss roadway cues such as flashing lights, signage, or brake lights and are therefore less able to react to sudden roadway hazards.

A follow-up study conducted in 2012 addressed the effectiveness of voice-to-text programs compared to manual texting on a handheld device. This study was also a first, as it too was conducted in an actual driving environment over a closed course. Results showed that driving performance suffered equally with both texting methods.



Texting while driving study participant. Photo courtesy of Jim Lyle, Texas A&M Transportation Institute.

SWUTC supports a variety of techniques to transfer research results. These include traditional methods such as reports, presentations, peer-reviewed publications, curriculum

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enhancements, conferences, seminars, workshops as well as more progressive approaches utilizing websites, YouTube videos, Facebook, and Twitter feeds.

SWUTC provides funding to enhance and update the *Urban Mobility Report* (UMR) methodology, and supports its dissemination. The UMR is the most widely quoted report on urban congestion and its associated costs in the nation, serving as a resource for decision makers across the country. The week following the latest release of the UMR on February 5, 2013, the report was covered in more than 1,300 articles, including *Time* magazine and the BBC online. In addition, the UMR generated 264 broadcast clips in 88 major markets and was followed by more than 800,000 Facebook and Twitter users.

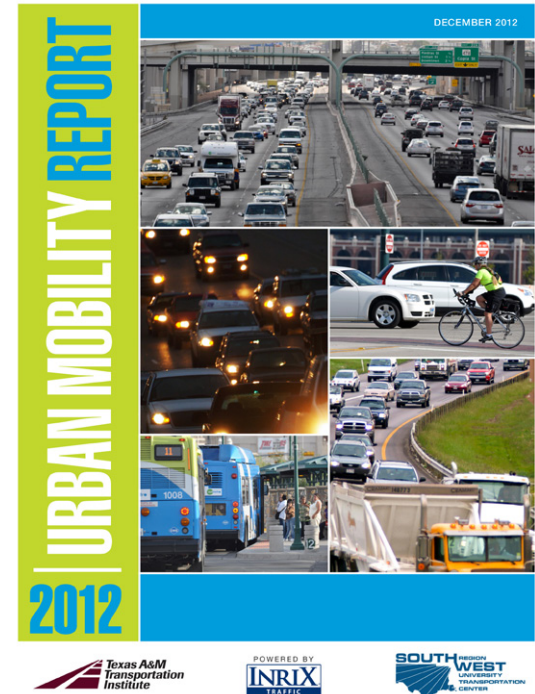
SWUTC sponsors Innovative K-12 programs, undergraduate summer fellowships, transportation curriculum enhancements, graduate degree programs and professional development opportunities to create a “pipeline” process that attracts and retains individuals in the field of transportation.

Over 460 students have graduated from SWUTC advanced degree programs with 97 percent finding employment in the transportation sector.

The following are just a few examples of SWUTC graduate titles and their respective employers:

- Director, Planning and Air Quality Team, Federal Highway Administration, CA Division
- Director of Business Development/Housing, Coalition for the Homeless, Houston/Harris County
- Vice President, Kimley-Horn & Associates, Inc.
- Regional Director, Delta Air Lines
- Vice President, Airports Council International North America
- Transportation Engineering Professor, University of Wisconsin-Madison

During the life of this grant and as part of its commitment to education, SWUTC has supported the Transportation Security Institute (TSI): Recruiting Next Generation Professionals. Held at TSU, this two-week summer program introduces a preselected group of 25 minority high school students to the profession of transportation security via hands-on technical activities, field trips to transportation facilities, lectures by transportation professionals, and on-site seminars. The program also reinforces the importance of mathematics, science, and technology skills. As with other SWUTC K-12 programs, a large percentage of students have continued their education after this program by majoring in engineering and science.



Urban Mobility Report 2012 cover art.



TSI Students Participating in Hands-on Fuel Cell Activity. Photo Credit: Khosro Godazi, Texas Southern University.

Sustainable Transportation Center (STC)

University of California–Davis

The goal of the Sustainable Transportation Center (STC) at the University of California, Davis (UC Davis) was to support the mission of the U.S. DOT by fostering an approach to transportation that met the needs of all segments of society, while minimizing environmental, societal, and economic costs.

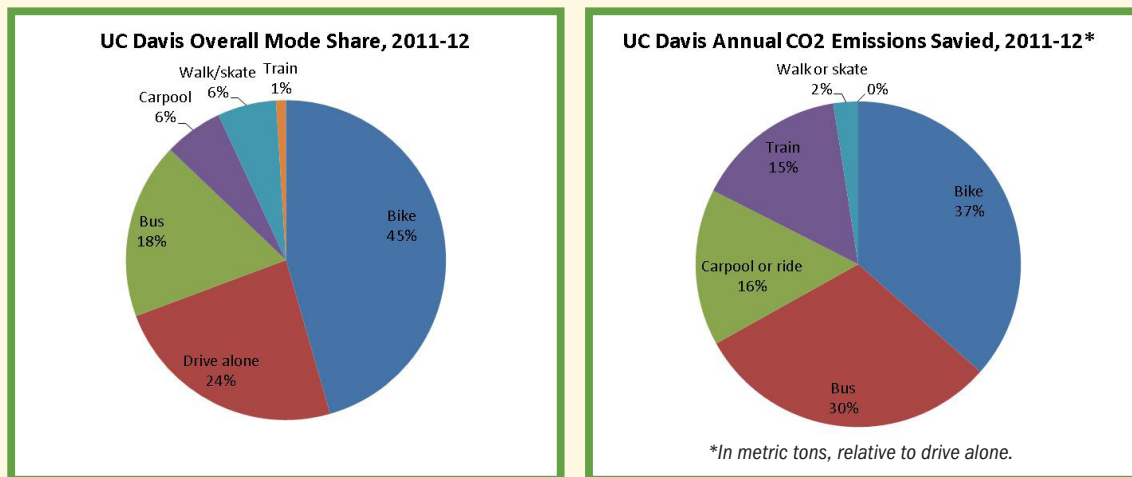
In its six years of operation, the STC funded 30 faculty research grants and 10 seed grants that produced 40 final reports, 35 peer-reviewed publications (and counting), and nearly 80 presentations in a variety of settings. Twenty-six dissertation fellowships produced at least 30 peer-reviewed publications and 56 presentations. The STC funded 40 additional graduate students on research projects focusing on sustainable transportation, supported 18 graduate courses, hosted more than 20 distinguished speakers, and cosponsored over 20 conferences and workshops. STC activities integrated research, education, and outreach as seen in the following examples:

