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TEXAS TRANSPORTATION
Researcher

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ON THE COVER: Quitman Street and I-45 in Houston after Hurricane Harvey. Helping the Texas Department of Transportation and local agencies restore transportation infrastructure following extreme weather events is a top priority for the Texas A&M Transportation Institute.
Cover photo by #skeez181.




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Publisher/Agency Director
Gregory D. Winfree

Editor
Chris Pourteau

Managing Editor
Samantha Atchison

Copy Editor
Michelle Benoit

Writers
Samantha Atchison
Richard Cole
Rick Davenport
Chris Pourteau
Chris Sasser
Kelly West

Art Director
John Henry

Designers
Vicky Nelson
Stacy Schnettler

Photographer
James Lyle

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phone: (979) 458-8834
email: n-pippin@tti.tamu.edu
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Texas Transportation Researcher
Texas A&M Transportation Institute
TTI Communications
3135 TAMU
College Station, TX 77843-3135

Highlights from ASCE's 2017 Infrastructure Report Card*

AT A GLANCE

See related story on page 10.

Our Aging Infrastructure

The nation's infrastructure is crumbling. The highways, railroads, pipelines, wastewater systems, bridges, ports and inland waterways essential to America's economy are suffering from a combination of spiraling demand, benign neglect and advancing age.

$160 BILLION

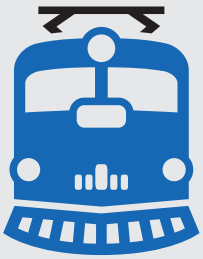
Annual cost of traffic delays and congestion, in wasted time and fuel.

49%

Percentage of vessels on inland waterways experiencing daily delays.

56 MILLION

Number of new users to be connected to centralized wastewater treatment systems in the next 2 decades.



51%

Percentage of American households without access to a grocery store via public transit.

43 YEARS

Average age of the **641,387** bridges in the United States.

9.1%

Percentage of U.S. bridges rated as "structurally deficient" in 2016.

**Source: American Society of Civil Engineers, 2017. http://infrastructurereportcard.org*

Total Pavement Acceptance Device

Lightweight Falling Weight Deflectometer

Air-Coupled Ground-Penetrating Radar

Rolling Density Meter

Helping Agencies Manage Infrastructure Renewal:

TTI's Asset Management Group

As in 2013, ASCE once again rated America's infrastructure a D+ in its latest 2017 assessment. Although several categories, such as ports and rail, achieved modest improvements, others declined. And six core categories that many think of when they think of infrastructure itself — including bridges, roads and aviation — remained unchanged from four years earlier.

The takeaway: America's infrastructure hasn't gotten healthier. It's no wonder, then, that infrastructure renewal is a principal policy focus for the Trump Administration.

The Texas A&M Transportation Institute's (TTI's) Asset Management Group helps sponsors optimize resources to manage infrastructure improvements. From TTI's groundbreaking application of ground-penetrating radar (GPR) to the development of other nondestructive pavement testing equipment and processes to helping agencies determine infrastructure priorities, TTI's expertise has provided innovative solutions for decades.

"For the longest time, we simply built our way out of whatever transportation problem we faced," explains TTI Research Engineer Andrew Wimsatt. "Now, as ASCE points out, those solutions — roads, bridges and other infrastructure elements — are failing and in need of repair or replacement. That's what the Moving Ahead for Progress in the 21st Century Act [MAP-21] was designed to address."

In 2012, MAP-21 restructured and provided strategic guidance for federal surface transportation spending. The act emphasized performance outcomes, which put the onus on states to demonstrate bang for the buck in order to secure federal funding. In 2015, the Fixing America's Surface Transportation Act authorized $305 billion through 2020 to fund transportation projects nationwide.

"These days, infrastructure maintenance is as much about strategic planning as it is about filling potholes," says Wimsatt. "Local agencies have to make resources stretch further, and also make sure the equipment and materials they use are up to code and that they have personnel properly trained to operate them. That's where TTI can help."

The Texas Department of Transportation (TxDOT), the U.S. Army Corps of Engineers, the Strategic Highway Research Program and the National Cooperative Highway Research Program — these are just a handful of the sponsors worldwide for whom TTI has evaluated and certified equipment, trained personnel, and provided innovative technological applications. The experts in TTI's Asset Management Group combine engineering best practices with economic principles and proven business strategies to develop or improve tools at all levels of decision-making.

Accurate, reliable data collection and analysis are key aspects of effective asset management. The way transportation agencies collect, store and analyze data is evolving to leverage the capabilities of advancing technology.

"Local agencies have to make resources stretch further, and also make sure the equipment and materials they use are up to code and that they have personnel properly trained to operate them. That's where TTI can help."

Andrew Wimsatt
TTI Research Engineer

TTI trains local personnel in how to collect and analyze data efficiently, reliably and cost-effectively to meet their needs. And Institute experts can help agencies calibrate and certify equipment to meet national standards of excellence. Whether it's pavements, bridges, pavement markings or signs, TTI's state-of-the-art equipment helps sponsors perform at peak accuracy and efficiency under MAP-21 requirements.

"Take the ongoing Corridor Analysis Project for TxDOT, for example," says Wimsatt. "It's just one example of the one-stop-shop kinds of services we offer."

Led by TTI Senior Research Engineer Tom Scullion, TTI researchers have conducted extensive evaluations of major highway facilities — such as I-20 in West Texas and I-45 in East Texas — and helped TxDOT rank segments of these corridors in terms of needed repairs. Researchers obtained core samples of the pavement materials and analyzed them in the laboratory. The team also evaluated pavement conditions using GPR, a falling weight deflectometer and the total pavement acceptance device. Traffic volume data were collected, maintenance histories compiled for each section, and local road project priorities studied.

