FY 19-20 **BIANNUAL REPORT**

Texas A&M Transportation Institute

Center for International Intelligent Transportation Research

El Paso, Texas

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Annual Report

A LETTER FROM THE DIRECTOR

Center for International Intelligent Transportation Research
Working Locally, Thinking Globally

2020: The year that's seen a world of changes. The spread of COVID-19 forced us to reexamine not only how we interact at a personal level, but also how we depend on our transportation system — particularly in terms of travel and the global supply chain. Ironically, the virus which necessitates social distancing has shown us just how much we depend on one another.

In that context, the research performed by the Center for International Intelligent Transportation Research (CIITR) has never been more relevant or essential. The border region — with its constant exchange of products and cross-border business and tourism — is especially vulnerable to the effects of COVID-19. This past year, CIITR researchers examined how cross-border transportation can affect the spread of COVID-19, as well as its effects on border communities.

CIITR's mission:

- maintain and improve **mobility** in the face of growing traffic and shrinking resources,
- increase border-crossing **efficiency** while maintaining security, and
- improve air quality to advance **public health**.

Store shelves were often bare in March and April, giving us a better appreciation for the vital nature of the international supply chain in getting goods to market. To help mitigate that impact over the long term, CIITR continued our ongoing research into how advanced technologies can facilitate border trade without compromising national security. For example, we studied how artificial intelligence and unmanned aerial vehicles can supplement more traditional measurement and monitoring practices at land ports of entry to determine more accurate wait times for both long-haul truckers and pedestrians.

In addition to the center's research initiatives, TTI's El Paso Research and Implementation Office conducted externally funded research, continuing to work with sponsors at all levels to transfer technology, document best practices and secure funding to improve existing transportation infrastructure or build new facilities. For example, the Texas Department of Transportation

(TxDOT) owns thousands of assets in its El Paso District that need regular maintenance; however, the condition of those assets (or even their locations) isn't always readily known. Using a GIS-based solution, center researchers developed a tool for the district to use in better accounting for assets; and that tool can be used in any TxDOT district for the same purpose. Regionally, we helped expand access to rural transit, firming up connections across different travel modes to improve access to essential services, like health care, at a time when those services are most needed.

At the municipal level, our folks made recommendations to the City of El Paso that can help prioritize pavement management projects to get the most maintenance bang for the taxpayers' buck. And our experts worked with local agencies to help them secure enhanced Better Utilizing Investments to Leverage Development federal grants to construct improved or all-new transportation facilities. Through the Federal Highway Administration's value-capture initiative, TTI El Paso program researchers also developed tools for local governments to use as they look for innovative funding sources in an era when dollars are tight but demand for transportation services is growing.

While we sometimes tend to think of our transportation system (local, regional, state and federal) as distinct, 2020 has shown us just how interconnected — and interdependent — the network really is. And like the county road that connects to the state highway that leads to the interstate, we all depend on each other to keep that system working. Challenging times like these — as we establish a "new normal" after COVID-19 — remind us of this fundamental fact. Put another way, the smallest research innovation developed at the local level can make a world of difference.

Rafael Aldrete, Ph.D.
Senior Research Scientist and
Director, Center for International
Intelligent Transportation Research

SAFETY

Safety and Mobility

El Paso is growing, and with that growth comes a need for improved mobility and congestion mitigation. Construction alone isn't the answer. CIITR's regional research focuses on more efficiently using the system we have, combined with smarter planning for growth and building out the local transportation network in a way that prioritizes safety.
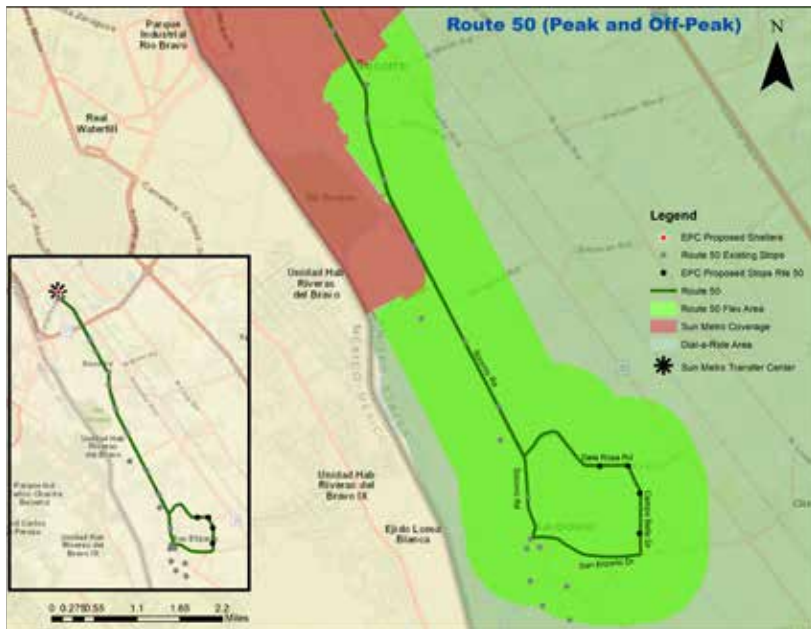
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Building the Case for Rural Transit Improvement Projects in El Paso County

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2020 Updates Improve Reporting Tool's Ease-of-Use for FHWA Reports on Route 50-Mission Trail Route

El Paso County (EPC) staff manages the rural transit route, Route 50-Mission Trail that provides service for EPC residents with low socio-economic status. The service is partially funded by the Federal Highway Administration (FHWA), so EPC staff reports monthly emission analysis estimates for the Route 50-Mission Trail fleet to FHWA and the El Paso Metropolitan Planning Organization (EPMPO) every year.

In a previous project from 2016, CIITR researchers developed an emission measuring and reporting tool for EPC staff to use in constructing monthly reports for FHWA and EPMPO. Each year, the researchers update the emission rates built into the model to ensure the tool provides accurate, timely results. This project's objective was to update the tool for the calendar year 2020.