UC Davis Campus Travel Survey

The STC partnered with UC Davis Transportation and Parking Services (TAPS) to establish the annual Campus Travel Survey, in which UC Davis students, faculty, and staff reported on their travel to campus. For five years, TAPS and STC together funded a graduate student to administer the survey, analyze the data, prepare a report, and present results to advisory committees and decision makers on and off campus. TAPS used the data for campus-related planning, and students used the data in their research.

Research Webinars

In 2010 and 2011, the STC coordinated a lunchtime webinar series offered by the five California UTCs. Each of the 10 webinars consisted of three presentations by UTC faculty on a transportation-related theme, followed by discussion. Although the primary intended audience was Caltrans employees, participants included people from a range of other California organizations as well as from other states. Recordings of the webinars were made available through the STC website.



These charts show the UC Davis Overall Mode Share and Annual CO2 Emissions Saved for 2011–2012. Source UC Davis/STC.

Center for the Commercialization of Innovative Transportation Technology (CCITT)

Northwestern University

The Center for the Commercialization of Innovative Transportation Technology (CCITT) at Northwestern University fosters the implementation of innovative technologies for all modes of surface transportation, which includes but is not limited to railways, mass transit, highways, and waterways.

Since its inception in 2006, CCITT has funded 18 technology transfer and implementation-oriented research projects involving 17 principal investigators and 31 undergraduate, graduate, and post-doctoral students from multiple departments in the McCormick School of Engineering and Applied Science. These projects resulted in more than 20 publications in academic journals and conference proceedings. CCITT also partially supported 12 dissertation fellowships awarded to graduate students in their final year of study.

CCITT promoted collaboration and the transfer of knowledge or technology to multiple industry partners, including: BNSF Railway; Ford Motor Corporation; Google; Philips Corporation; Norfolk Southern Railroad; PacketVideo Corporation; PTV America; Redondo Optics; and Union Tank Car Company. CCITT also enabled several collaborations to improve transit operations with its public-sector partner, the Chicago Transit Authority. Notable outcomes included:

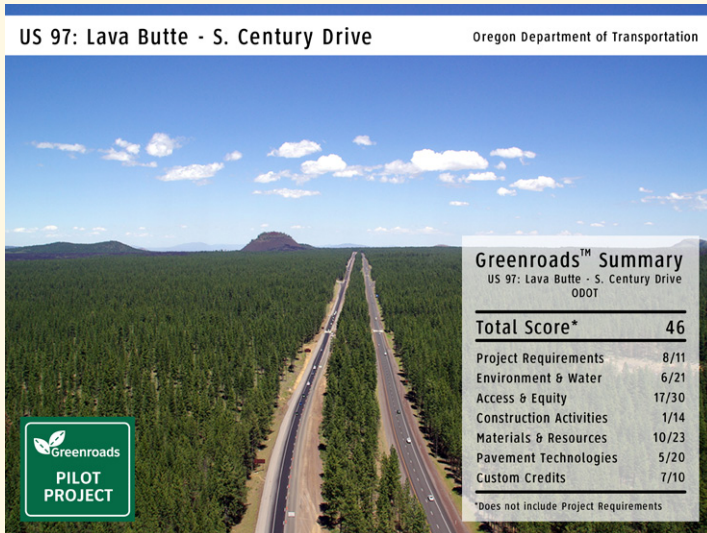
- High-strength steel evaluated for use in next-generation rail tank cars;
- Cloud-based software to improve railroad maintenance planning;
- Fiber-optic sensors for monitoring the physical condition of infrastructure;
- Haptic technology to minimize driver distraction when using flat panel displays in moving vehicles;
- An agent-based information system for the design of fueling networks for alternative-fuel vehicles;
- A test-bed of routing problems designed for humanitarian relief logistics scenarios, for use by the operations research community to evaluate new methods;
- Software tools to estimate lifecycle emissions of freight operations; and
- Embedded software to improve the transmission of video data for real-time situational analysis over wireless communications networks.



CCITT has promoted a culture of innovation-process learning and collaboration through its Technology Commercialization Speaker Series and its Industry Workshops held in conjunction with the Northwestern UTC.

Transportation Northwest (TransNow) Region X

University of Washington



Greenroads pilot project scorecard for the Oregon DOT's US 97: Lava Butte to S. Century Drive project through the Deschutes National Forest and Newberry National Volcanic Monument. Photo courtesy of Steve Muench, University of Washington Associate Professor and Greenroads Foundation Board Member.