After evaluating all the data, TTI created four categories of needed repairs for the sections studied: roads expected to last two years, two to five years, five to ten years, and ten years or longer. After creating an optimum rehabilitation strategy for each section, TTI provided its recommendations to TxDOT's district engineers. TxDOT officials have said TTI's expertise helped save Texas millions in taxpayer dollars.

"What our districts really appreciate is how TTI helps us boil down all the masses of data collected in these studies into one simple, short report with detailed, project-level recommendations," says Dar-Hao Chen of TxDOT's Construction Division. Chen managed the Corridor Analysis Project for the department. "That helps us set priorities as we develop our 10-year pavement rehabilitation plan for each identified project." ■

For more information, contact **Andrew Wimsatt** at (512) 407-1143 or a-wimsatt@tti.tamu.edu.

TTI DEMONSTRATES NEW TECH AIMED AT MITIGATING WRONG-WAY DRIVING CRASHES

Based on Finley's findings that flashing wrong-way signs decreased San Antonio incidents by 38 percent, TxDOT is expanding its use of countermeasures around the Lone Star State.

On Aug. 17, reporters and transportation agency representatives gathered under a tent near a repurposed runway at The Texas A&M University System's RELLIS Campus. They watched as Texas A&M Transportation Institute (TTI) Research Engineer Melisa Finley — known for her innovative studies on wrong-way drivers — led a first-of-its-kind and successful connected-vehicle demonstration funded by the Texas Department of Transportation (TxDOT).

Finley was joined by Senior Research Analyst Cameron Mott of the Southwest Research Institute (SwRI), and before the demonstration, both described for attendees how the system would operate.

Dedicated short-range communications radios mounted along the roadway were set up to detect a connected vehicle as it entered a highway exit

ramp from the wrong direction. Integration with existing detectors would provide multiple alerts, one of them triggering a wrong-way warning sign, viewable to the driver along the roadway. Meanwhile, another connected vehicle would travel in the correct direction and encounter the wrong-way driving vehicle. Warnings displayed in both vehicles would alert drivers that a vehicle was moving in the wrong direction, and a traffic management center (displayed to the crowd on a monitor) was set to be immediately notified of the incident. A nearby law enforcement vehicle would also receive notification that a wrong-way driving event was taking place.

"TTI's researchers have done a wonderful job of helping prepare TxDOT for the fast-approaching connected-vehicle environment. We need to continue to assure that Texas is ready."

Darrin Jensen
TxDOT Research Project Manager

All of it played out as promised, and members of the crowd were invited to ride inside the vehicles as researchers repeated the demonstration multiple times.

Currently, about 240 wrong-way driving events are reported each year on Texas freeways. Previous research by Finley has shown that most wrong-way drivers are inebriated. Her research also showed that flashing wrong-way signs implemented along San Antonio's US 281 corridor resulted in a 38 percent decrease in wrong-way driving incidents. Based on Finley's findings, TxDOT is currently expanding its use of flashing wrong-way signs in San Antonio, Fort Worth and Houston.

"Countermeasures do work, but, unfortunately, because drivers are under the influence of alcohol, they will continue to drive the wrong way. With this technology, we can warn innocent drivers and give them the chance to react before they encounter the wrong-way vehicle. Law enforcement could also receive information about the wrong-way driver in their patrol vehicle, giving them a head start in preventing a crash," Finley says.

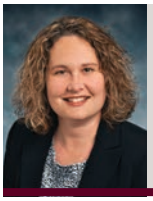
The project, Connected Vehicle Wrong-Way Driving Detection and Mitigation Demonstration, began in February 2015 as a joint effort between TTI and SwRI. TxDOT chose to fund it under its innovative research project program. In addition to developing a proof-of-concept system, researchers also conducted human factors studies to investigate the in-vehicle information needs of right-way drivers when a wrong-way driving event occurs.

"There are more than 32,000 high-end luxury vehicles on the road today that came equipped from the factory with connected-vehicle technology," Mott states. "I could see this providing an improvement to the safety of travelers as early as 2020."

TTI Research Engineer Melisa Finley describes for attendees how new technology can help prevent wrong-way driving crashes.

Although the demonstration project has ended, TxDOT is considering a new phase of wrong-way driving research. It's possible that a specific Texas roadway could become part of a connected-vehicle, wrong-way driving test location.

"One of TxDOT's goals is to reduce crashes and fatalities by continuously improving guidelines and innovations. So far, this project has been a success," states TxDOT Research Project Manager Darrin Jensen. "TTI's researchers have done a wonderful job of helping prepare TxDOT for the fast-approaching connected-vehicle environment. We need to continue to assure that Texas is ready." ■



For more information, contact **Melisa Finley** at (979) 845-7596 or m-finley@tti.tamu.edu.

Texas A&M's Infrastructure Renewal Symposium Brings Together Industry Experts, Leaders to Discuss Critical Issues

"In light of recent events, there's nothing more important than we as professionals in the transportation and infrastructure space talking about how we go about rebuilding our infrastructure to make it stronger, last longer, cost less and be delivered more quickly."

John Barton
Associate Vice Chancellor
The Texas A&M University System

OPTIMISM about future transportation funding and new efforts to modify regulatory restrictions were prominent themes of Texas A&M University's National Symposium on the Barriers and Opportunities for Infrastructure Renewal, held at the Annenberg Presidential Conference Center Sept. 18. Members of the Trump Administration and other high-level state and federal officials, as well as private-sector stakeholders, were in attendance.