In FY20, the team conducted an assessment and update of the tool, verifying that the tool includes all the data variables and information requeste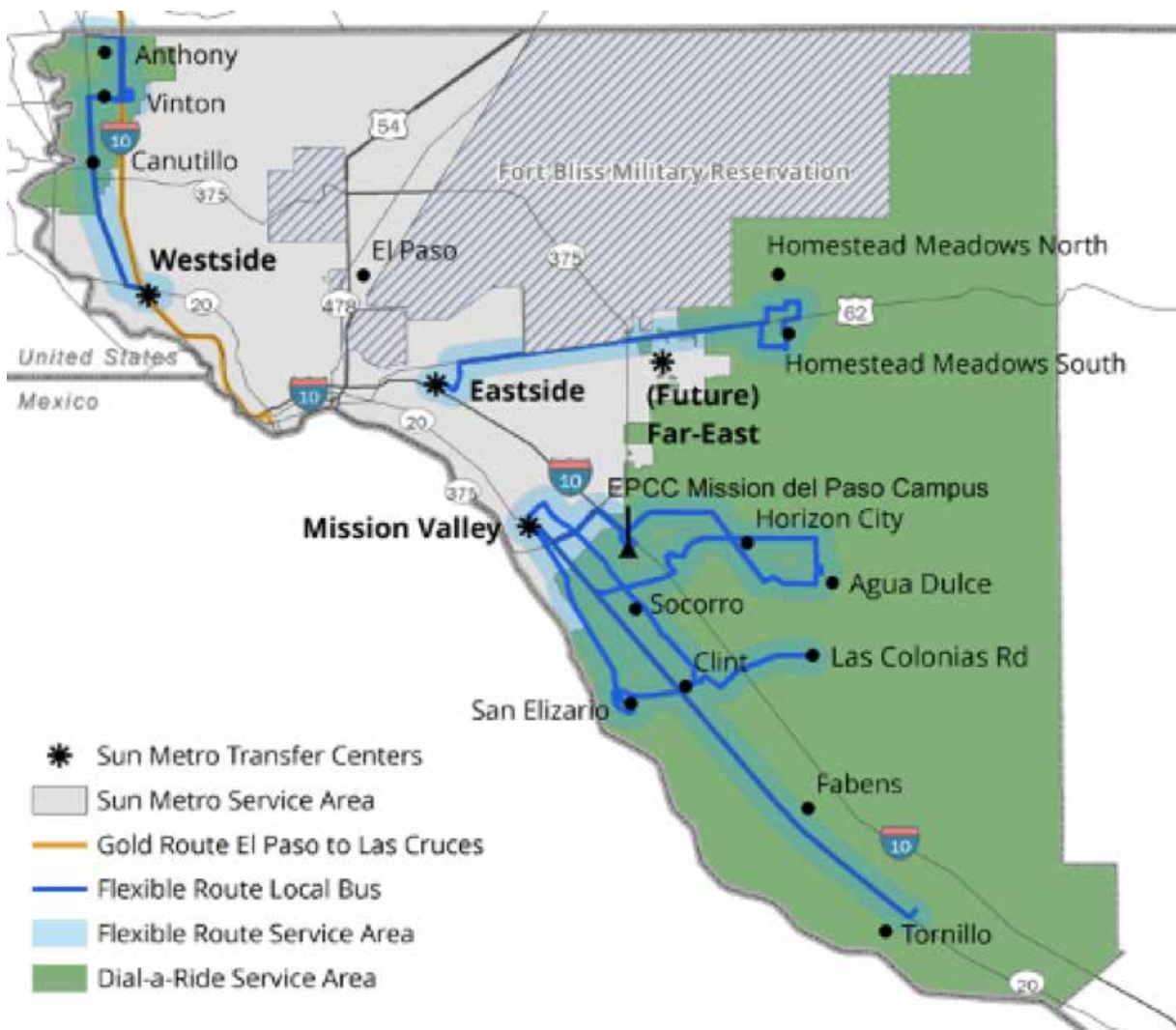d by FHWA and EPMPO for reporting emissions. They also built and ran an emissions model using EPC's most recent data and updated all the inputs in the reporting tool.

Updating the tool allows EPC staff to efficiently produce more accurate emissions reports to FHWA, facilitating meeting the agency's eligibility requirements, and EPMPO relevant to this year's data. More accurate, reliable reporting means maintaining federal funding, which in turn offers more resources to continue improving the mobility of transit riders in the county's rural communities.

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Legend:
- ✳ Sun Metro Transfer Centers
- ☐ Sun Metro Service Area
- — Gold Route El Paso to Las Cruces
- — Flexible Route Local Bus
- Flexible Route Service Area
- Dial-a-Ride Service Area

Building the Case for Rural Transit Improvement Projects in El Paso County

The El Paso County (EPC) Planning and Community Development Department wants to improve rural transit system efficiency through an improvement project in Horizon City, Vinton, Anthony, San Elizario, Clint, and Socorro. To accomplish that, EPC sought Congestion Mitigation and Air Quality Improvement (CMAQ) Program funding as part of the El Paso Metropolitan Planning Organization's (EPMPO's) call for projects.

The project seeks to produce a CMAQ air quality analysis and estimates for a rural transit improvement project located in the EPC region, as well as develop a report on the potential benefits of implementing the project. The research team summarized the CMAQ estimates in a final report, which was provided to the EPMPO, the Federal Highway Administration, and others.

Researchers divided the CMAQ analysis into two phases or scenarios. The first phase involved a short-term rural transit improvement scenario related to the EPC region; in the second phase, the team turned its attention to a long-term rural transit improvement scenario. The researchers also submitted a report outlining the benefits of these improvement projects.

Researchers estimated air quality benefits for implementing each scenario. In both scenarios, there was a reduction in pollutants including carbon monoxide (CO), oxides of nitrogen (NOx), volatile organic compounds (VOCs), and PM-10 (particulate matter 10 micrometers or less in diameter). The project's findings provide a base of research that EPC can use in proposing rural transit improvement projects for CMAQ funding.

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Inviting Discussion, Research into the Development of El Paso County Transit Planning Best Practices

Improving transit service and rural community mobility in El Paso County (EPC) starts with identifying transit needs, such as potential stop locations and route and service configurations. In a 2017 project, EPC engaged CI-ITR researchers to evaluate the possibility of implementing a countywide regional transit institutional authority. The next step is to research best practices and develop guidelines for improving the current transit level of service (LoS) and delivering efficient transit service to EPC residents.

The research team conducted analyzed the state-of-the-practice in peer research publications to catalog best practices for determining potential stop locations and route and service configurations for rural transit. From this research, the team crafted guidelines for the EPC staff to use in current and future planning.

CIITR researchers also facilitated discussions with current and potential EPC transit riders and other relevant stakeholders to ensure riders had a voice in defining their transit needs and interests. The team also had conversations with educational institutions and other community stakeholders to understand the pros and cons of implementing changes to the EPC rural transit system.

This project continues to assist EPC staff in enriching their transit planning process through an analysis of potential scenarios and changes to the transit system and how they might impact transit riders, stakeholders and the community. The information collected in the project offers a wealth of knowledge on how to improve LoS for EPC residents and improve mobility across the county and is further applicable in other communities with similar transit needs.

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A Method for Identifying and Prioritizing Rural Transit Improvement Projects in El Paso County

In rural areas, transit agencies often lack the resources to provide bus stops with benches and shelters. One way to mitigate this issue is to identify different bus stop types and prioritize where to make improvements. In El Paso County (EPC), for example, bus drivers do not stop at a designated bus stop location or shelter. Instead, passengers exit the bus by asking the driver to "stop" and enter the bus by flagging down the driver similar to a taxicab.

CIITR researchers developed guidelines and best practices to identify and prioritize potential bus shelter locations on rural transit routes. The team used project data gleaned from previous EPC projects and conducted a literature review on transit service design and bus stop locations. Using on-board data collection methods, the team recorded ridership travel behavior and patterns. Researchers also conducted public outreach activities — including community meetings, pop-up events, stakeholder meetings and a public survey — to gather anecdotal evidence of rider needs and preferences. They also developed a method for identifying

potential bus stop locations and accounting for potential issues (e.g., inclement weather, roadside right-of-way, utility conflicts, etc.) that might affect choice.

Using CIITR's recommendations, EPC staff can begin the strategic planning and development process for deciding where to build infrastructure improvements. More generally, project findings can guide rural transit agencies in how to set up a method for determining transit service improvement needs specific to them.

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Using Artificial Intelligence to Better Understand Pedestrian Travel

Re-identification (re-ID) methods — such as WiFi or Bluetooth® detection — have been used to better understand how pedestrians move from place to place. Although this approach has largely been accepted as accurate, there is no guarantee that the devices detected accurately represent pedestrian movements. Also, there is no way to guarantee one person is carrying only one device.

CIITR researchers investigated a way to vastly improve the reliability of re-ID using images from video footage. Leveraging the recent adaptation of deep learning and convolutional neural networks to deal with large-scale datasets, researchers are better able to process the vast amount of real-world data needed to train a working model to track pedestrians. Since supervised approaches are inherently fraught with reliability and efficiency problems, the research team investigated unsupervised approaches — used in cases where no labeled dataset exists or the input is unlikely to be repeated — that focus on extracting personal features from video images to differentiate pedestrians, first by batching pedestrians with similar features together, the differentiating them individually. Researchers tested different neural network approaches for post-processing video footage to extract better features that, in turn, improve results produced by the neural network's analysis.

Once perfected, approaches like this can help traffic management agencies better understand pedestrian origin-destination movements, allowing them to optimize resource allocation and improve customer service. Since this re-ID approach relies on feature identification instead of facial recognition, it does not pose traditional privacy issues.

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OPERATIONS
Traffic Operations

Advanced, intelligent transportation technologies hold the potential to vastly improve the efficiency and safety of our transportation network. Properly implementing those technologies in the coming decades will depend on accurately gathering and analyzing large amounts of traffic data from disparate sources. CIITR researchers are at the forefront of this research in the region.