“TransNow is committed to the development and maintenance of a center of excellence in transportation research and education. It will serve as a primary source of, and resource for, competent transportation professionals for the 21st Century.” – *Mission Statement, TransNow Strategic Plan*

National and International Impact of Research

Greenroads is a sustainability rating system for roadway design and construction. Development of the system began in 2007 with initial RITA/UTC funding and it is currently recognized nationally and internationally as the leader in roadway sustainability rating. The Greenroads Foundation, a 501c3 nonprofit organization,

implements the rating system. Eight projects have been certified and 40+ projects worldwide are under review for certification in Canada, New Zealand, and South Africa. The total construction value of projects the Greenroads Foundation has or is reviewing exceeds \$4 billion. These efforts were used as a platform for building the current FHWA rating system known as INVEST, as well as several other rating systems worldwide. In April 2013, Greenroads was selected as a White House Champion of Change during Transportation Week.

OneBusAway is an open-source transit traveler information system that combines a number of integrated tools and shares them across multiple interfaces, including the Internet, standard cell phones, smart phones, and text-messaging. OneBusAway was developed as an open-source system to allow other developers to enhance the code in conjunction with the project team, and gives other transit agencies access to the code. This tool was initially developed as a class project and was later adopted and implemented by Sound Transit as the primary passenger information system in the Seattle area. OneBusAway has also been deployed in Atlanta, Tampa, and Washington, DC, and acts as the backbone for New York City's bus information system.

Education

TransNow's education program graduated 30 master's degree students each year as well as several PhD recipients who are now teaching in research universities in the United States and abroad. A master's level internship program placed students at local firms and agencies, and for the past 15 years, a Washington State DOT intern program has employed 8 to 10 undergraduates per year at the Traffic Management Center.

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The Washington State DOT has hired approximately 25 of these students on a full-time basis, including the current director of the Traffic Management Center.

Technology Transfer

In addition to producing publications and presentations, TransNow researchers apply for commercialization grants which provide funding and services for website development, business and legal expertise, market analysis, trade show marketing, printed materials, or other commercialization needs. These grant funds are used by principal investigators in making important steps toward commercializing their technologies.



Greenroads certification scorecard for the silver-certified SE Pioneer Way in Oak Harbor, WA. Photo courtesy of Jeralee Anderson, Greenroads Foundation Executive Director.



Left to right: Steve Muench (University of Washington professor and Greenroads Foundation founder and board member), Jeralee Anderson (Greenroads Foundation founder, Executive Director and University of Washington 2012 PhD recipient), Craig Weiland (Greenroads Foundation Project Engineer, University of Washington MSCE 2008), and Freeman Anthony (city of Bellingham Public Works Project Engineer and Greenroads advocate). This award was given to the Greenroads Foundation team in the White House Executive Office Building. Jeralee Anderson spoke on a panel discussion of winners and later traveled to ITS America for yet another panel discussion.

University of California Transportation Center (UCTC) Region IX

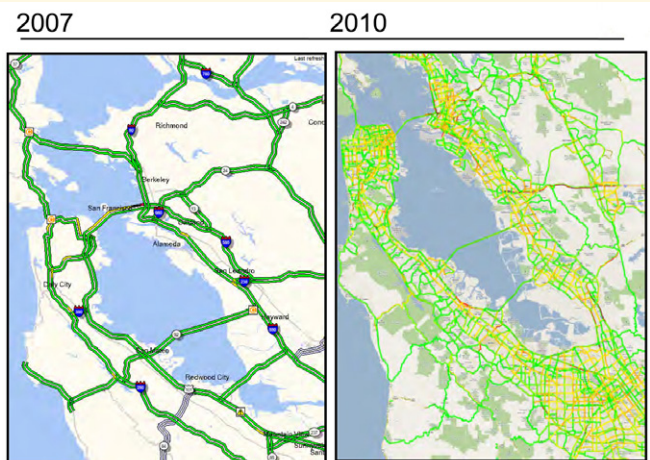
University of California–Berkeley

The University of California Transportation Center (UCTC) is a multi-campus organization headquartered at the University of California, Berkeley that carries out basic and applied research in three related areas: environmental sustainability, economic competitiveness, and livability. Research findings are disseminated in multiple ways, including journal publications, seminars, webinars, and conference proceedings as well as less technical forums aimed at reaching wider audiences. These include the award-winning *Access* magazine, succinct two-page UCTC Policy Briefs, and the UCTC Policy Syntheses that integrates findings across related research projects. UCTC has an equally strong educational mission, supporting students through graduate research appointments, dissertation grants, curriculum development, new graduate course sponsorship, and an annual UCTC Student Conference.

Under SAFETEA-LU, UCTC researchers have advanced knowledge and shaped practice in a number of important areas, including: urban logistics; transportation and land-use modeling and integration; congestion pricing; eco-driving; clean-vehicle technologies; inter-vehicle communications; transit performance evaluations; lifecycle costing of transport infrastructure; transit-oriented development; environmental justice; parking policy; dynamic traffic operations; freight competition; and air quality impacts of transportation improvements. UCTC research projects on peak-load pricing of bridges and parking in the San Francisco Bay Area found that passing on congestion charges to motorists increases transit ridership. In this context, revenues go to enhance transit services in addition to producing net economic benefits such as higher labor productivity.

UCTC is proud to support interdisciplinary research that allows complex policy and technological challenges to be taken on. One early mobility app project, the Bay Tripper, integrated schedules and routes of more than 77 San Francisco Bay Area transit agencies into a single platform, setting the stage for transit service and fare integration. UCTC has also contributed to the prototyping and testing of new information-communications technologies, such as Mobile Millennium. Mobile Millennium is a joint initiative of academia and private industry to monitor traffic and real-time, system-wide information on highway system performance.