Although focused on transportation, the symposium addressed energy, water and wastewater systems, electric grids, and other systems considered critical infrastructure sectors.

"Being able to exchange ideas, to openly discuss these topics, to gather your thoughts and your concerns will help us frame a report we will share with President Trump and his administration, with Congress, and with the national conferences of mayors, as well as state legislators," John Barton, associate vice chancellor of The Texas A&M University System, told attendees at a gathering the night before the symposium.

The symposium occurred while construction is under way at the A&M System's RELLIS Campus, a 2000-acre high-tech research and education complex, which will house many of the university engineering agencies, including the Texas A&M Transportation Institute (TTI), the Texas A&M Engineering Experiment Station (TEES) and the Texas A&M Engineering Extension Service (TEEX).

The Center for Infrastructure Renewal, currently under construction and a centerpiece of RELLIS, is a 138,000-square-foot research, testing and training facility focused on building longer-lasting infrastructure in less time and for less money.

"TEES, TEEX, TTI and the Bush School are masters — as good as it gets — when it comes to infrastructure," A&M System Chancellor John Sharp said at the pre-symposium gathering. "And then you add the new Center for Infrastructure Renewal that these legislators provided us. I personally think it will be an awesome place for a national laboratory on infrastructure before it's over with."

Many of the panel participants at the symposium reminded the audience

U.S. Rep. Bill Shuster, Chair, U.S. House of Representatives Committee on Transportation and Infrastructure.

Texas Rep. Celia Israel.

TTI Agency Director Greg Winfree.

John Barton, Associate Vice Chancellor and Executive Director of the A&M System's RELLIS Campus and Executive Director, Center for Infrastructure Renewal.

Finch Fulton, Deputy Assistant Secretary for Transportation Policy, U.S. Department of Transportation.

Left to right: Rep. Bill Poole, Alabama House of Representatives Committee on Ways and Means for Education; Darryl Davis, Morgan Stanley; and Tom Kelly, Fluor Corporation.

Attendees tour TEEX's Disaster City and the Brayton Fire Field.

that rebuilding the "nation's crumbling infrastructure" (the American Society of Civil Engineers gave the nation's infrastructure a D+ rating in 2017, renewed from its 2013 report) will take numerous approaches — including creating new funding sources, removing some of the layers of bureaucracy, and educating the public about the benefits of specific projects at the local level.

"We have to make sure we have those regulatory reforms that are absolutely essential so we get the government out of the way," stated keynote speaker Bill Shuster, chair of the U.S. House of Representatives Committee on Transportation and Infrastructure. "Time is money, and some of these projects linger on. We are very focused to make sure we get those kinds of reforms in place."

Shuster said we need to consider everything to increase funding for infrastructure, including public-private partnerships, a user-fee system, and an increase in the fuel tax.

The second keynote speaker, Finch Fulton, deputy assistant secretary for transportation policy at the U.S. Department of Transportation, told attendees that the new administration has made infrastructure one of its top priorities. President Trump has appointed, for the first time ever, a special advisor on infrastructure, a special advisor on environmental quality, and a task force on regulatory reform.

"The president is a builder. He's felt the pain that you feel when trying to push forward an infrastructure project," Fulton said. "As many of you know, you must get up to 16 different approvals from 10 different agencies covered by 29 different statutes and at least five executive orders to get anything done — for a highway project for example."

Fulton described the president's infrastructure initiative as $200 billion in new federal funding that will be leveraged into $1 trillion over the course of 10 years.

"There are lots of challenges out there, but it's a wonderful time for transportation in Texas and throughout the country because of the leadership we are seeing on the federal level, in the private sector, and in our research institutes," Tryon Lewis of the Texas Transportation Commission said. "This is an exciting time."

A&M System agencies partnering on the symposium were TTI, TEES, TEEX, the Texas A&M College of Engineering, and the Bush School of Government and Public Service. Private-sector cosponsors were HNTB at the silver level and Econolite Group, Inc., at the bronze level.

"Assessing our existing infrastructure to determine how we can make it more resilient and figuring out how best to incorporate advanced technologies to meet tomorrow's transportation challenges are the focus of a number of TTI research initiatives going forward," says TTI Agency Director Greg Winfree, who moderated a panel discussion on eliminating regulatory roadblocks to delivering infrastructure projects. "Deep conversations by thought leaders like those we hosted here at Texas A&M are how we'll accomplish those goals." ■

Left to right: Patrick Vieth, Dynamic Risk Assessment Systems, Inc.; Tyler Duvall, McKinsey & Co.; Ananth Prasad, HNTB.

Left to right: John Barton, The Texas A&M University System; Art Daniel, Associated General Contractors of America; James Ray, U.S. Department of Transportation; Geanie Morrison, Texas House of Representatives Committee on Transportation; Tryon Lewis, Texas Transportation Commission.

Left to right: Caitlin Durkovich, Department of Homeland Security; Ronald D. Hahn, AECOM; Dan Woodfin, Electric Reliability Council of Texas.

For more information, contact **Terri Parker** at (979) 862-8438 or t-parker@tti.tamu.edu.

ACCELERATED CONSTRUCTION CAN CUT RED TAPE, SAVE TIME FOLLOWING EXTREME WEATHER EVENTS

Before reconstruction can happen, roadways and other infrastructure necessary to access needed repairs must, themselves, be repaired. Accelerated construction techniques can make that happen faster, cost-efficiently and more safely.