IN THIS SECTION

**Cataloging the Status of CAV Technology
at the U.S.–Mexico Border**

**Using ITS and Automated Vehicle Technologies
to Achieve Cost and Time Benefits to Park,
Cross and Ride Behavior**

Cataloging the Status of CAV Technology at the U.S.–Mexico Border

Connected and autonomous vehicles (CAVs) are poised to disrupt the global transportation system through fewer crashes, shorter inter-vehicular headways (i.e., the distance between moving vehicles), and a more efficient travel environment. The primary difference between privately owned CAVs and commercial CAVs is that commercial CAVs spend a lot of time driving on long stretches of highway. In theory, this means automated trucks, for example, should have a simpler task in the simpler driving environment, making them very attractive to logistics companies and fleet operators.

CIITR researchers compiled information currently available related to CAVS in the border region, addressing aspects like 1) literature pertaining to CAVs at the border; 2) existing efforts to use CAVs at the border; 3) technology used by CAVs at the border; and 4) CAV applications at the border that could improve trade flow. Both public agencies responsible for regulating the national transportation system and private companies, like commercial distribution companies, can benefit from reviewing the white paper produced.

Using ITS and Automated Vehicle Technologies to Achieve Cost and Time Benefits to Park, Cross and Ride Behavior

Some people crossing the U.S.–Mexico border choose to park their car, walk across the border, and find a ride on the other side (called "park, cross and ride behavior"). International bridges linking the City of El Paso and Ciudad Juárez are crossed by more than 10 million pedestrians annually. Previous studies have not analyzed the cost and benefits of the park, cross and ride behavior.

The U.S. Department of Transportation C2SMART Tier 1 University Transportation Center (UTC) — along with The University of Texas at El Paso (a member of the C2SMART UTC) — funded a project to measure City of El Paso parking performance and better understand intelligent transportation system (ITS) applications. The researchers conducted a literature review of the international bridges as well as ITS and automated vehicle projections.

The project's first phase involved a cost-benefit analysis using scenarios to evaluate park, cross and ride behavior. In the second phase, CIITR researchers held project meetings and developed methods for measuring parking performance. As ITS and automated vehicle technologies become more ubiquitous, park, cross and ride behavior is expected to increase. This project evaluated the cost for parking, crossing the border, and taking a ride, as well as calculated time saved or lost. The project's results can serve as a base study for future studies evaluating non-traditional travel behaviors and their impacts on mobility.

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BORDER CROSSING
Border Crossing Efficiency

Trade, tourism, and international security— all depend on the efficient, safe, and thorough monitoring of cross-border traffic. CIITR researchers are evaluating advanced monitoring technologies—as well as facilitating communication among stakeholders from both countries—to ensure the secure, efficient movement of people and goods between the United States and Mexico.

IN THIS SECTION

Charting a History of Cross-Border Commodity Flow, Freight Traffic Trends

Exploring Alternative Methods for Estimating Traffic Volumes at the U.S.–Mexico Border

Implementing Pedestrian Detection Technologies to Improve Transit Planning at the U.S.–Mexico Border (FY19 and FY20)

Leveraging CV Technologies for Safer, More Efficient Vehicle Border Inspections (FY19–20)

**Moving from FAST to FASTER: Improving Border Shipment Planning, Efficiency**

Predicting Real and Hypothetical Economic Costs Associated with Border Crossing Delays and Operational Changes (FY19–20)

Testing a Short-Term Prediction Model for Crossing Times at the Ysleta-Zaragoza Land Port-of-Entry (FY19–20)

Using Drones and AI Algorithms to Better Estimate Crossing Times at the Border

Charting a History of Cross-Border Commodity Flow, Freight Traffic Trends
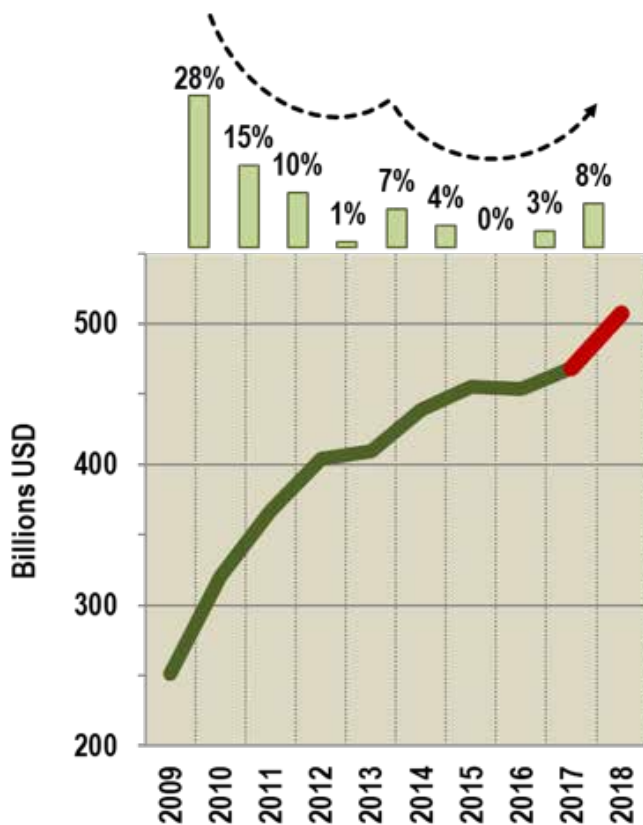
Trade gateways between the United States and Mexico include 25 land ports of entry (LPOEs) along the 1,969-mile border. Since 2009, CIITR has monitored freight activities at the LPOEs in Texas, California, Arizona, and New Mexico to better understand the movement of goods, the popularity of each LPOE with shippers, and the most frequently used transportation shipping modes. The center's 2019 research updates statistics and trends and identifies new relationships and potential anomalies in cross-border freight activities for 2018.

On a national scale, cross-border freight movement is an important indicator of the U.S. economy's health. A gradual inconsistent recovery of surface trade between Mexico and the United States followed the recession of 2008–2009. In the last two years, the value of traded goods increased significantly compared to 2016, when it did not grow at all. In 2018, surface trade increased by 8 percent compared to 2017, with 42 percent of the total surface trade with Mexico being exports, and 58 percent being imports. This is almost the same as the average distribution over the entire period from 2004 through 2017. Trucks remained the most important transport mode, contributing 84 percent of all goods movement compared to rail's 16 percent (import) and 14 percent (export).

Manufactured goods remained the highest-value commodities moved across the border. Other than Nogales, four of the top five ports — Otay Mesa, El Paso, Laredo, and Hidalgo — all experienced significant growth in manufactured goods trade. Texas remains the number-one trading partner with Mexico based on the value of its surface trade, with the highest growth in imports of any U.S. state.

Public agencies, commodity shippers, and manufacturers can use this research to help them predict future freight activities and plan resource allocations for border crossings. With more reliable data informing the planning process, goods movement can be more efficient and cost-effective, thereby reducing shipping costs and potentially passing those savings along to consumers.