Another example of connected UCTC projects is the study of how place-making and livability initiatives influence travel and community redevelopment. Separate UCTC-funded studies of transit-oriented development and the replacement of elevated freeways with tree-lined boulevards found that such initiatives not only triggered urban regeneration, they also increased physical activity, social interaction, and place identity.



Real-time traffic mapping on highway networks in the San Francisco Bay Area.
Source: Alexandre Bayen, UC Berkeley

University of Massachusetts Transportation Center (UMTC)

University of Massachusetts–Amherst

The theme of the University of Massachusetts Transportation Center (UMTC) is *Improving Transportation Mobility and Safety with Innovative Technologies and Strategies*. This principle aligns with the mission and vision of the U.S. DOT to advance technology and expertise in the many disciplines that comprise transportation. Through the mechanisms of education, research, and technology transfer at university-based centers of excellence, the UMTC serves as a vital source of leaders who are prepared to meet the nation's need for a safe, efficient, and environmentally sound transportation system. A major goal of the UMTC is to raise the transportation awareness of faculty and students from a variety of disciplines. This includes not only engineers, but also management, computer science, human factors, and other fields.



James Schleicher, RTIC Systems Engineer along with two UMass students (Dwayne Henclewood, MS 2007 and Haizhong Wang, PhD 2010) install traffic sensors in the field. Photo courtesy of Dr. Daiheng Ni, Associate Professor, Civil & Environmental Engineering at UMass Amherst.

The UMTC funded 12 research projects involving 11 faculty and 25 graduate students from 3 UMass campuses (Amherst, Lowell, and Boston), as well as the Michael E. DeBakey VA Medical Center in Houston, Texas; and across disciplines of civil and environmental engineering/transportation engineering, mechanical and industrial engineering/human factors, psychology, and gerontology.

UMTC research and technology transfer activities included:

- Nine seminars/symposia with 600 total participants
- Eleven published research reports
- Thirty-four papers presented at professional/academic meetings
- UTC Spotlight December 2008 – “A Research Test Bed, a Teaching Laboratory, and a Deployment Project.” The Regional Traveler Information Center (RTIC) project began in the late 1990s with the support of a National Science Foundation grant secured by Drs. John Collura and Paul Shuldiner. Multiple research funding sources were used to support the continuing RTIC efforts, including funds from the U.S. DOT University Transportation Centers Program along with other monies, staff, and equipment provided by the UMTC, the UMass Transit System, MassHighway, and FHWA.
- Poster presentation given at University Research Technology Transfer Day, exhibits/presentations of UMTC research to U.S. DOT leadership, April 2011
- Sponsored the Climate Change Symposium, May 2008
- Sponsored the Transportation Workforce Summit, May 2008
- Dr. John Collura co-chaired the National Transportation Workforce Summit, April 2012

University of Rhode Island Transportation Center (URITC)

University of Rhode Island

To understand the accomplishments of the University of Rhode Island Transportation Center (URITC), it is important to know something about URITC's strategy for the UTC. Under both TEA-21 and SAFETEA-LU, the URITC's goal was to use funds to not only encourage faculty in every engineering department, but to engage other universities in transportation and transportation-related research, outreach, and education.

The URITC was successful in this effort, with projects in every college on campus. Research projects under SAFETEA-LU resulted in numerous papers, presentations, patents, dissertations, theses, and awards. In many of these projects, the URITC partnered with other universities and state agencies making its federal dollars go further. One project which had benefits far beyond its research expenditures was completed by members of URITC's supply chain faculty and students. In this project, the team provided data and scenarios which were used in a successful TIGER grant application, resulting in a \$22.3 million grant for the Port of Davisville.

Another good example of URITC's transportation-related research is the work of Michael Greenfield, Victor J. Baxt Chair of Polymer Engineering and Associate Professor of Chemical Engineering at URI. When he first came to the university, Michael worked within the broad sphere of transportation research. With the help of URITC grants and its relationship with the Rhode Island DOT, Michael has become a major researcher in asphalt rheology and was recognized by the International Road Federation as the 2011 Researcher of the Year. This grant and its match have enabled the work being done by Norbert Mundorf (Professor of Communication Studies, URI) and Tat Fu (Professor of Civil Engineering, University of New Hampshire), who are utilizing

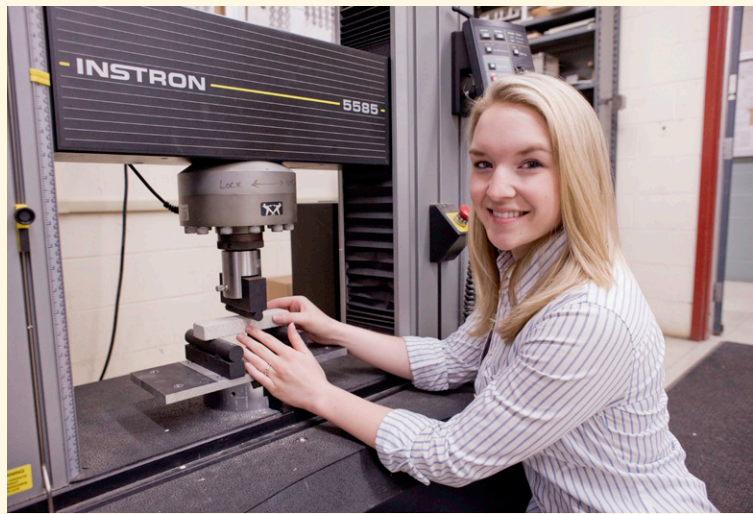
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A URITC instructor works with a student during Engineering Career Day. Source: URITC.



