



Program Progress Performance Report

Submitted to: U.S. Department of Transportation
Office of the Assistant Secretary for Transportation and Research (OST-R)

Federal Grant: #DTRT12-G-UTC06

Project Title: Southwest Region University Transportation Center (SWUTC)

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Submission Date: October 1, 2016

DUNS Number: 93-848-5539

EIN Number: 74-2270624

Recipient Organization: Texas A&M Transportation Institute
Texas A&M University System
3135 TAMU
College Station, TX 77843-3135

Recipient Identifying Number: 600451

Grant Period: January 1, 2012 – September 30, 2016

Reporting Period End Date: September 30, 2016

Report Term: Semi-annual – January 1, 2016 – September 30, 2016
FINAL

Melissa S Tooley

Melissa Tooley - Director

1. Accomplishments:

SWUTC Goals as stated in *SWUTC Prospectus* – to produce research, education and workforce development and technology transfer initiatives that serve the needs of Region 6 and support the five strategic goals of USDOT.

SWUTC Goal #1: Research Program

With this grant, SWUTC's research program will build on historical accomplishments, and make fundamental strides in basic and advanced research that will be implementable by operating agencies responsible for improving accessibility and mobility while reducing congestion in our urban transportation systems; provide infrastructure renewal; harmonize freight movements between Canada, U.S. and Mexico; reduce the bottlenecks while improving the technology and linkages among the freight and passenger modes in the intermodal transportation network; improve the livability of our rural and urban neighborhoods; and contribute to improvements in the overall safety of the transportation enterprise in our region and nation.

Completed Research Project Accomplishments/Dissemination of Results for this Reporting Period:

◆ SWUTC Project #600451-00049: A Synthesis Report of Purpose and Need: Assessment of Event Egress for Houston's NRG Stadium - Given advances in technology from the perspective of handheld devices and traffic management software, this effort reexamined protocol and strategies to determine whether an opportunity exists to facilitate or streamline egress at large area events, specifically looking at NRG Stadium in Houston. This work produced a symposium which convened Stakeholders familiar with NRG stadium in Houston, Texas. The symposium, held in December 3, 2015 detailed concepts to potentially improve egress, particularly in consideration of Super Bowl XLIX to be held at NRG in 2017. Participants in at the symposium included representatives of the City of Houston, Harris County, Texas Department of Transportation (TxDOT), Houston TranStar and the Houston Livestock Show and Rodeo.

Research results disseminated through:

- Final Report: A Synthesis Report of Purpose and Need: Assessment of Event Egress for Houston's NRG Stadium, Carol Abel Lewis, Latissha Clark, Velyjha Southern, Texas Southern University (TSU), December, 2015.
- Symposium Conducted: Citation in Products Section of this PPR.

◆ SWUTC Project #600451-00050: Intercity and High Speed Rail Passenger Distribution – The Texas Central Partners are in the process of developing a high speed rail line connecting Houston and Dallas, Texas. Ultimately, plans are for 8 car trains that accommodate 200 people per vehicle scheduled every 30 minutes. In addition, Texas Department of Transportation (TxDOT) and officials in Austin, Houston and San Antonio are investigating intercity (interregional) rail to provide frequent rail service linking those cities. After arriving, passengers will need disbursement throughout the cities from the rail terminal station. The menu of options includes passenger pick-up (private by a friend or relative, or purchased through a provider), taxi/limousine, rental car or public transportation. This research

investigated the distribution patterns of northeastern cities with a history of intercity ground transportation as well as distribution patterns from a Houston area airport to assess the potential modal choices of passengers disembarking from intercity rail systems in Texas. In addition, a gravity formula was applied to several employment/activity locations to anticipate patrons' distribution choices. The research focuses on the proposed location for the high speed rail terminal.

Governmental and quasi-governmental agencies served on the advisory committee and jointly financed later portions of the research. Specifically, those agencies are the Houston Galveston Area Council, Uptown Houston Association and the Central Houston Improvement District.