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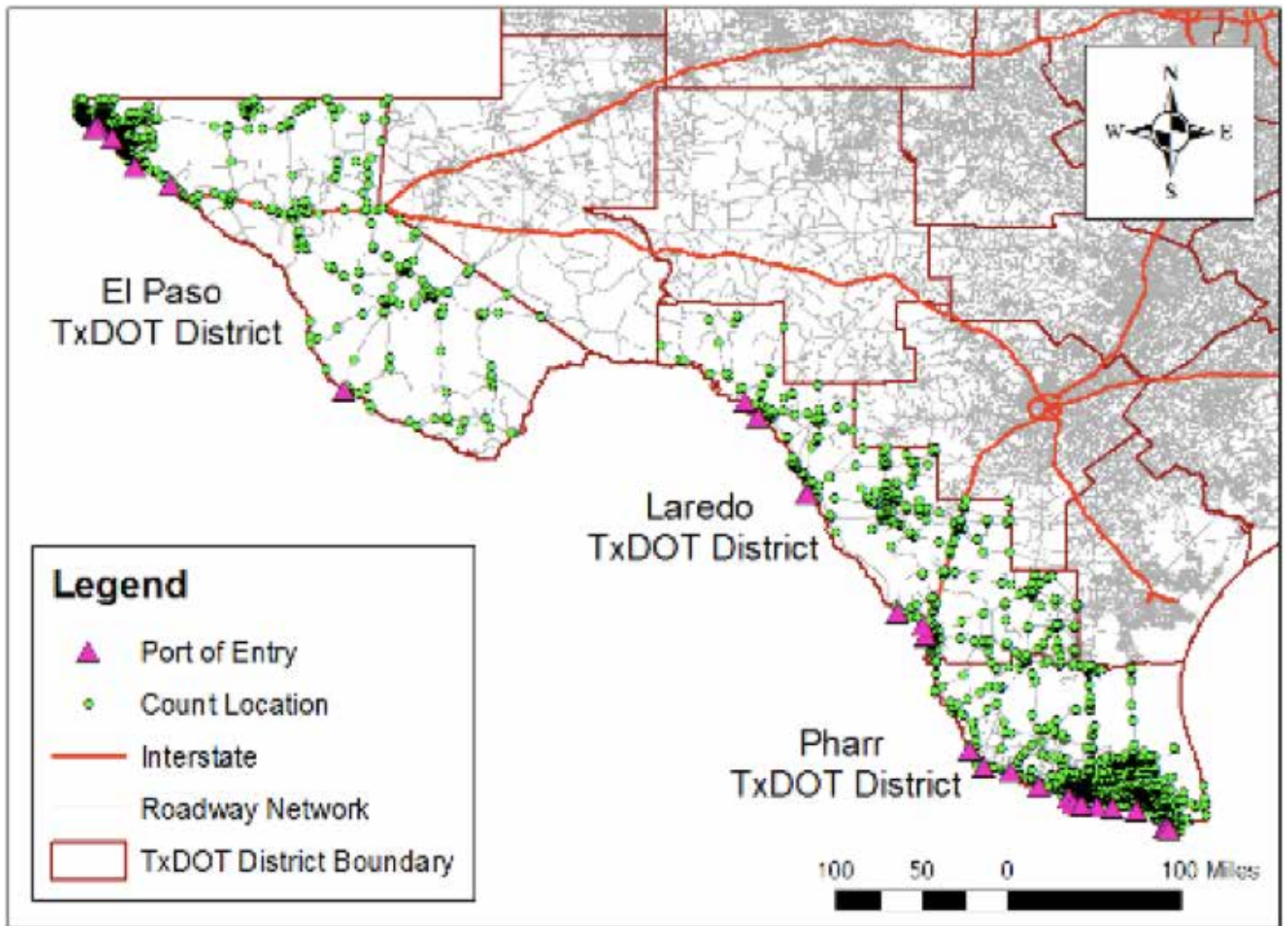
Exploring Alternative Methods for Estimating Traffic Volumes at the U.S.–Mexico Border

Traffic congestion at U.S.–Mexico border crossings can be significant, especially during peak travel times. Transportation agencies use traditional detection systems for traffic monitoring on the U.S. side of the border, though these systems are often expensive to buy, install, and manage.

CIITR researchers evaluated how accurate less expensive, alternative methods are in calculating annual average daily traffic (AADT) estimates for Texas–Mexico border crossings and along U.S. roads close to the borders. Determining their effectiveness required comparing data collected through alternative methods with traditionally data collected by state and local agencies in Texas.

StreetLight Data, Inc., a third-party data vendor, provided GPS data and AADT estimates relevant to the project's specified locations. The project involved 28 ports-of-entry between Texas and Mexico and more than

4,000 roadway locations in TxDOT districts near the border. The AADT estimates used in this project resulted in lower errors than the AADT estimates used in a project several years prior.\

As people further integrate mobile devices into their lives, data providers can improve traffic volume estimates by using these devices to gather data via alternative means. In turn, as data providers improve their methods, AADT estimates can become more accurate and useful to measuring traffic passing through border regions.

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Implementing Pedestrian Detection Technologies to Improve Transit Planning at the U.S.–Mexico Border (FY19 and FY20)

Commuters from Ciudad Juárez, Mexico, frequently walk to the bus stops in El Paso, Texas. Transit agencies and planning organizations in the Paso del Norte region are interested in how many pedestrians are crossing to get to one of these bus stops daily and what their walking distances are. Currently, there is no information on this pedestrian activity.

Researchers at CIITR developed a concept using wireless technologies to determine patterns in pedestrians crossing to use the El Paso transit system. They used media access control address scanners (a Wi-Fi sensor system with applications in intelligent transportation systems). The team tracked pedestrian activity between the Paso del Norte (PDN) Port of Entry and Sun Metro's Downtown Transfer Center, the busiest transit terminal in El Paso.

The project results estimate 10 percent of the total pedestrians at the PDN Port of Entry during Sun Metro's service hours came from Ciudad Juárez and rode a Sun Metro bus. Determining possible times, days, or seasons when pedestrians from Ciudad Juárez might ride an El Paso bus could lead to more efficient bus schedules, times, and costs.

Another project is under way to test other detection methods based on the lessons learned from the initial study. Testing will occur at other U.S.-Mexico ports of entry or other locations where there is a high concentration of pedestrians (e.g., shopping centers, bus terminals, and massive public events), making sure the researchers use COVID-19 safety precautions.

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Source: Geotab ELD Website

Leveraging CV Technologies for Safer, More Efficient Vehicle Border Inspections (FY19–20)

The Federal Motor Carrier Safety Administration and the Texas Department of Public Safety manually screen and perform random safety inspections on commercial traffic entering the United States. However, vehicle-to-infrastructure communication can potentially automate some of these activities as well as identify unsafe vehicles, improving motor carrier safety and efficiency at the border. Connected vehicle technologies had the potential to conduct electronic inspections (e-inspections) but the technologies were not mature enough to allow for meaningful implementation and demonstration at an international border port-of-entry.

The U.S. Department of Transportation is interested in e-inspections to improve the current manual process but not necessarily using traditional connected vehicle components. With the electronic logging device (ELD) mandate came a new opportunity for investigating additional functionality beyond monitoring driver hours of service. This project found that better leveraging traditional technologies together with future application of ELDs could help enforcement agencies conduct more efficient commercial vehicle safety inspections while reducing sometimes costly delays incurred by motor carriers crossing the U.S.–Mexico border. For the first time, agencies can receive advance information on approaching trucks, then provide opportunities to bypass standard inspection protocols and/or allow enforcement personnel a preview of several trucks in the queue at once to determine the level of inspection needed.

Meanwhile, the company Drivewyze is conducting a similar safety e-inspection demonstration (to that conceived by CIITR) in four northeastern U.S. states. Since Drivewyze has agreements with ELD manufacturers with devices in more than 60 percent of trucks utilizing ELDs, CIITR partnered with them to conduct the border demonstration. Researchers developed a test plan based on the experience and methodology used by Drivewyze to begin initial testing at the Texas A&M Transportation Institute's headquarters to prepare for the demonstration planned for 2021. This solution provides a unique opportunity to improve transportation safety and efficiency at U.S. ports of entry and beyond.

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Moving from FAST to FASTER: Improving Border Shipment Planning, Efficiency

After 9/11, U.S. and Mexico border agencies set up the Free and Secure Trade (FAST) program, which expedites the crossing of commercial vehicles with known, low-risk cargo moving from Canada or Mexico to the United States. However, border-crossing wait times are often unreliable. For example, the wait times range from 14 minutes to more than 100 minutes at the Ysleta-Zaragoza commercial land port-of-entry (LPOEs). CIITR researchers developed a Free and Secure Trade with Enhanced Reliability (FASTER) framework that can improve crossing time reliability at commercial LPOEs. Researchers worked with stakeholders on identifying demand management strategies and evaluated the strategies regarding their potential for improving crossing time reliability.