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James Prochaska's (Professor of Psychology, URI) Theory of Change for a project titled "Developing Tailored Intervention Technology for Alternative Transportation." This project seeks to identify communication strategies that encourage people to think beyond single-occupancy vehicle trips. The URITC has also begun a series of port seminars led by members of the supply chain faculty, which will bring global researchers and port managers together to discuss the issues and research needs in the rapidly changing strategies and roles of ports affecting global freight movement.



A URITC graduate student works on the self-healing concrete project. Source: URITC.

The URTIC continues to expand its workforce development programs targeting grades K-12, as well as professional development for the current workforce. The URITC conducts a series of summer camps and school programs designed to give students multiple touch points with professionals in the transportation industry. Among these activities are Engineering Career Day, Construction Career Day, summer academies in landscape design, construction, engineering, supply chain, maritime and freight, plus two Summer Transportation Institutes. URITC also supports after school programs that reinforce STEM disciplines and their use in transportation and transportation-related careers. The 8th Annual Construction Day Engineering event alone attracted an average of 730 students from 45 Rhode Island schools.

While it is difficult to track students under the age of 18, URITC has a number of success stories which prove early exposure to these programs and activities can lead to careers in the transportation sector. One favorite example involves a young lady who spoke very little English when she came to a Summer Transportation Institute as a 7th grader. She also attended several URITC high school academies. She was the first in her family to graduate from college (URI in Civil Engineering), and is now a commissioned officer in the U.S. Navy. URITC also provides K-12 teachers with summer externship opportunities where they are allowed to shadow people in the transportation industry and develop a curriculum piece for their particulate grade/subject that will be delivered during the upcoming academic year. The URITC has distributed these curriculum pieces to teachers in Rhode Island. URITC professional development activities are now focusing on courses/training in development of performance management systems and lean processes.

University of Toledo University Transportation Center (UT-UTC)

University of Toledo

The Tier II \$2 million grant that established the University of Toledo University Transportation Center (UT-UTC) began in fiscal year 2007 and finished in fiscal year 2011. During those five years, research projects of \$3,758,854 and education projects of \$260,067, including matches, were completed; technology transfer initiatives saw intermodal transportation move to the forefront in local, regional, and state news.

Working with the Ohio DOT, UT-UTC researchers tackled the problem of ice formation on the I-280 cable stayed bridge in Toledo, which fell in sheets on the cars below. The result was a significant reduction in the formation of ice and the prevention of falling ice. UT-UTC researchers are now engaged in projects involving similar bridges in other countries. In another project with the Ohio DOT, the UT-UTC installed, monitored, and documented a 100 KW solar field next to the I-280 bridge. Electric power generated by the solar field runs the street and pylon lighting and provides data to evaluate the costs and benefits of using transportation land to expand solar resources. The demonstration project resulted in an estimated total savings of 6,177 kWh (kilowatt hours).

One successful UT-UTC project expanded the knowledge of using magnetic sensors to gage the deterioration of embedded prestressing strands in aging concrete bridges that cannot be inspected visually. The result of this work is presently being used by the university to evaluate the safety and replacement requirements of its parking structures. Another UT-UTC project developed the Great Lakes Maritime Information Delivery System, an extensive database that can be accessed through the interactive Midwest FreightView by researchers, decision makers, and transportation professionals. This program was developed as a comprehensive data repository and information clearinghouse for the maritime industry in the Great Lakes. The user-friendly database is available for transportation agencies, regional planning agencies, port authorities, and economic development organizations as well as other stakeholders and decision makers. The database is used to:

- Facilitate the acquisition, storage, management, analysis, and exchange of data between analysts and stakeholders.
- Draw linkages between maritime freight movements and economic development.

The International Network of Scholars program, begun by the UT-UTC, held symposia in Toledo, Korea, India, Spain, and Japan with over 300 researchers and scholars developing alliances to work together on universal transportation issues. The U.S. DOT's investment in the UT-UTC has positively impacted students from elementary school through PhD programs, government decision makers, transportation professionals, as well as the general public in northwest Ohio, the region, across the country, and throughout the world.

University of Vermont Transportation Research Center (UVM TRC)

University of Vermont

The University of Vermont's Transportation Research Center (UVM TRC) was established in 2006 with a national grant from the U.S. DOT under SAFETEA-LU. The grant created unique infrastructure and programs at UVM TRC by attracting diverse faculty, staff, and students from across the university to pool their expertise in the study of transportation in new ways that offer value to the Green Mountain State of Vermont and beyond. UVM TRC has grown into a progressive, interdisciplinary, research center that is focused on sustainable transportation systems to support livable communities. The center's unconventional approach to research has allowed it to develop partnerships across disciplines including UVM's schools of business, engineering, natural resources, medicine, agriculture and life sciences, arts and sciences, as well as with external public and private sector partners in Vermont and beyond. Through the new Certificate of Graduate Study in Sustainable Transportation Systems and Planning, students take innovative courses in transportation while completing their degrees at their home college. These students from diverse backgrounds have generated extensive original data and unique research results on accessibility and travel in northern non-urban communities, making contributions to a growing body of research in sustainable transportation.

The UVM TRC developed a suite of workforce development programs focused on opening access to career pathways in transportation to future labor pools. The TRC partners with other institutions on workforce development throughout New England, and has been part of a national leadership initiative in this field. UVM's state-of-the-art Transportation Air Quality Lab (TAQLab) includes on-road data collection, but it also uses lab-based equipment to study biofuel emissions. TAQLab focuses on collecting real-world, on-board, and lab-based tail pipe emission performance data, which is being used in the new generation of mobile source emissions models. Using the UTC grant, the TRC launched cooperative research programs such as a travel data partnership with Vermont DOT and the Vermont Clean Cities Coalition.