In 2015, Texas' state demographer estimated the population of the Lone Star State could double by 2050. TxDOT is preparing to deal with this population expansion by providing $70 billion in highway expenditures over the course of 10 years.

Damaged roads and devastated homes. Chemical plant explosions in Crosby, Texas. The shutdown of the Colonial Pipeline, which supplies much of the East Coast with fuel.

The shockwaves from extreme weather events like Hurricane Harvey can last for years. Getting damaged infrastructure back online is key to public safety, as well as the nation's economy, over the long term. Accelerated construction techniques can help cut red tape as Houston and other Texas communities rebuild.

"Practices like design-build contracting — where designers and contractors work closely together to facilitate plan reviews and make design changes in a timely fashion — can really help," explains Texas A&M Transportation Institute (TTI) Senior Research Engineer David Newcomb, head of the Institute's Materials and Pavements Division. "Accelerated construction principles can be especially useful when applied to critical structures such as roads and bridges with high traffic volumes."

As waters receded and roads became passable in southeast Texas, the Texas Department of Transportation (TxDOT) began the reconstruction process as it prioritized repairs of roadways, bridges, airports, pipelines and port facilities.

Getting facilities like this Houston wastewater treatment plant back online after Hurricane Harvey is a top priority to safeguard public health.

Another example of how accelerated construction can expedite the process: reusing materials already in place (so builders save time in excavation and hauling) while stabilizing those materials to form a good foundation for the structure being rebuilt.

Though it's a long road ahead to rebuild the communities devastated by Hurricane Harvey, Newcomb says he's confident in TxDOT and Texans to get the job done. "Once the reconstruction is complete, the restoration of the roads to pre-hurricane quality can be completed and the economy can recover," he says.

TTI, TxDOT Team Up on Accelerated Construction Workshops

Implementing accelerated construction principles has been ongoing for a while in Texas. This year, TTI has teamed up with TxDOT to deliver workshops to the department's districts across the state on the use of accelerated construction practices.

Even under the best of circumstances, planning, financing, scoping, designing, bidding/letting and constructing a highway project typically require 8 to 15 years. Reducing this time can result in significant cost savings for the responsible agency, road users and business owners, as well as decreased costs associated with construction delays.

In 2015, Texas' state demographer estimated the population of the Lone Star State could double by 2050. TxDOT is preparing to deal with this population expansion by providing $70 billion in highway expenditures over the course of 10 years.

"With this volume of work ahead of us, TxDOT and industry should work together to deliver transportation improvements more quickly and cost-effectively to minimize delay costs, economic losses and safety risks," says TxDOT Director of District Operations Randy Hopmann. "The Accelerated Construction Program provides a framework to accomplish these objectives and engage stakeholders in the process."

Key steps in the rapid construction process include

- incorporating accelerated construction into the planning phase,
- isolating the construction work from the traffic to provide unimpeded access and maintain a steady flow of construction work,
- maximizing existing pavement material and equipment usage, and
- developing innovative approaches to facilitating traffic movement.

The TTI-TxDOT team conducted accelerated construction workshops in three regions of Texas this summer, with attendance in the hundreds at each workshop. As part of the project, the team developed technical briefs and implementation reports to capture best practices and share lessons learned for the future. Four additional workshops are planned.

"Accelerated construction will become a more popular way of doing business since the approach demonstrates the economic and/or safety justification for minimizing the length of time work zones are present on Texas highway projects," explains TTI Executive Associate Director Jon Epps, an instructor for the workshops and the technical lead who produced the briefs. "The thoughtful implementation of that strategy will result in safer work zones and a better value for the citizens of Texas." ■

For more information, contact **David Newcomb** at (979) 458-2301 or d-newcomb@tti.tamu.edu.

Texas State Transportation Innovation Council Recommends **TTI Project for Statewide Implementation Funding**

In June, the Texas State Transportation Innovation Council (STIC) met for the third time since its inception in 2016. The Texas Department of Transportation (TxDOT) and Federal Highway Administration (FHWA) co-hosted the Austin event, with 110 transportation personnel attending. The STIC brings stakeholders together semiannually to facilitate more rapid deployment and implementation of new technologies, strategies and methods that have demonstrated success in real-world scenarios.

Texas A&M Transportation Institute (TTI) researchers presented updates on eight out of thirteen projects selected by the STIC, all of which will likely receive additional TxDOT and FHWA support as their products and recommendations are adopted across the state. Four other universities participated as well.

"The STIC meeting is a great venue for research products to gain traction for implementation," says TTI Associate Director Bill Stockton. "We're always happy to have an opportunity to highlight innovations and get the word out about TTI research ready for the next steps."

Co-chaired by TxDOT Director of Strategy and Innovation Darran Anderson and FHWA Texas Division Administrator Al Alonzi, the STIC is composed of 25 individual members who span the private and public sectors from across the state.

"We want to find ways to take innovative ideas and adapt them to the way we do things here in Texas, so it's not just one large urban area using something," says Alonzi. "Local agencies and the private sector are included, and we're all coming together collaboratively to find the best ways to improve transportation for the citizens of Texas."

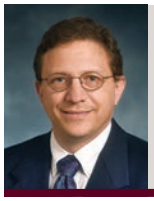
> **"We want to find ways to take innovative ideas and adapt them to the way we do things here in Texas, so it's not just one large urban area using something," says FHWA Texas Division Administrator Al Alonzi.**

The TxDOT Research Oversight Committee and the FHWA Texas Division Office review and recommend projects from their respective research programs to be discussed at the meeting. FHWA selects projects from its Every Day Counts Initiative to receive implementation support from the STIC. Recommended projects must be innovative and show the promise of significant benefits if implemented statewide, institutionally and across multiple transportation organizations.