With the FASTER framework, shipping companies can better predict how long it'll take to cross the border, ensuring cargo arrives at its destination on time. On the U.S. side of the border, companies receiving the shipments can achieved increases efficiencies by more accurately predicting when a shipment will arrive from.

U.S. Customs and Border Protection (CBP) and Aduanas (a Mexican customs agency) can also benefit from implementing the FASTER framework by better optimizing staff assignments and LPOE capacity, which in turn saves money and resources.

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Predicting Real and Hypothetical Economic Costs Associated with Border Crossing Delays and Operational Changes

Required security inspections and increased truck traffic at U.S.–Mexico ports of entry (POEs) create disruptive delays costly to manufacturers, shippers and, ultimately, consumers. With current information on traffic conditions, wait times, and the economic costs of delays, shippers can more efficiently move goods across the border, potentially passing supply chain savings on to consumers.

In 2019 — and building on earlier research efforts that developed a framework and dashboard for estimating the direct costs associated with POE delays — CIITR researchers successfully created a web-based prototype application to estimate the economic impact of such delays. The app uses real-time commercial vehicle and traffic volume data, and interfaces with the Federal Highway Administration/Texas Department of Transportation-sponsored Border Crossing Information System in real time. The app format enables end users to determine the real-time economic costs of border delays at El Paso-Juarez regional POEs.

During the second quarter of 2019, stakeholders (including legislators and the media) inquired about the economic impact of excessive delays caused by inspection staff shortages at the U.S.–Mexico border, as well as the potential impact of closing selected ports of entry (POEs). Because the app CIITR developed only works with real-time data, it could not an-

swer the hypothetical questions the stakeholders asked regarding the economic costs of

- Closing the Bridge of the Americas POE for half day;
- Increasing border crossing times by three hours;
- Changing U.S. Customs and Border Protection staffing levels at primary inspection facilities ; and
- Changing demands at POEs.

To answer these "what if" scenarios, CIITR built on its previous innovation to develop a new tool in FY20. The Border Operations Scenario Economic Impact Evaluation Tool allows users to evaluate scenarios affecting operational processes at commercial POEs and is powered by the economic impact estimation dashboard engine developed in 2019 to compute the economic cost of delays. With the new tool, CIITR can now project the potential economic costs associated with delays affecting commercial operations at El Paso-Ciudad Juárez regional POEs.

Testing a Short-Term Prediction Model for Crossing Times at the Ysleta-Zaragoza Land Port-of-Entry (FY19–20)

Crossing time is the time it takes a vehicle to travel from the start of the queue at a land port-of-entry (LPOE) to the end. Several LPOEs in Texas use re-identification-based systems to estimate crossing times for commercial and passenger vehicles. These systems pick up radio frequencies from commercial vehicles and Bluetooth® or Wi-Fi from passenger vehicles to measure crossing times (at the time vehicles exit the LPOE). However, the crossing time experienced by a vehicle that just left the LPOE is not necessarily the crossing time that a vehicle entering the LPOE will experience (traffic volumes vary). Thus, a need exists to provide vehicles arriving at the LPOE with more accurate crossing times using short-term prediction models.

CIITR researchers installed LED sensors, which measure the number of vehicles entering and exiting the LPOE in real time, at the Ysleta-Zaragoza commercial LPOE. The team also identified new data sources that provide insights into LPOE traffic operations, such as the average daily processing time (per hour) at U.S. Customs and Border Protection (CBP) inspection booths and the number of open lanes at CBP primary inspection booths.

With these new data sources and LED sensors, researchers developed a crossing time short-term prediction algorithm model — currently in testing — for the Ysleta-Zaragoza commercial LPOE. This model can better inform commercial vehicles about crossing times they can expect at the LPOE, improving shipping time reliability.

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Using Drones and AI Algorithms to Better Estimate Crossing Times at the Border

El Paso-Juarez border ports of entry (POEs) are a critical link in the supply chain for transporting goods using semi-trucks. Occasional, extreme changes in border crossing flows have caused crossing times for trucks to become so long that queues exceed the reach of traditional technology (e.g., Bluetooth®, WiFi, and RFID sensors) to accurately estimate crossing times. Inaccurate border crossing time estimates are the result, and those unreliable estimates 1) create costly delays for shippers and manufacturers attempting to get goods to market and 2) inconvenience casual cross-border travelers (e.g., tourists).

Recent advances in unmanned aerial vehicle (UAV), or drone, technology have shown promise for effectively supplementing these traditional data-gathering methods. CIITR researchers studied using UAVs, which are not limited by geography, to capture imagery that is then analyzed by artificial intelligence (AI) tools to more accurately estimate crossing times for traffic in extremely long queues. To test this theory, researchers used UAVs to collect video from slow-moving traffic at El Paso regional intersections and applied AI image recognition algorithms to identify individual vehicles and movement patterns. In the process, researchers developed aerial video shooting guidelines (to ensure accurate image recognition) and documented the process and documentation required to comply with complex international, federal, state, and local regulations to conduct UAV flights at an international border location.

The study showed that AI image recognition algorithms could be successfully applied on UAV-generated imagery to determine movement patterns and speeds. The findings support using the UAV/AI estimation method to more accurately predict crossing times for excessively long traffic queues and at a relatively low cost. Simple, viable, and cost effective, the use of UAVs to improve the accuracy of long-queue estimates not only has the potential to reduce inconvenience for causal travelers and save shipping costs for manufacturers, but also to potentially provide consumer savings as those lower shipping costs are passed along on store shelves.

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EL PASO

El Paso Regional Support

CIITR is helping local stakeholders like the El Paso Metropolitan Planning Organization, the County of El Paso, the City of El Paso, and Sun Metro create a more reliable transportation system on both sides of the border as the economies of El Paso and its sister city in Mexico, Ciudad Juárez, grow more interdependent.

IN THIS SECTION

Calculating Cost-Benefit for Proposed El Paso Infrastructure Improvements (FY19–20)

New Online Inventory System for Recording Roadway Assets Using COTS Solutions

New Rapid, Reliable Method and Software for Aligning Speed Signage on Horizontal Curves

One-Stop Shop for Transportation Asset Management Tracking Online

Providing El Paso with a Pavement Recovery and Maintenance Plan

Calculating Cost-Benefit for Proposed El Paso Infrastructure Improvements (FY19–20)

Known as the Better Utilizing Investments to Leverage Development (or "BUILD Transportation grants") program, the U.S. Consolidated Appropriations Acts of 2019 and 2020 established funds to be awarded by the U.S. Department of Transportation for local agencies to spend in enhanced the national transportation infrastructure. The City of El Paso contracted with the Texas A&M Transportation Institute (TTI) in both years to conduct benefit-cost analyses (BCAs) to determine the value accrued to the city for investing in several infrastructure improvement projects.

In 2019, TTI conducted a BCA for constructing a bridge over a green belt levee that would include four driving lanes, two shoulder lanes, two bike and hike lanes, and a 700-space parking garage. In 2020, TTI evaluated the return on investment for two separate initiatives: 1) building a Medical Center of the Americas Transit Terminal and Parking Garage and 2) building the Piedras Corridor Project aimed at improving connectivity between I-10 gateways in downtown El Paso and Piedras Street in central

El Paso. In each case, TTI provided benefit calculations using the latest available FY dollars as a baseline, projecting potential cost savings over a 20-year period. Benefits were detailed in terms of safety enhancements, infrastructure improvement advantages, vehicle operational cost savings, environmental cost savings, residual land values, and maintenance and operational cost savings accrued over time. In all cases, TTI's infrastructure investment experts were able to provide reliable, data-driven guidance to city officials to help them make sound fiscal decisions regarding what improvements to prioritize.