Photo: Courtesy of Local Motion, Burlington, Vermont, <http://www.localmotion.org>

University Transportation Research Center (UTRC) Region II

The City College of New York

The Region 2 University Transportation Research Center (UTRC) is comprised of 18 major universities encompassing New York, New Jersey, Puerto Rico, and the U.S. Virgin Islands. Diversity is reflected in the region's 30 million people and in its mixture of land uses and socioeconomic demographics. At its core, it is a complex transport network that integrates all modes and moves great numbers of people and tons of freight.

Since 1987, UTRC's mission is to support research, education, and technology transfer consistent with its theme of *Planning and Managing Regional Transportation Systems in a Changing World*. UTRC has achieved a position of national and regional prominence through its active involvement in addressing critical issues in transportation.

In close cooperation with public agencies and stakeholders and through the extensive work of its faculty and students, UTRC conducted research in critical transportation areas and developed programs that emphasized the formation of multidisciplinary and intercampus partnerships to address the region's research needs. Hundreds of studies have been completed and numerous findings have been applied.

UTRC provided education support and training through scholarships and internships such as the Advanced Institute for Transportation Education and the September 11th Memorial Program. UTRC also developed and administered a Technical and Managerial Training Program for employees of public agencies. UTRC graduates have gone on to positions of leadership and responsibility in public agencies, non-governmental organizations, and the private sector.

UTRC reached thousands of people by promoting an immediate and ongoing exchange of ideas. National and regional outreaches were provided in many forms. Technical briefings were presented at agencies and served as a stimulus for further interaction between UTRC study teams and agencies.

As the needs of the region's transportation system grows more complex, UTRC will continue to develop innovative solutions to meet 21st-Century transportation needs.



Images of transportation-related projects taken by New York City Planning (NYCP) and a collage created by UTRC intern, Andriy Blagay.

University Transportation Center for Alabama (UTCA)

University of Alabama–Tuscaloosa

The University Transportation Center for Alabama (UTCA) was funded as a Title III UTC under SAFETEA-LU. The center's theme was *Management and Safety of Transportation Systems*. UTCA's mission statement echoed that of RITA (now OST-R) which administered the UTC Program: To advance technology and expertise in the multiple disciplines that comprise transportation through the mechanisms of education, research, and technology transfer while serving as a university-based center of excellence.

UTCA is a three-campus UTC comprising the University of Alabama (UA), the University of Alabama at Birmingham (UAB), and the University of Alabama in Huntsville (UAH). Three notable UTCA projects funded during SAFETEA-LU are presented below. Journal papers based on these projects represent some of UTCA's research, education, and technology transfer activities.

- **Advanced Transportation Institute (ATI).** This educational project took place each summer during SAFETEA-LU. ATI involved a three-day institute jointly sponsored by UTCA and the Alabama DOT, and was open to rising high school juniors and seniors with an emphasis on African Americans and women. Institute presentations, lab experiences such as computerized bridge design and an egg-drop competition, as well as field trips were designed to give participants an overview of Alabama DOT, an introduction to transportation engineering as a career, and hands-on examples and challenges. During the SAFTEA-LU grant, this program included over 400 middle and high school students.
- **Safe Routes to Schools (SRTS) Implementation.** The aim of this project was to encourage K-8 students living within two miles of school to walk or bicycle to school. UTCA and the Alabama DOT worked together to set up an administrative framework for the Alabama SRTS program, funded at approximately \$9 million during fiscal years 2005

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ATI Students during Egg-Drop Competition



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to 2009. This framework included establishing an advisory board, setting a project schedule, formulation of SRTS policies for the state of Alabama to set up a comprehensive website, and creating proposal/project review criteria.

- **School Bus Seat Belts.** UTCA conducted a three-year project for the Governor's Study Group on School Bus Seat Belts and the Alabama State Department of Education. The project explored the implementation of lap/shoulder belts on newly purchased large school buses and provided the nation's best summary of the cost effectiveness, usage rates, and effects on school bus capacity of adding seat belts to school buses. Recommendations were disseminated by the governor's office to local cities and school districts for implementation.



*Above: ATI Attendee and the Computer Bridge Design.
Left: ATI Students Testing their Pin and Straw Bridge.
Photos are courtesy of the University of Alabama.*

The University Transportation Center for Mobility™ (UTCM)

Texas A&M University

The University Transportation Center for Mobility™ (UTCM) was established at the Texas A&M Transportation Institute (TTI) with a UTC grant of \$1.5 million per year. In keeping with its theme of *Improving the Quality of Life by Enhancing Mobility*, the UTCM developed sustainable, high-impact programs in research, education, and technology transfer in four focus areas:

- Coast to coast and border to border mobility,
- Rural public transportation,
- Congestion management and mitigation, and
- Innovative financing.

Just a few examples of UTCM's many successful efforts include ground-breaking research in mileage-based user fees (MBUF), addressing needs in rural public transportation, and programs to develop the transportation workforce.

In early 2008, UTCM authorized the study of MBUF as a potential alternative to the dwindling gas tax. This feasibility study in rural and small urban areas of Texas was followed later that year by a project to determine the feasibility of MBUF implementation. In 2009, the UTCM sponsored a national symposium to foster discourse on MBUF and implementation issues. Five annual MBUF symposia have now occurred nationwide in collaboration with the University of Wisconsin, International Bridge, Tunnel and Turnpike Association, and ITS America, to name a few. In this time, attendance has grown from 80 to over 250 attendees. The UTCM's MBUF website provided symposia results, a clearinghouse for national MBUF research, a listserv, and other resources. In 2010, UTCM research in this area was extended to include air quality and energy in performance measures of MBUF. TTI has continued to build on the UTCM foundation in this area, conducting MBUF projects for Texas DOT, U.S. DOT, other state DOTs, the Texas legislature, and more.