FHWA's Center for Accelerating Innovation can award an incentive budget of $100,000 each year to a project nominated by the STIC. This year, the STIC selected the TTI-TxDOT implementation project Accelerated Traffic Incident Management Data Collection to Improve Overall Traffic Incident Management as its first project for which to request incentive funding. In Texas, traffic incident management (TIM) programs are being used to shorten the duration and impact of incidents through coordinated actions and policies among different first-responder agencies, including law enforcement, fire and EMS services, and medical examiners. Gaps in recording aspects of incident management performance remain, however, resulting from a lack of data integration and analysis tools.

Led by TTI Associate Research Scientist Jeff Kaufman, the project involves a team of researchers working with the multiple TxDOT districts, toll road authorities, the department's Traffic Operations Division, the Texas Department of Public Safety and FHWA to increase the amount, consistency and quality of TIM data collection. Improving TIM data will support development of performance measures for evaluating and improving traffic incident response.

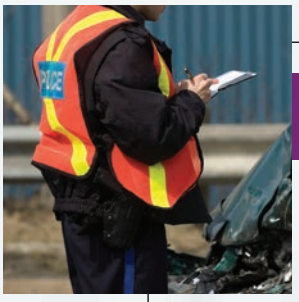
"While this project will identify how we can improve the quality of TIM data collected," says Kaufman, "it will also give us a better understanding of how we respond to incidents throughout the state and what is truly needed to clear our roads faster." ■



For more information, contact **Jeff Kaufman** at (713) 686-2971 or j-kaufman@tti.tamu.edu.

TxDOT Implements 2017–2018 Every Day Counts Innovations — Round 4

Every Day Counts, a state-based initiative of FHWA's Center for Accelerating Innovation, works with state, local and private-sector partners to encourage the adoption of proven technologies and innovations aimed at shortening and enhancing project delivery. The Texas STIC has selected four projects from the 2017–2018 fourth round of innovations for statewide implementation. TTI researchers are working with TxDOT divisions and districts on three of these implementation project efforts.



1

Data-Driven Safety Analysis, TTI

This innovation is the use of cutting-edge software to analyze crash and roadway data and determine the expected safety performance of roadway projects more reliably. This type of analysis enables agencies to predict the safety implications of their decisions with confidence.

2

Accelerated Traffic Incident Management Data Collection to Improve Overall Traffic Incident Management, TTI

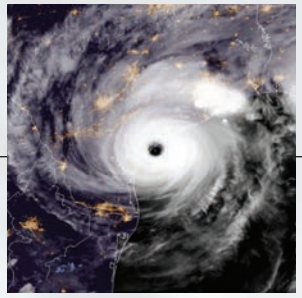
To shorten the duration and impact of incidents on U.S. roadways, this innovation focuses on improving the adoption and consistency of the collection of TIM data and increasing the volume of data from transportation, law enforcement and other first-responder agencies.

3

Automated Traffic Signal Performance Measures (ATSPMs) for Improved Traffic Signal Operation and Maintenance in Texas, TTI

ATSPMs will revolutionize the management of traffic signals by providing the high-resolution data needed to actively manage performance and deliver high-quality service to customers, with significant cost savings to agency maintenance and operations.

4



Road Weather Management — Weather-Savvy Roads, Center for Transportation Research, The University of Texas at Austin

To reduce the negative impacts of weather events that lead to traffic delays, reduced operational effectiveness, and increases in crashes, this innovation deploys two distinct road-weather management solutions.

The Texas 100:

Texas Leads the Way in Data-Driven Performance Measures

In 2009, researchers at the Texas A&M Transportation Institute (TTI) began compiling its Texas 100 Most Congested Highways list as part of an interagency contract with the Texas Department of Transportation (TxDOT).

Over the past nine years, the list has helped TxDOT identify and begin to address the most congested highways in the state. It's also enhanced Texas' reputation as a recognized leader in performance measurement activities. Several departments of transportation around the country have expressed interest in implementing strategies similar to the Lone Star State's proactive approach to measuring and mitigating congestion.

"Performance measures are important to determine problem areas that need further investigation or improvement, as well as to provide assessments of the benefits from implemented projects, programs and policies," explains David Schrank, TTI senior research scientist and principal investigator. "This is true for all kinds of projects in large urban regions, small urban centers and even rural areas."

The Texas 100 list gauges numerous mobility performance measures for almost 1,800 sections (or 10,000 centerline miles) of roadway. For the past three years, major roads in all of the 25 Texas urban areas have been included in the list; at least 20 road sections are monitored annually for congestion in each region.

"The multilevel approach enables us to tell TxDOT and local planners how the state's entire highway system is performing," says Schrank. "But our work produces many other benefits that help TxDOT expand its analytical capabilities."