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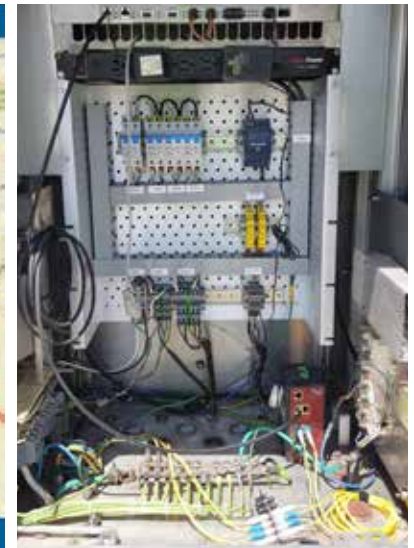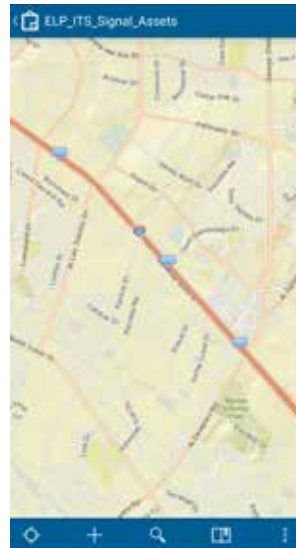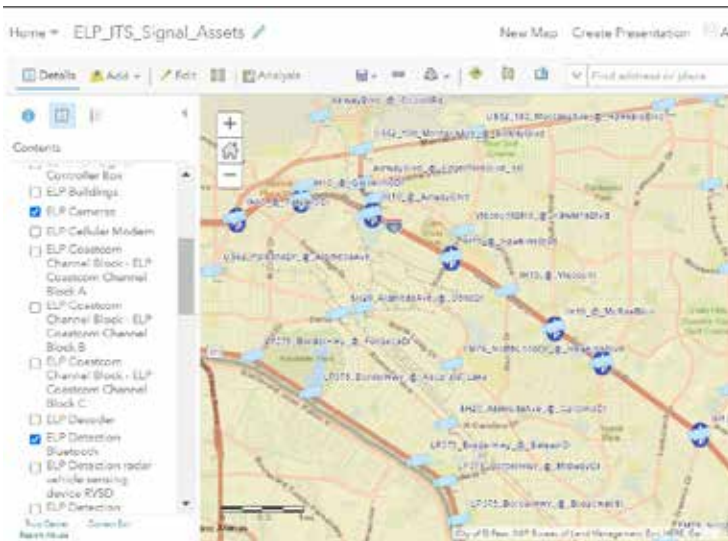
New Online Inventory System for Recording Roadway Assets Using COTS Solutions

The Texas Department of Transportation's (TxDOT's) Information Management Division (IMD) requested that all TxDOT districts develop an intensive intelligent transportation system (ITS) assets inventory, so the El Paso District asked CIITR for help in doing so. After evaluating several geographic information system (GIS) technologies, researchers chose ArcGIS Online because it allows online map development. Another benefit of this software: the data may be added, revised, or viewed using two complementary mobile applications.
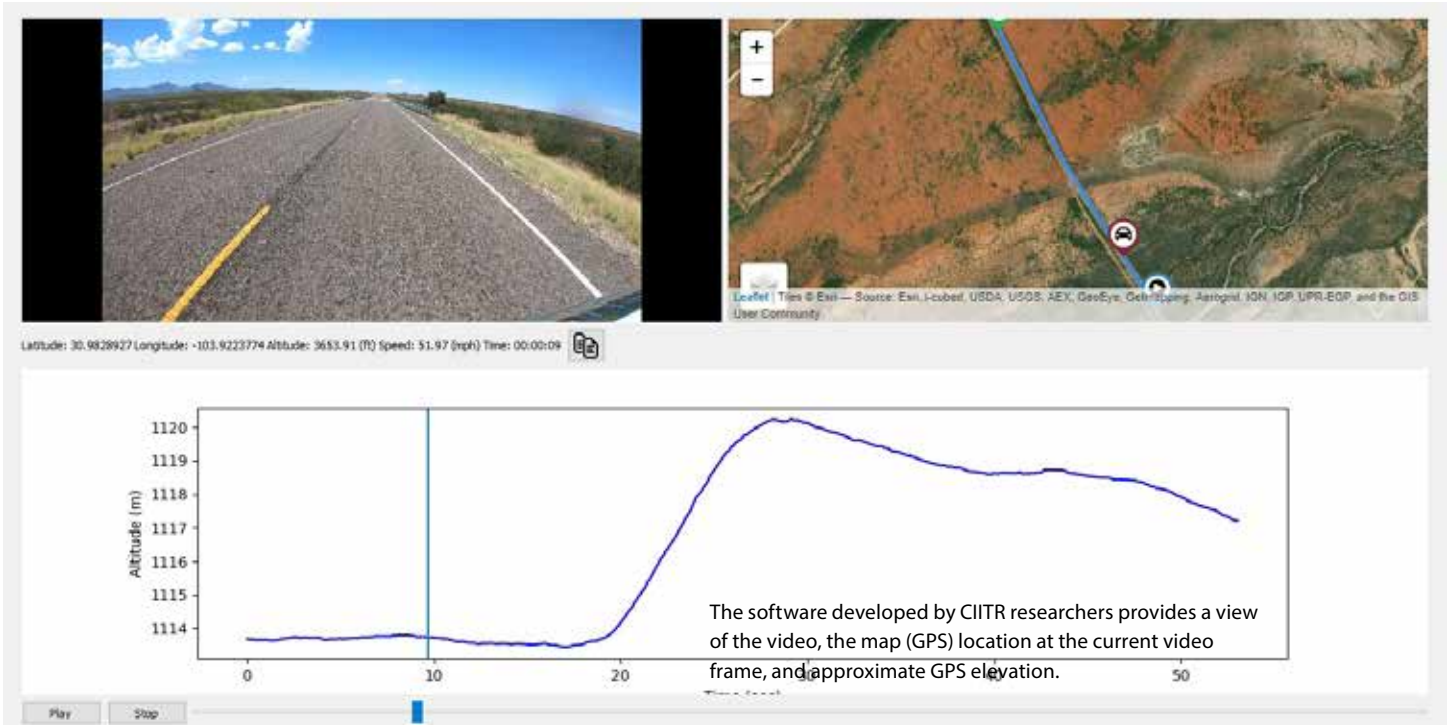
CIITR used El Paso's existing spreadsheet-based inventory containing information on various assets to populate the GIS asset map. The team developed a map layer for each asset type, and IMD provided attribute templates to maintain TxDOT GIS map standards. Using the mobile application ESRI Collector, CIITR and TxDOT worked together in the field to capture asset data the district had not yet gathered. The information collected included global positing system (GPS) location, asset specific information (e.g., asset model, IP address), and photos of the asset.

The now-complete ITS inventory provides the El Paso District with an exhaustive accounting of its assets. The online format — as well as the ease for updating and constant connectivity of the data via mobile application — allows for the convenient sharing of asset data across the district and through TxDOT. The format and data entry approach using the app also enables multiple personnel to keep the data updated while ensuring consistency of format and attributes captured using IMD's template. Finally, the GIS data format provides visual recognition of the asset location that a simple spreadsheet cannot, enabling the quick identification of any gaps that may exist on a facility and improving TxDOT's future ITS planning capability with better baseline data of current assets and their conditions/locations.

FOR MORE INFORMATION

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The software developed by CIITR researchers provides a view of the video, the map (GPS) location at the current video frame, and approximate GPS elevation.

New Rapid, Reliable Method and Software for Aligning Speed Signage on Horizontal Curves

To make highways safer, the Texas Department of Transportation (TxDOT) requested that districts to optimize speed advisory signage on horizontal curves throughout its districts. The El Paso District asked CIITR researchers to determine the best methodology to identify horizontal curves with a high difference between tangent road segment speed limits and curvature advisory speeds.