Historically, rural public transportation research has been underfunded. As a UTC in a category that did not require match, UTCM was in a unique position to help, funding such topics as evaluating the use of transfers for improving rural transit systems, assessing rural mobility and economic development under SAFETEA-LU's Coordinated Planning and Human Services network, evaluating impacts of funding and allocation changes on rural transit, improving demand response productivity and service quality through dispatch strategies, and providing transit services for sprawling areas with low-demand density.

UTCM's workforce development programs included activities at all levels: developing sustainability for K-12 workforce development programs across the state of Texas, expanding a long-standing FHWA-sponsored Summer Transportation Institute program for senior high school students at Prairie View A&M University, creating a successful multidisciplinary graduate certification program in transportation planning at Texas A&M University, and instituting a Texas A&M professional transportation management certification program for practitioners.



UTCM's work has improved rural public transportation access for senior citizens and others in many areas of Texas.

Photo ©Jenny Kane, The Central Pennsylvania Patriot News.

Utah Transportation Center (UTC)

Utah State University

Success has been a hallmark of the Utah Transportation Center (UTC). For the five years of its Tier 2 UTC grant, the UTC developed numerous external relationships, established strong ties with other university departments, conducted research, enhanced education, and disseminated accomplishments through journal publications and a wide variety of conferences and meetings.

New external partners include:

- Rutgers University, Center for Advanced Infrastructure and Technology (CAIT)
- Virginia Tech
- Utah Transit Authority
- Cache Valley Transit Authority
- Cache Valley Metropolitan Planning Organization
- Oak Ridge National Laboratory
- University of Utah

At Utah State University, the UTC combined resources with the Energy Dynamics Lab, the Consumer Sciences Department, the Wildlife Resources Department, and the Electrical and Computer Engineering Department, which has resulted in significant sharing of both funding and expertise.

A five-year snapshot of the UTC's activity and accomplishments includes:

- 24 research projects initiated
- 15 research projects completed
- 40 master's degrees awarded
- 8 doctoral degrees awarded
- 85 papers presented
- 50 papers published

Two UTC research projects outlined options in Accelerated Bridge Construction (ABC) techniques and developed guidelines for curved-stand connections. ABC techniques have resulted in state-of-the-art options that save time and money during the construction of new or existing bridges. As a result, ABC technologies are one of the top priorities of the Every Day Counts 2 (EDC2) initiative. One such group of techniques that has generated considerable interest is the use of precast concrete deck panels. Utilizing precast concrete deck panels allows for offsite curing, thus eliminating long delays due to formwork construction and concrete curing time. Despite the benefits, problems can develop due to the inherent joints between the individual panels. These joints are locations for potential leakage, which can result in corrosion or inadequate long-term performance. Post-tensioning the precast deck panels helps eliminate leakage; however, conventional longitudinal post-tensioning systems require complete deck replacement in the event of a single faulty deck panel.

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Layout of full-scale precast concrete deck panel specimen prior to grouting. Photo courtesy of UTC.

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The UTC partnered with Utah DOT to develop new guidelines for post-tensioned, curved-strand connections allowing for a single panel replacement. As part of this investigation, full- and small-scale, curved strand connection details were constructed in the Systems, Materials, and Structural Health (SMASH) Laboratory at Utah State University. The curved-strand connection was found to be comparable to a standard post-tensioning system. The ultimate flexural and cracking capacity of the curved-strand connection was found to be approximately 116 percent and 100 percent of the respective values for the standard post-tensioned

connection. The long-term, prestress losses were also quantified and predicted to be approximately 6 percent in 75 years. These data are described in a recent UTC publication titled “Performance of Post-Tensioned Curved-Strand Connections in Transverse Joints of Precast Deck Panels,” authored by Zane G. Wells, Paul J. Barr, and Patrick H. James.

Western Transportation Institute (WTI)

Montana State University

As one of 10 national UTCs, the Western Transportation Institute's (WTI) theme was *Integrated Approaches to Rural Travel and Transportation*, with research programs such as safety, winter maintenance, road ecology, infrastructure, systems integration, and public transportation. By developing solutions to rural challenges, WTI has supported U.S. DOT goals to develop a safe, efficient, and comprehensive national transportation network.

WTI led pioneering research to deploy Intelligent Transportation Systems (ITS) and other advanced technologies in rural areas. Working with the California DOT (Caltrans), WTI developed the Responder System, a mobile data terminal enabling transportation workers to collect and share critical at-scene information from remote locations. The Responder System received numerous awards, including a "Best of Rural ITS" award (2010).

WTI also established an internationally recognized Road Ecology Program. In 2007, WTI completed the National Wildlife Vehicle Collision Reduction Study for FHWA and Congress, detailing the causes, impacts, and costs of Wildlife Vehicle Collisions (WVCs), and identifying the most effective prevention tools and strategies.

WTI offered a comprehensive education program that ranged from K-12 outreach to professional development training. Many activities offered experiential learning to university students. The Undergraduate Research Experience (URE) provided four students a year with hands-on research experience and personal mentoring. The Graduate Transportation Award provided tuition support and stipends to top students pursuing advanced degrees. Over six years, the UTC grant supported paid research opportunities to more than 260 university students.

WTI's Technology Transfer Program focused on innovative ways to implement advancements as quickly as possible. Working with Caltrans, Oregon DOT, and several other states, WTI started the Western States Transportation Technology Implementers Forum, an annual event where researchers and practitioners share ideas and best practices for deploying ITS. WTI also worked with numerous partners to coordinate the Winter Maintenance Peer Exchange, a multi-state forum facilitating research and implementation of winter operations improvements, such as advancements in snow and ice control.