Ancillary benefits from compiling the list include the following:

- Speed data are provided to all TxDOT divisions and districts by TTI after they are linked to the TxDOT Roadway-Highway Inventory Network (RHiNo). This linkage allows all of the conversations and analyses to be based on TxDOT's mapping and the other data in TxDOT's road inventory and condition dataset. In addition to the speed data, TTI calculates congestion statistics for all RHiNo segments where speed data are available. This allows users to have ready-to-use statistics for comparing roadway sections.
- TxDOT's partnerships with Texas metropolitan planning organizations (MPOs) allow access to speed and congestion statistics. MPOs can then team with their local TxDOT districts to prioritize potential projects aimed at relieving congestion and improving mobility.
- TxDOT's Freight and International Trade Section and Freight Advisory Committee can use data derived from the Texas 100 to identify truck bottlenecks and potential mobility improvement strategies.
- TTI calculates annual statewide system performance measures for TxDOT's Key Performance Measures list based on the available congestion statistics. ■

"The multilevel approach enables us to tell TxDOT and local planners how the state's entire highway system is performing. But our work produces many other benefits that help TxDOT expand its analytical capabilities."

David Schrank
TTI Senior Research Scientist

For more information, contact **David Schrank** at (979) 845-7323 or d-schrank@tti.tamu.edu.

Find the latest list of Texas' Most Congested Roadways at https://mobility.tamu.edu/texas-most-congested-roadways/.

New Delivery Methods, New Transportation Challenges in the Era of E-Commerce

Our transportation system will need to change in order to accommodate the dramatic growth in e-commerce, a research project by the Texas A&M Transportation Institute (TTI) reveals.

In numbers that have grown and will likely rise, Americans are going online to buy everything from shoes to avocados — with many of their purchases delivered the same day. As a result, the transportation network is being used in ways not anticipated before.

"With this huge increase in e-commerce, delivery hubs are being moved closer to urban areas, so there's additional truck- and employee-related traffic. And, in a trend that is just beginning, independent contractors are being hired and using their personal vehicles to make home deliveries," explains Allan Rutter, head of TTI's Freight Mobility and Infrastructure Analysis Division. "All of it means an increase in daytime traffic near these hubs, but also in neighborhoods where the items are being delivered."

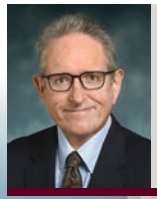
> **"It's clear that planning and operating our transportation system will have to evolve to meet the needs of consumers," explains Allan Rutter, head of TTI's Freight Mobility and Infrastructure Analysis Division.**

The research, conducted by TTI's Transportation Policy Research Center, encourages legislators, local governments and transportation planners to "keep abreast of rapidly changing trends in retail growth in e-commerce, shorter shipping timelines, and use of express delivery services to replace shopping trips with delivery trips."

The project produced a report with TTI's research recommendations.

The report highlights the expansion of Texas express delivery services by Walmart and Amazon for typical warehouse items, but also by other industries for grocery, parcel, and meal/restaurant delivery services. Rutter and his coauthors point out that independent contractors using their personal vehicles are not required to register or meet the safety and operational requirements as other motor carriers.

"Policy makers will need to pay close attention to these changes in business patterns and driving patterns, as well as the regulatory differences for these delivery drivers," Rutter says. "It's clear that planning and operating our transportation system will have to evolve to meet the needs of consumers." ■



For more information, contact **Allan Rutter** at (972) 994-2205 or a-rutter@tti.tamu.edu.

Photo credit: Jeramey Lende/Shutterstock.com

TTI, Aruba Partner to Improve Bus Riding Experience

On July 20, TTI and Aruba, a Hewlett Packard Enterprise company, announced an exploratory transportation project to optimize traffic flows for bus ridership and use data analytics to improve navigation at Texas A&M University through Aruba Wireless and Data Analytics.

Texas A&M is one of the largest universities in the United States, with a College Station-based student population of 61,000, and a 5,200-acre campus. Like many large universities, navigating the campus can be challenging across a diverse mix of students, faculty, staff and visitors.

The project is taking place through the Campus Transportation Technology Initiative, which seeks to bring private-sector transportation innovation into the campus community to improve mobility, safety and quality of life. To track and monitor traffic flows related to bus ridership, Texas A&M deployed Aruba's outdoor access points for dense outdoor Wi-Fi coverage and location triangulation at the most-used bus stop on campus. For data analytics, TTI is using Aruba's Analytics and Location Engine, and Skyfii's cloud-based data visualization and analytics.

"Our primary goal is to examine the optimization of bus stops in the implementation area," said Robert Brydia, TTI senior research scientist. "If a high percentage of visitors move from the current stop location to other venues where there are spaces for transit stops, perhaps stop locations on routes should be adjusted. Our new data analytics will give us this information." ■

Statewide Safety Conference Unites Child Car Seat Technicians for Unique Gathering

Organized by TTI and Texas A&M Agrilife Extension and sponsored by the Texas Department of Transportation (TxDOT), the 2017 Texas Child Passenger Safety Conference was held July 10–12 in Richardson, Texas. Safety advocates, health care professionals, law enforcement officers, seat manufacturers, and nearly 300 child passenger safety technicians and instructors (CPSTIs) attended.

There are approximately 1,800 CPSTIs in Texas. Many CPSTIs conduct child seat checkups as part of their employment with hospitals, emergency medical services, TxDOT, Texas A&M Agrilife Extension offices and other groups; but many volunteer their time to educate families on the proper installation and use of car seats. CPSTIs are required to be recertified every two years.

"There are many confusing elements associated with proper child safety seat installation and use," says TTI Senior Research Scientist Katie Womack. "The car seat has to be matched to the child and the vehicle correctly." Manager of the Behavioral Research Group at TTI's Center for Transportation Safety, Womack is responsible for observational surveys to assess the safety belt and child restraint use rates for Texas.