Researchers studied several methods to identify the most viable method to determine curvature advisory speed. One method comes from the Horizontal Curve Evaluation Handbook recently developed by the Texas A&M Transportation Institute (TTI) and involves using software to record sensor data from an electronic ball-bank indication and a GPS unit. The TTI team drove the entire six-county El Paso state highway system to collect curvature data, then loaded the raw data into a prepared spreadsheet that calculates various curve data, including advisory speed. Video of the roadway with GPS attributes was taken simultaneously with the curve data. The curvature data also included GPS data, used to develop a GIS map of curve locations. CIITR then developed software to assist in locating the existing curvature signage recorded by the video.

The long-term benefits of this project include identifying curves that need revised curvature signage based on the unique, calculated advisory speed for each curve. Capturing the GIS data enabled the development of several layers of the same data using different filters, which identify worst cases; curves with highest differences of their advisory speeds; and their respective tangent speed limit. These same layers will work as a checklist as signage improvements are made and inventory data is updated. Other TxDOT districts (and, indeed, other agencies) can use this software and video-capture method in other situations where curvatures signage and calculated advisory speeds need to be better aligned.
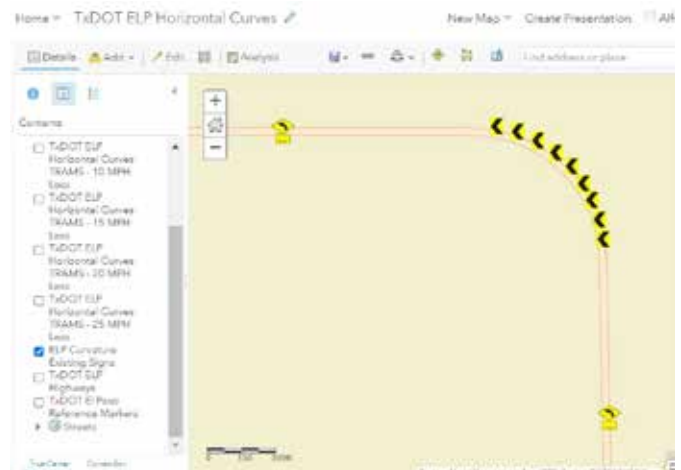
FOR MORE INFORMATION

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Sponsor: TxDOT El Paso District
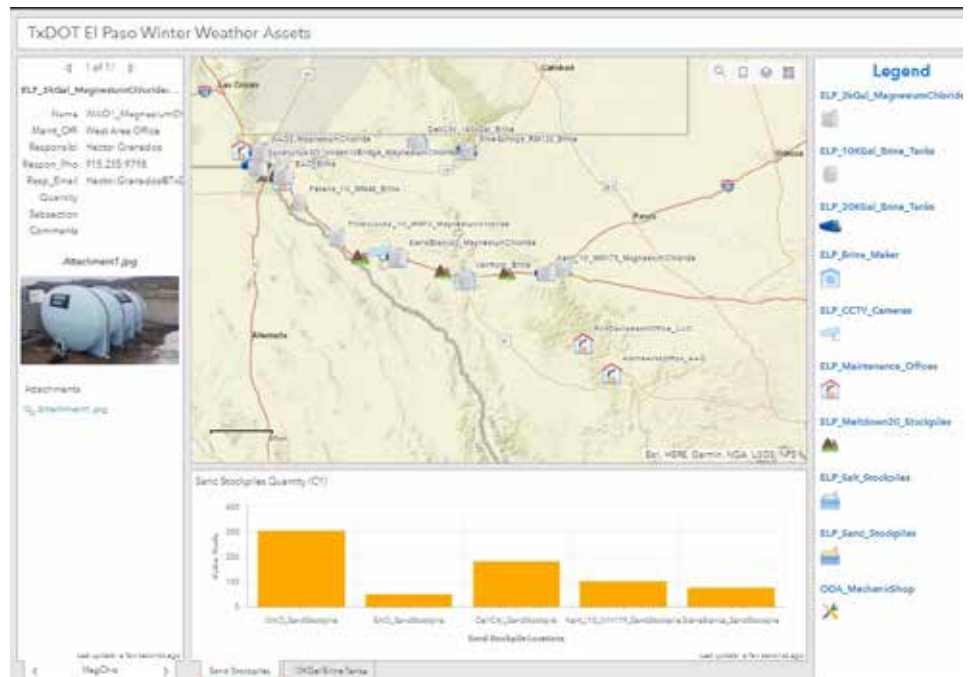
The CIITR team located assets like these: the left image shows the locations of the winter weather assets at the West Area Maintenance Office in northeast El Paso, Texas; the bottom image shows a photo of one of the salt asset locations.

One-Stop Shop for Transportation Asset Management Tracking Online

The Texas Department of Transportation (TxDOT) El Paso District has winter weather assets (e.g., salt, sand, brine, etc.) located across its six counties. TxDOT requested that Texas A&M Transportation Institute (TTI) researchers study how best to track these assets.

Of the options considered, including Google Earth, ArcGIS Online proved the best choice. The research team coordinated with district personnel to identify all winter weather assets and their locations. Researchers then drove to each site, capturing the geolocation and photo of each asset via the ESRI Collector mobile app.

Knowing exactly where these assets are is critical for TxDOT maintenance staff that handle winter weather events. The TTI solution provides access to a single, current database of assets, with the location and an image of each asset in its last known state. Another advantage of the asset inventory is the ability to access it online in a map format, with each asset as-

signed attributes including who is in charge of it, its maintenance requirements, its proper distribution rates, etc. Having all the info available in one data record is particularly helpful to new field employees unfamiliar with the assets. Now, they literally have access to every asset in the district on their smartphones or laptops.

To enhance user-friendliness of the solution, CIITR personnel developed a dashboard to use in accessing the information via the Internet. The dashboard and methodology for recording asset information can be easily translated to other districts or departments of transportation nationwide.

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Providing El Paso with a Pavement Recovery and Maintenance Plan

In recent years, the City of El Paso has undertaken to improve its regional mobility by optimizing and connecting different travel modes (e.g., transit, biking, pedestrian travel). In 2018, the city identified 25 major roads needing significant maintenance. These roads became the initial focus of a comprehensive recovery plan aimed at improving city streets. City engineers turned to the Texas A&M Transportation Institute (TTI) to review current operations, such as automated distress data collection techniques, and to verify the reliability of current practices. TTI was also asked to provide guidance in establishing a long-term maintenance plan, a process which included analyzing the city's proposed pavement maintenance management strategies to identify potential improvements by comparing El Paso's approach to those of peer cities.

TTI researchers reviewed El Paso's maintenance practices, including conducting manual re-inspection of roadways with differing pavement condition index values to determine if differences actually exist. The team also reviewed the city's new pavement inventory and proposed new pavement maintenance management strategies by working with city staff on a revised prioritization methodology. TTI presented its findings and recommendations with the El Paso City Council, detailing the principles behind pavement management; how refurbishment principles can prioritize maintenance projects; and budgeting techniques to get the most bang for the city's maintenance buck. With its newly optimized maintenance methodology, the City of El Paso can stretch taxpayer dollars to meet its larger vision of synergizing disconnected travel modes across the region.

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NATIONAL
National Research Initiatives

Transferring technology and best practices developed from state and local research projects to the national level is a priority for CIITR. A principal focus in this biannual period has been lending the Federal Highway Administration center staff's expertise in the use of value capture techniques as a funding mechanism to help deliver transportation improvement projects.

IN THIS SECTION

Encouraging Local Transportation Finance Solutions Nationwide via FHWA's Technical Working Group

Encouraging Local Transportation Finance Solutions Nationwide via FHWA's Technical Working Group

The Federal Highway Administration (FHWA) is implementing an initiative Every Day Counts 5 (EDC-5) innovation initiative to increase the use of value capture (VC) techniques to help deliver highway projects. VC funds infrastructure improvements by recovering a portion of the increase in real property value generated by the improvements, mitigating transportation project funding challenges while providing benefits to property owners.