Research results disseminated through:

- Final Report: High Speed Rail Distribution Study, Carol Abel Lewis, Latissha Clark, Grace Asanaenyi and Wu Ying, TSU, August, 2016.
- Presentation: 1 (citation in Products Section of this PPPR)

♦ SWUTC Project #600451-00071: Quantification of Infrastructure Consumption under Different Axle Configurations and Wheel Loads - Traditionally, pavement damage, or consumption, has been evaluated empirically by means of Load Equivalency Factor (LEF) developed primarily based on the results of the AASHTO Road Test. In this study, researchers developed an equivalent to LEFs but refer to this new concept as Equivalent Consumption Factors (ECFs). The ECFs are mechanistically-based, are based in multiple failure criteria, and have a wider range of applicability. These equations can then be used to estimate pavement consumption of different heavy vehicles with different axle configurations and wheel loads. In addition, the consumption models developed as part of this research have been used as the basis for quantifying pavement consumption. These models are now being updated and will be used as part of a (TxDOT) Research Project (0-6817) to establish a new overweight permit fee structure in Texas.

Research results disseminated through:

- Final Technical Report: Quantification of Infrastructure Consumption under Different Axle Configurations and Wheel Loads, Ambarish Banerejee, Maria Burton, and Jorge Prozzi, University of Texas at Austin (UT-Austin), January, 2016.
- Published Paper: 1 (citation in the Products Section of this PPPR)
- Models Developed: The consumption models developed by this research are being utilized by TxDOT to identify pavement-friendly vehicles and to review the current permit fee schedule.

Complete listing of publications and presentations generated by this research available at:
<https://swutc.tamu.edu/research/swutc-completed-research/600451-00071/>

♦ SWUTC Project #600451-00085: Effect of Aggregate Micro- and Macro-texture on Pavement Skid Resistance - This study explored different ways to characterize the micro-texture of pavement surfaces with the main objective of quantifying the effect of accounting for both the micro and the macro components of the texture, rather than just the macro-texture, on the prediction of skid resistance.

Research results disseminated through:

- Final Technical Report: The Contribution of Micro- and Macro-texture to the Skid Resistance of Flexible Pavement, Pedro A. Serigos, Prasad Buddhavarapu, Grant M. Gorman, Feng Hong, and Jorge A. Prozzi, UT-Austin, February, 2016.
- Presentation: 1 (citation in the Products Section of previous PPPR)

Complete listing of publications and presentations generated by this research available at:
<https://swutc.tamu.edu/research/swutc-completed-research/600451-00085/>

♦ SWUTC Project #600451-00090: Boundary Conditions Estimation on a Road Network using Compressed Sensing - This project is one of the first attempts to aid traffic engineers by integrating traffic flow models with the complex problem of estimating boundary conditions (demand and supply patterns) on a road network. Using a compressed sensing approach, we can regularize this underdetermined problem and find unique solutions that exhibit a low number of features over time and space.

Research results disseminated through:

- Final Technical Report: Boundary Conditions Estimation on a Road Network using Compressed Sensing, Michele Simoni, Ofer Eldad, Andrew Alexander and Christian Claudel, UT-Austin, February, 2016.
- Software: This research developed software for integrating traffic flow data with models, for the purpose of boundary condition estimation.
- New Technique: A new technique for solving the boundary estimation problem, based on Mixed Integer Linear programming was developed. The researchers do not anticipate sharing this technique right now, though we will include it in a future journal article submission.

Complete listing of publications and presentations generated by this research available at:
<https://swutc.tamu.edu/research/new-research/600451-00090/>

♦ SWUTC Project #600451-00101: Mega-Region Traffic Modeling Project - This research effort developed a micro-level traffic simulation model for a megaregion. To accomplish this, a mass evacuation event was modeled using a traffic demand generation process that created a spatial and temporal distribution of departure times, origins, and destinations based on past hurricane scenarios. A megaregion-scale simulation was required to assess this event because only at this level can traffic from multiple cities, over several days, with route assignments in multiple and overlapping directions be analyzed.

Among the findings of the research was that it is possible to scale-up and adapt existing models to reflect a simultaneous multi-city evacuation covering a megaregion. The movements generated by the demand and operational models were both logical and meaningful and they were able to capture the key elements of the system, including the traffic progression over vast spaces and long time durations. They were also adequate to demonstrate benefits of proactive traffic management strategies and the

effect of increased and decreased advanced warning times. The project also revealed numerous limitations of existing modeling and computational processing capabilities.