Sessions featured health professionals, pioneers in the child passenger safety crusade, researchers and car seat manufacturers. Conference workshops and session topics included Working with Children with Special Needs, Preschool Transportation, Child Safety Seat Distribution and Education Program, Heat Stroke, and Car Seats and Crash Performance. ■

TTI Expert Briefs Cyber Campers on Self-Driving Vehicle Research

Mike Lukuc, head of TTI's Connected and Automated Transportation Group, introduced high school students attending this summer's Cyber Innovation Camp to the complexity and promise surrounding the advent of connected and automated vehicles.

TTI's Mike Lukuc shows cyber campers a video of his truck platooning project.

"There are about 35,000 deaths a year in the nation, and last year we had the largest increase in 50 years," Lukuc told the students. "Almost all 6 million crashes each year are related to driver error. That's really the reason the federal government and industry are looking at vehicle-to-vehicle communication and automation: to take away driver error."

This is the third year for the popular camp, presented by the Texas A&M Engineering Extension Service (TEEX) and funded by the Texas Workforce Commission's Governor's Summer Merit Program. It often attracts more applicants than there is space available, says TEEX Cybersecurity Training Coordinator Diane Cornwell.

"One of the goals of this camp is to introduce students to various careers in technology and engineering," Cornwell says. "Many students from previous camps say the program helped them decide what career path to pursue, including computer science or engineering." ■

WSP and TTI Partner to Advance Transportation Research

TTI and WSP USA — a leader in the design, deployment and operation of transportation systems in the United States, including intelligent transportation systems and connected and automated vehicle (CAV) technology — have signed a memorandum of understanding to jointly collaborate on creating a stronger connection between research and deployment of transportation systems management and operations, as well as CAV solutions.

"TTI and WSP have a long history of collaborating, beginning with the early development of high-occupancy vehicle lanes," says TTI Agency Director Greg Winfree. "We see similar opportunities with next-generation transportation technologies, such as CAVs."

Besides sharing expertise, the agreement encourages educational and mentoring opportunities by involving WSP in Texas A&M engineering class seminars and lectures, as well as sponsoring engineering capstone design projects. The agreement also provides opportunities for TTI and Texas A&M University engineering students to gain real-world experience on the day-to-day challenges facing leading transportation operations centers.

"Collaboration between leading researchers and everyday practitioners will help to better define needs for national and state-sponsored research, while helping agencies reflect the current state of the practice in their efforts," explains John Porcari, president of U.S. advisory services at WSP. ■

Winfree Participates in National Congressional Roundtable on CAV Policy

Winfree

U.S. Rep. Dan Lipinski invited TTI Agency Director Greg Winfree to participate in a connected and automated vehicle policy roundtable in Washington, D.C., July 26. The roundtable, titled The Road Ahead: Developing Policies to Make Connected and Automated Vehicles a Reality, focused on understanding crash risks, safety testing for assurance, and resolving crash liability for automated vehicles.

Comprised of national policy experts, the roundtable identified relevant issues and discussed collaborative solutions on issues including technology deployment, infrastructure requirements and vehicle cybersecurity.

"I'm pleased that TTI was invited to become a stakeholder in this important series of discussions that Rep. Lipinski has been convening across the country," says Winfree. "It's extraordinarily important that the legal and policy implications receive thorough analysis so that these technologies can be made available in a thoughtful manner to the traveling public." ■

FHWA Texas Division Staff Visit TTI

Seven staff members from the Federal Highway Administration (FHWA) Texas Division spent the day at TTI on July 26 to learn about current research initiatives and tour TTI laboratories. The group visited both the TTI Proving Grounds at The Texas A&M University System's RELLIS Campus and TTI's State Headquarters on the Texas A&M University campus. In addition to various TTI research initiatives, the visitors were able to see a Texas Department of Transportation–sponsored crash test of a pickup truck hitting a pinned concrete barrier. The device was being tested for compliance with the *Manual for Assessing Safety Hardware* standards.

"This was a valuable day and brought to light the depth and scope of world-class research and innovation going on at TTI," FHWA Texas Division Administrator Al Alonzi said. "FHWA's partnership with TTI gives me more confidence in the future of transportation." ■

FHWA staff members participating in the visit (left to right): Marcus Wilner, chief operating officer; Al Alonzi, division administrator; Mike Leary, director of planning and program development; Melanie Twehues, director of technical programs; Greg Punkse, District B engineer; Toni Whitfield, traffic operation/ intelligent transportation system engineer; and Donny Hamilton, director of finance and administration.

For more information about TTI News, contact **Rick Davenport** at (979) 862-3763 or r-davenport@tti.tamu.edu.

TTI, South Korean Transportation Agencies Sign Cooperative Agreements

On July 12, TTI signed a memorandum of agreement (MOA) with the Korea Transport Institute (KOTI). The five-year MOA recognizes each institute as a center of excellence that can benefit one another via collaboration. Robert Wunderlich, director of TTI's Center for Transportation Safety, and Dr. Choong Yeol Ye, chief director for global transport research for KOTI, will serve as coordinators for this effort.

"There are many areas of research, professional training and technical assistance that are of common interest to our two agencies," says TTI Assistant Research Engineer Myunghoon Ko.

Left to right: TTI Assistant Research Engineer and MOA facilitator Myunghoon Ko; TTI Graduate Assistant Dahye Lee; Head of KOTI's Electric Vehicle Research Kyuok Kim; Chief Director for Global Transport Research for KOTI Choong Yeol Ye; President of KOTI Chang Woon Lee; TTI Executive Associate Director Bill Stockton; TTI Associate Transportation Researcher Don Kang; and Director of the Center for Transportation Safety Robert Wunderlich.