Since 2018, TTI Senior Research Scientist Rafael Aldrete has supported FHWA's EDC-5 Value Capture innovation initiative through a contract with the USDOT Volpe Center. He continues to lend his expertise to the FHWA Value Capture Implementation Team, which provides technical assistance to state and local highway agencies implementing VC funding mechanisms. In December 2019, Aldrete assisted in organizing and facilitating a two-day VC peer exchange workshop attended by more than 40 local government public works and transportation officials and Texas Department of Transportation (TxDOT) districts. The workshop included presentations on successful VC techniques used in Texas and Arizona. He recently assisted in developing a set of frequently asked questions for practitioners and policy-makers on several transportation value capture techniques, including transportation reinvestment zones; tax increment reinvestment zones and tax increment financing; and transportation corporations.
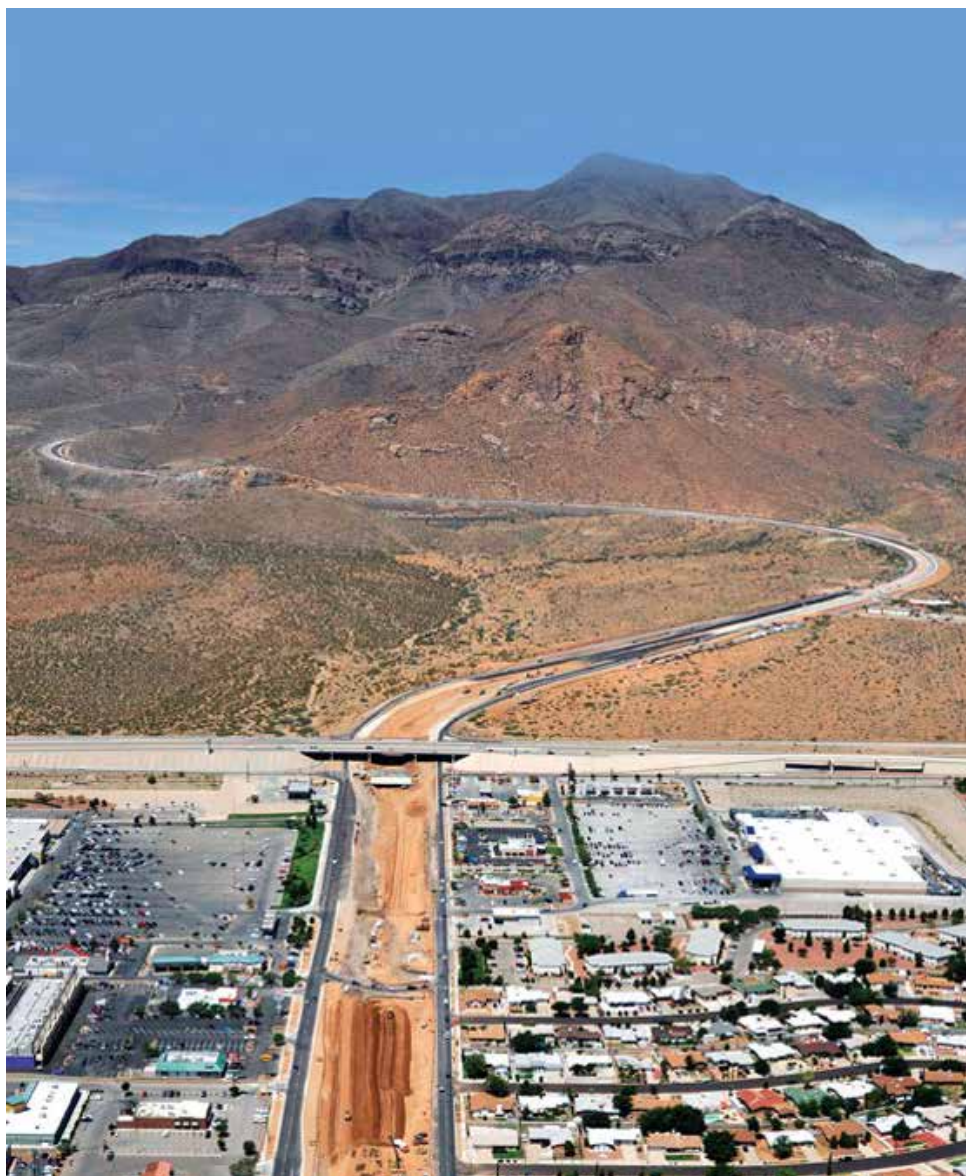
A nation's economic health is tied directly to the efficiency and reliability of its transportation network. As the U.S. transportation infrastructure continues to age, innovative financing techniques such as value capture are vital to bringing the national transportation network up to par. Technology transfer initiatives by experts like Aldrete can help state and local agencies leverage VC's benefits to improve their leg of the network, thereby encouraging the nation's future healthy economic development.

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INTERNATIONAL

International Research Initiatives

The significant contributions of TTI's Center for International Intelligent Transportation Research are made possible through the support, dedication and expertise of our many partners.

IN THIS SECTION

Anticipating USMCA Impacts on Energy Trade and Border Crossing Logistics

Keeping Communities Healthy by Understanding Transportation Is a Disease Vector

Anticipating USMCA Impacts on Energy Trade and Border Crossing Logistics

Texas is a major energy producer in the United States; Mexico is the U.S.'s largest importer of refined petroleum products. While the U.S.–Mexico-Canada Agreement (USMCA) will impact energy trade between the United States and Mexico, the impact has not been estimated in full, especially related to transportation and logistics at border crossings such as Texas–Mexico border crossings.

CIITR researchers conducted a big-picture study to assess the USMCA's effects on energy trade between the United States and Mexico. Additionally, they focused in on the potential implications for transportation and logistics at border crossings.

The first phase of the project included a literature review and logistics scenario development at border crossings. The second phase of the project involved a quantitative analysis of potential changes at border crossings. The literature review reveals the difficulty in predicting the USMCA's impact on transportation at border crossings. However, Mexico's oil and gas imports are expected to increase, which could lead to expanded trade between the United States and Mexico. The project is currently in scenario development (project phase one).

Beyond providing a deeper understanding of the U.S.–Mexico energy trade relationship, the project's results could improve interaction broadly between energy and transportation, two strongly related sectors important in legislative and business decision-making. Assessing the USMCA's potential implications for border crossings can make policymakers and businesses into smart, informed stewards of where to anticipate changes and allocate funding.

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Keeping Communities Healthy by Understanding Transportation Is a Disease Vector

Transportation is considered a vector for the spread of COVID-19. The pandemic's impact has proven mitigated in countries limiting non-essential travel and recommending citizens stay at home where possible. Studying these safety measures in the El Paso–Ciudad Juárez region is a way of further mitigating the impact of transportation in spreading the disease, especially in anticipating potential additional waves.

The project sought to provide a data-driven understanding of the relationship between cross-border transportation and the speed of spreading disease in bi-national metropolitan areas, such as El Paso–Ciudad Juárez. Researchers began with a literature review of previous similar outbreaks (e.g., SARS, MERS, and EBOLA), as well as international practices and technology applications.

After collecting data, the center's researchers developed models for the U.S. and Mexican sides of the border. The models show how factors, such as number of daily public transit passengers or land border cross-ings, might impact the spread of COVID-19. The research team identified technologies and strategies to measure, track, and mitigate the speed of spreading COVID-19.

Preliminary findings report that, if a U.S. county or Mexico state shares a border, the region is more likely to have a higher spread of COVID-19. This project can provide a better understanding on which measures might be more effective against COVID-19, while facilitating border mobility, in case of additional waves. Keeping informed on how transportation can act as a vector for spreading COVID-19 and other diseases can inform transportation planning and help communities stay as healthy and safe as possible.

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The significant contributions of TTI's

Center for International Intelligent

Transportation Research are made

possible through the support, dedication

and expertise of our many partners.

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Madrid Polytechnic University (Spain)
Mexican Red Cross
Mexico's Secretaria de Comunicaciones y Transportes
    (SCT)
Municipality of Ciudad Juárez

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