Research results disseminated through:

- Final Technical Report: Gulf Coast Megaregion Evacuation Traffic Simulation Modeling and Analysis, Zhao Zhang and Brian Wolshon, Louisiana State University (LSU), December, 2015.
- Model Developed: This research pioneered the development of a microscopic traffic simulation model for a megaregion evacuation. The methodology developed for this work is now the state-of-the-art in developing similar models. Further, the model itself is being shared with other research institutes to help further the contribution of this research effort.
- Publications: 3 (citations in the Products Section of this PPPRs and previous PPPRs)
- Presentations: 8 (citations in the Products Section of previous PPPRs)
- Dissertation: 1 (citation in the Products Section of previous PPPR)

Complete listing of publications and presentations generated by this research available at: <https://swutc.tamu.edu/research/swutc-completed-research/600451-00101/>

♦ SWUTC Project #600451-00112: Assessment of Vehicle Performance in Harsh Environments Using Driving Simulator and Numerical Simulations - With the economic booming development of coastal areas, the importance of the traffic planning becomes obvious not only in a hurricane evacuation but also in the daily transportation. Vehicle performance on the freeway during harsh environments is critical to the success of the planning process. This study aimed to study the effect of harsh environments on the driving behavior and vehicle performance. The driving simulator installed in Louisiana State University was used to investigate the driver's behavior and vehicle performance in different adverse conditions such as strong crosswinds, wet road surface, and curving.

Research results disseminated through:

- Final Technical Report: Assessment of Vehicle Performance in Harsh Environments using LSU Driving Simulator and Numerical Simulations, Steve C.S. Cai, Sherif Ishak, and Jiexuan Hu, LSU, December 2015.
- Publication: 1 (citation in Products Section of this PPPR)
- Presentations: 2 (citations in the Products Section of previous PPPRs)

Complete listing of publications and presentations generated by this research available at: <https://swutc.tamu.edu/research/swutc-completed-research/600451-00112/>

♦ SWUTC Project #600451-00114: Analysis of Evacuation Clearance Time under Megaregion Disaster Threats - This research revealed several key aspects of the megaregion evacuation process in the Gulf Coast area of the US as well as for other megaregions in general. Among of the most interesting and potentially the most useful are the relationships between demand generation and the use of capacity enhancing techniques like contraflow and how they ultimately impact the capacity of megaregion-scale networks.

The results produced by this research are likely to affect the field of emergency planning and management. This project demonstrated the interdependent nature of a megaregion during an evacuation. This illustrates that planning for such events should be considered as a holistic approach, instead of the current practice where individual cities and municipalities prepare and plan for emergencies as single entities and not as a cohesive megaregion.

Research results disseminated through:

- Final Technical Report: Analysis of Evacuation Clearance Time under Megaregion Disaster Threats, Zhao Zhang and Brian Wolshon, LSU, January, 2016.
- Publication: 1 (citation in Products Section of previous PPPR)
- Presentations: 3 (citations in the Products Section of previous PPPRs)

Complete listing of publications and presentations generated by this research available at: <https://swutc.tamu.edu/research/swutc-completed-research/600451-00114/>

♦ SWUTC Project #600451-00116: The Tensions and Opportunities of Historic Preservation and Transit Oriented Development: Developing a Policy and Tools for Preservation in TODs - In recent years, there has been much research on Transit Oriented Development (TOD) in the United States and abroad. There has been decades of study of historic preservation, both in the United States and internationally. Yet the intersection of TOD and historic preservation has received scant attention. This project cross-references data on TOD and historic preservation, examines case studies of where TOD and historic preservation intersect and recommends policy and tools for preservation in TODs.

Research results disseminated through:

- Final Technical Report: The Opportunities and Tensions of Historic Preservation and Transit Oriented Development, John Renne, David Listokin, Tara Tolford, Kim Mosby and James Amdal, University of New Orleans (UNO), December, 2015.
- Database Developed: Of historic properties near rail stations in the United States.
- Guidebook Published: Citation in Products Section of this PPPR.
- Project Summary Video Produced: Citation in Products Section of this PPPR.
- Webinar Hosted: Opportunities and Tensions of Transit Oriented Development and Historic Preservation Guidebook, hosted by the TRB Transportation and Land Development Committee (to be conducted October 20, 2016)

Plans for Next Reporting Period to Accomplish Research Goal:

- The SWUTC research program is now 100% complete. All deliverables have been received and posted on the SWUTC website.