Pictured is a screenshot from the Responder System with an example of an annotated photo created at the incident site. Photo courtesy of the WTI.

Abbreviations and Acronyms

AAA	American Automobile Association	CSC	Clean Snowmobile Challenge
AAAFST	AAA Foundation for Traffic Safety	CSU-UTC	Cleveland State University Transportation Center
AASHTO	American Association of State Highway and Transportation Officials	CTIS	Center for Transportation Infrastructure and Safety
ADA	Americans with Disabilities Act	CTL	Campus Transit Lab (OSU)
ALEDA	Advanced Loop Event Data Analyzer	CTME	Center for Transportation and Materials Engineering
APCO	Association of Public Safety Communications Officials International (APCO International)	CUTC	Council of University Transportation Centers
APC	automated passenger counting	DCT	Delaware Center for Transportation
API	application programming interface	DEER	Driving Evaluation, Education, and Research Center
APTA	American Public Transportation Association	DOT	Department of Transportation
ARTBA	American Road and Transportation Builders Association	E3	Energy, Environment, and Education
ASM	acoustical signature monitoring	EMC	electromagnetic compatibility
AVL	automatic vehicle location	EMS	emergency medical services
BRT	Bus Rapid Transit	ESITAC	Eastern Seaboard Intermodal Transportation Applications Center
CABS	Campus Area Bus System	FDOT	Florida Department of Transportation
CAIT	Center for Advanced Infrastructure and Transportation Caltrans California DOT	FHWA	Federal Highway Administration
CFIRE	National Center for Freight and Infrastructure Research and Education	FRP	fiber-reinforced polymer
CID	Controller Interface Device	FTA	Federal Transit Administration
CIFTS	Center for Intermodal Freight Transportation Studies	GHG	greenhouse gas
CMAQ	Congestion Mitigation and Air Quality Improvement	GIFT	Geospatial Intermodal Freight Transportation
CMS	Center for Multimodal Solutions for Congestion Mitigation	GIS	geographic information system
		GL MTS	Great Lakes Maritime Information Delivery System

GPS	global positioning system	MTI	Mineta Transportation Institute
GTI/UTC	Georgia Transportation Institute, University Transportation Center	MVTA	Minnesota Valley Transit Authority
HIG	Honda Initiation Grant	NASA	National Aeronautics and Space Administration
HOT	high-occupancy toll	NCHRP	National Cooperative Highway Research Program
HOV	high-occupancy vehicle	NCIT	National Center for Intermodal Transportation
IDOT	Idaho Department of Transportation	NCTR	National Center for Transit Research
IPCs	interpenetrating phase composites	NDE	nondestructive evaluation
ISTEA	Intermodal Surface Transportation Efficiency Act of 1991	NEUTC	New England Transportation Center
ITI	Intermodal Transportation Institute	NIATT	National Institute for Advanced Transportation Technology
ITS	intelligent transportation systems	NOAA	National Oceanic and Atmospheric Administration
LPS	Laboratory for Port Security	NRI	Network Robustness Index
LTBP	Long-Term Bridge Performance	NTAD	National Transportation Atlas Database
MDOT	Michigan Department of Transportation	NTC	National Transportation Center
MATC	Mid-America Transportation Center	NUF	National Urban Freight
MBTC	Mack-Blackwell National Rural Transportation Center	NYCDOT	New York City DOT
M-CASTL	Michigan Center for Advancing Safe Transportation Throughout the Lifespan	NYMTC	New York Metropolitan Transportation Council
MDSS	Maintenance Decision Support System	OTREC	Oregon Transportation Research and Education Consortium
METRANS	National Center for Metropolitan Transportation Research	OSU	Ohio State University
Missouri S&T	Missouri University of Science and Technology	OTC	Ohio Transportation Consortium
MiSTI	Materials in Sustainable Transportation Infrastructure	PCBs	polychlorinated biphenyls
MIT	Massachusetts Institute of Technology	PHEV	plug-in hybrid electric vehicle
MPO	metropolitan planning organization	PEM	proton exchange membrane
MTC	Midwest Transportation Consortium	PORTAL	Portland Transportation Archive Listing

RFID	radiofrequency identification	TTI	Texas Transportation Institute
RITA	Research and Innovative Technology Administration	UAB	University of Alabama at Birmingham
SAE	Society of Automotive Engineers	UMTRI	University of Michigan Transportation Institute
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users	URITC	University of Rhode Island Transportation Center
SHM	Structural Health Monitoring	USDOT	U.S. Department of Transportation
SWUTC	Southwest Region University Transportation Center	usRAP	U.S. Road Assessment Program
STC	Southeastern Transportation Center	UTA	Utah Transit Authority
STEWARD	Statewide Transportation Engineering Warehouse for Archived Regional Data	UTC	University Transportation Center
SWARM	System-Wide Adaptive Ramp Metering System	UTCM	University Transportation Center for Mobility
TAD	Travel Assistant Device	UTRC2	Region II University Transportation Research Center
TDM	Transportation Demand Management	V/C	volume-to-capacity
TEA-21	Transportation Equity Act for the 21st Century	VMT	vehicle-miles traveled
TFO	Transportation Funding Options	VOCs	volatile organic compounds
TOC	Traffic Operations Center	VTRC	Virginia Transportation Research Council
TransNow	Transportation Northwest	VTS	Vessel Traffic Services
TRB	Transportation Research Board	WSU	Washington State University
TSA	Transportation Security Administration	WTI	Western Transportation Institute



University Transportation Centers



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