TTI also signed a memorandum of understanding (MOU) with the Korea Agency for Infrastructure Technology Advancement (KAIA) on July 25. Part of the Korean Ministry of Land, Infrastructure and Transport, KAIA is responsible for research and development projects, technology valuation, and industrial promotion and commercialization.

"We are pleased to enter into an MOU with KAIA," notes TTI Executive Associate Director Katie Turnbull. "The MOU will lead to research cooperation on connected and automated vehicles, intelligent transportation systems, innovative services, autonomous vehicle test beds, and other advanced technology applications." ■

Dignitaries from KAIA and members of TTI's Executive Team celebrate the signing of an MOU between the two agencies.

New Textbook and Workshop Combine Science, Computational Analysis to Improve Pavements

TTI researchers recently published *Modeling and Design of Flexible Pavements and Materials,* a first-of-its-kind book that can potentially transform the pavement installation process. The approach emphasizes the use of computational modeling to create longer-lasting, less-costly pavements.

"We've combined the science associated with the chemical makeup and physical properties of all the components of asphalt with computational modeling to create a tool that can be used to build finite element algorithms," explains TTI Senior Research Engineer David Allen, director of the Center for Railway Research. "These algorithms can then be used to predict the performance of the roadway over time."

Allen co-authored the book with Dallas Little and Amit Bhasin. Little is a TTI senior research fellow, regent's professor and E. B. Snead Endowed Chair Professor in the Zachry Department of Civil Engineering at Texas A&M University. Bhasin is an associate professor at The University of Texas Department of Civil, Architectural and Environmental Engineering.

"In the first part of the book, Bhasin and I set the stage by examining the chemistry and physical properties of the various materials that make up asphalt, including additives, so that we can model them in Dr. Allen's sophisticated computational models," Little says.

The authors will share their method in a continuing education short course titled Computational Analysis and Design of Flexible Pavement on April 18–19 at the Mays Business School in Houston. ■

THE LAST STOP

with Greg Winfree, Agency Director

Accessibility May Be the Future's Most Precious Transportation Commodity

Hurricane Harvey's impact on the Texas Gulf Coast was widespread and overwhelming. Thousands of survivors lost their homes and possessions. But everyone I saw interviewed was thankful for what they still had, especially their lives and loved ones.

If extreme weather events can have a silver lining, perhaps it's to help us realize what really is important to us, what we tend to take for granted. Before Harvey, the greatest concern many Texans had about transportation infrastructure was how long they had to sit in bumper-to-bumper traffic. Following the hurricane, the precious commodity of accessibility — of victims to first responders and survivors to drinking water and shelter — made morning traffic jams seem like trivial things. Now, nearly two months later, the Texas Department of Transportation (TxDOT) is rebuilding the region's transportation infrastructure and reconnecting communities along the coast. Those hit hardest by Harvey are likely seeing their local roadways in a whole new light of appreciation.

The Texas A&M Transportation Institute (TTI) has partnered with TxDOT for nearly 70 years to enhance the safety, mobility and reliability of the state's transportation system. The trust and seamless interaction we've developed as partners were never more important than during Hurricane Harvey, when

Photo credit: MDay Photography/Shutterstock.com

TTI personnel continuously updated Houston's traffic management website, TranStar, accessed by over 1 million people and countless local and national news media during the event. Ensuring our infrastructure is as flexible and resilient as possible during extreme weather events must remain a priority moving forward.

Though I hope to see those flying cars from *The Jetsons* in my lifetime, it's fair to say we'll be utilizing surface transportation assets far into the future. Population growth will continue to expand urban communities, filling in the rural spaces between to form megaregions. In coming decades, city footprints will appear less like the signature skylines of Dallas and Houston and more like the nighttime images seen from space, where a whole region lights up the map well beyond the city limits sign.

As growth happens, we have two agendas related to infrastructure. To remain competitive in a global economy while improving safety and mobility at the local level, we have to refurbish crumbling assets built more than half a century ago. But for those facilities to meet our needs in the 21st century, we must incorporate advanced technologies such as connected and automated vehicles and smarter infrastructure to enhance connectivity between communities.

As we Texans do our part to rebuild our nation's transportation infrastructure, it's important to remember how vitally important that system of roads, airports, pipelines and ports is — to our daily lives as commuters, to the vitality of our economy in the international marketplace, and, most especially, to protecting our citizens during the worst of times. Working together to restore our Gulf Coast communities, let's resolve to never take our transportation system for granted — and to better appreciate all it enables us to do for ourselves, our communities and one another. ■

TEXAS TRANSPORTATION
Researcher 53.3
Texas A&M Transportation Institute/TTI Communications
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College Station, TX 77843-3135

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The Intelligent Transportation Society of Texas (ITS Texas) annual meeting brings together engineers, planners, government and industry for three days of informative training, technical sessions and presentations.

A highlight of this November's meeting: ITS Texas is sponsoring a cybersecurity-based training class aimed at professionals working with surface transportation systems. Cybersecurity is an increasingly important topic and is constantly changing as technologies evolve under competitive pressure. This course is intended to help transportation professionals improve their understanding of the subject, and offers useful tools for learning about cybersecurity and system resilience.

Also part of the meeting will be an update on the Texas Department of Transportation's Transportation Systems Management and Operations efforts, sessions on a wide range of ITS topics (from connected and automated vehicles to special events to ITS research), and updates from ITS America on national initiatives.

2017|HOUSTON

ITS TEXAS ANNUAL MEETING

November 8–10, 2017
Hilton Houston North
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