SWUTC Goal #2: Education and Workforce Development Programs

With this grant, SWUTC will promote excellence and the preeminent status of the education programs at each of the consortium member universities. This consortium nurtures world-class innovators in the education and preparation of transportation leaders for the emerging information-rich economy, through a continuing process of improvement in curriculum, courses and teaching methods.

Efforts Active January 1, 2016 – September 30, 2016:

♦ **SWUTC Graduate Scholarship Programs** have the ultimate goal to prepare a highly qualified cadre of new professionals into transportation science. These programs provide financial support to students to participate in classroom and sponsored research activities. In addition, the program provides increased communications skills as students make presentations, participate in debates, and write proposals and reports. Students also participate in technical tours and professional meetings throughout the year. Students in these programs receive tuition, fees and/or stipend support.

Current Status:

Transportation Scholars Program at TAMU: Program not active during this time period.

Advanced Institute at the UT-Austin – Number of students currently in program: 12

Graduate Stipend Program at TSU: Program not active during this time period.

♦ **Summer Undergraduate Fellows Programs**

The SWUTC Summer Undergraduate Transportation Scholars (UGTSP) at TAMU continues to be an extremely successful recruiting endeavor, attracting a diverse group of students into the graduate programs in transportation. Each year, the UGTSP recruits juniors and seniors from other universities and from diverse academic backgrounds into a summer-long program in transportation research and education as a first step towards graduate study in transportation. While at TAMU, the students have the opportunity to work with graduate students, faculty members, and researchers and are also exposed to research through meetings with project sponsors and weekly research seminars. Students make field trips to various transportation agencies and attend professional meetings such as the summer meeting of TexITE. At the end of the summer term, the students make presentations on their research and produce a paper for publication. These papers are published annually as a *Compendium of Student Papers* and posted on the SWUTC website.

Current Status:

2016 program completed. Number of students participating in 2016 program: 2.

♦ **Ph.D. Candidate Assistantship Program** at TAMU:

This competitive program selects Ph.D. candidates for a maximum of 12 months of salary support while their dissertation is being completed. No tuition or fees are paid. Candidates are chosen based on the quality and value of the proposed research. The goal of this program is to expedite the progress of students to complete doctoral requirements and begin their careers as transportation leaders.

Current Status:

2012 PhDCA Program:

Of the six proposals selected for funding in FY12, all six are now complete. (Six citations in Products Section of previous PPRs)

2013 PhDCA Program

Of the six proposals selected for FY13 funding, all six are now complete. (Five citations in Products Section of previous PPRs and one in this PPR)

2014 PhDCA Program

The one project selected for funding in FY14 is now complete. (Citation in Products Section of this PPR)

2015 PhDCA Program

Of the three projects selected for funding in FY15, two are now complete. (Citations in Products Section of this PPR)

Plans for Next Reporting Period to Accomplish Education and Workforce Development Goal:

- The PhDCA project funded in 2015 - #600451-00051 (Methodologies for Developing Driveway Functional Areas for Urban Corridor Access Management – Student: Yanfen Zhou) is not yet complete. Yanfen Zhou left PhDCA program in September 2016 to take full time employment. She is still enrolled at TAMU and plans to complete PhD requirements. Graduation date TBD. Publication date of dissertation TBD.
- All other SWUTC Education Programs are now complete.

SWUTC Goal #3: Technology Transfer

Timely information, delivered to the right people is the desired outcome for SWUTC's technology transfer program. SWUTC supports a varied menu of techniques to transfer SWUTC derived results. These include: continually updating the SWUTC website at <http://swutc.tamu.edu/> with center news and downloadable publications; publishing and distributing research final technical reports to 20 state and national libraries; and support for SWUTC researchers as they present their research results through peer-reviewed publications and professional presentations.

See complete listing of publications and presentations produced during this reporting period in the following Products Section.

Plans for Next Reporting Period to Accomplish Technology Transfer Goal:

- One final technology transfer event will be held October 20, 2016 after the close of the SWUTC grant. The TRB Transportation and Land Development Committee will host a webinar developed by the SWUTC.

Title of Webinar: Opportunities and Tensions of Transit Oriented Development and Historic Preservation Guidebook.

Speakers: John Renne (formerly with the University of New Orleans, now with Florida Atlantic University), and David Listokin (Rutgers)

Summary of Webinar: This webinar presents a new guidebook (developed by the SWUTC) to help better understand the TOD–historic preservation interaction. It also aims to help understand the tensions and opportunities of this interaction and provides tools to coordinate both. The audience for this guidebook is any stakeholder or group of stakeholders that have interest in preserving buildings in and near TODs. These stakeholders include: community activists, real estate developers, local government, redevelopment authorities and transit agencies.

The guidebook was part of a larger study on the same topic funded by the SWUTC. (SWUTC Project #600451-00116)

- All Other SWUTC Technology Transfer Program Tasks Complete

2. Products:

SWUTC Publications/papers/presentations for this reporting period:

Publications Submitted for Review:

Boundary Condition Estimation on a Road Network Using Compressed Sensing, Michele Simoni, Edward Canepa and Christian Claudel, UT-Austin, article submitted to *ASCE Journal of Computing in Civil Engineering*, September 2016. (Product of SWUTC Project #600451-00090)

Book/Journal Submissions Published (citations not captured in previous PPPRs):

Framework for Determining Load Equivalencies with DARWin-ME, Jorge Prozzi and Prasad Buddhavarapu, UT-Austin, published in the *Transportation Research Record*, Volume 2368, pp. 24-35, Washington, D.C., 2013. (Product of SWUTC Project #600451-00071)

Performance Characteristics of Megaregion Traffic Networks During Mass Evacuations, Z. Zhang, K. Spansel, V. Dixit and B. Wolshon, LSU, submitted for publication in the *International Journal of Transportation*, Vol. 2, No. 3, 2014, pp 53-72. (Product of SWUTC Project #600451-00101)

Megaregion Network Simulation for Evacuation Analysis, B. Wolshon, LSU, published in the *Transportation Research Record: Transportation Research Record*, No. 2397, 2014, pp. 161-170. (Product of SWUTC Project #600451-00101)

Guidebook Published:

A Guide to Facilitate Historic Preservation through Transit Oriented Development, John Renne, David Listokin, UNO, September 2016. (Product of SWUTC Project 600451-00116)

Products of SWUTC Ph.D. Candidate Assistantship Program at TAMU: (citations not captured in previous PPPRs):

Real Option Analysis to Value Managed Lanes Using Big Data, Sunghoon Lee, TAMU, Product of SWUTC Ph.D. Candidate Assistantship Program, May, 2016 (Product of SWUTC Project #600451-00036)

Waterway System Maintenance Optimization, Mohammadadel Khodakrami, TAMU, Product of SWUTC Ph.D. Candidate Assistantship Program, August, 2016 (Product of SWUTC Project #600451-00039)

Integration of Heuristics and Statistics to Improve the Quality of Network-level Pavement Condition Data, Salar Zabihi Siabil, TAMU, Product of SWUTC Ph.D. Candidate Assistantship Program, December, 2016 (Product of SWUTC Project #600451-00052)

Modeling Deformation of Freezing Concrete: Towards the Identification of D-cracking Susceptible Aggregates and Construction of all Concrete LNG Tanks, Syeda Farhana Rahman, TAMU, Product of

SWUTC Ph.D. Candidate Assistantship Program, December, 2016 (Product of SWUTC Project #600451-00053)

Presentations (citations not captured in previous PPRs):

Estimating Mobility Improvement Benefits Using Private-Company Speeds Datasets, David Schrank, Tim Lomax, TAMU, presented at the TRB NATMEC 2016 Improving Traffic Data Collection, Analysis and Use Conference, Miami, Florida, May 1-4, 2016. (Product of SWUTC Project #161302)

Estimating Freeway Route Travel Time Reliability from Data on Component Links and Associated Cost Implications, Jha, K, J.W. Wikander, W.L. Eisele, M.W. Burris and D.L. Schrank, TAMU, presented at the 95th Transportation Research Board Meeting, Washington D.C., January 2016. Also published in the proceedings. (Product of SWUTC Project #161302)

Developing Multimodal Performance Measures: Understanding What They Are and How to Develop Them, Phil Lasley, TAMU, presented at the 95th Transportation Research Board Meeting, Washington D.C., January 2016. (Product of SWUTC Project #161302)

Safety Impacts of Directional Median Openings at Downstream U-turn Locations, Yi Qi, X. Wang, X. Chen and G. Liu, TSU, presented at the 95th Transportation Research Board Meeting, Washington D.C., January 2016. (Product of SWUTC Project #161342)

Study Findings: A Synthesis Report of Purpose and Need: Assessment of Event Egress for Houston's Reliant Stadium. Carol Lewis, TSU, presented to a gathering of stakeholders familiar with NRG stadium in Houston, TX, December 3, 2015. (Product of SWUTC Project #600451-00049)

Study Findings: High Speed Rail Distribution Study, Carol Lewis, TSU, presented to the Houston Galveston Area Council, Uptown Houston Association, Central Houston Improvement District, and the Texas Central Partners, Houston, TX, September, 2016. (Product of SWUTC Project #600451-00050)

Evaluation of Detection Mode, Weather Condition, and Incident Location on Freeway Incident Duration Prediction, Moggan Motamed and Randy Machemehl, UT-Austin, presented and published in the Proceedings of the CSCE 2016 Annual Conference, London, Canada, June 2016. (Product of SWUTC Project #600451-00083)

Methodology for Simulating Manual Traffic Control, Scott Parr and Brian Wolshon, LSU, presented at the 95th meeting of the Transportation Research Board and submitted for publication in the Transportation Research Record, Journal of the Transportation Research Board, January, 2016. (Product of SWUTC Project #600451-00113)

Websites (other than SWUTC website) and other social media utilized for this reporting period:
<https://transportationandlanddevelopment.wordpress.com/webinars/>
<https://vimeo.com/183883823>

Technologies or techniques for this reporting period:

◆ **New Technique Developed:**

- SWUTC Project #600451-00090 – Boundary Conditions Estimation on a Road Network using Compressed Sensing – This research developed a new technique for solving the boundary estimation problem, based on Mixed Integer Linear programming.

Inventions/patent applications/licenses for this reporting period:

Nothing to report at this time.

Other Products for this reporting period:

◆ **Database Developed:**

- SWUTC Project #600451-00116 – The Opportunities and Tensions of Historic Preservation and Transit Oriented Development: Developing a Policy and Tools for Preservation of TODs – This study developed a database of historic properties near rail stations in the United States.

◆ **Software Developed:**

- SWUTC Project #600451-00090 – Boundary Conditions Estimation on a Road Network Using Compressed Sensing – This research developed software for integrating traffic flow data with models, for the purpose of boundary condition estimation.

◆ **Models Developed:**

- SWUTC Project #600451-00071 – Quantification of Infrastructure Consumption under Different Axle Configurations and Wheel Loads – The consumption models developed by this research are being utilized by TxDOT to identify pavement-friendly vehicles and to review the current permit fee schedule.
- SWUTC Project #600451-00101 – Mega-Region Traffic Modeling Project - This research pioneered the development of a microscopic traffic simulation model for a megaregion evacuation. The methodology developed for this work is now the state-of-the-art in developing similar models. Further, the model itself is being shared with other research institutes to help further the contribution of this research effort.

◆ **Guidebook Developed:**

- SWUTC Project #600451-00116 – The Opportunities and Tensions of Historic Preservation and Transit Oriented Development: Developing a Policy and Tools for Preservation of TODs – This study developed a guidebook titled A Guide to Facilitate Historic Preservation through Transit Oriented Development. This guidebook establishes new way of thinking about TOD and historic preservation to assist local governments, transit agencies, developers and other stakeholders.

◆ **Project Summary Video Produced:**

- This project summary video - [A Guide to Facilitate Historic Preservation through Transit Oriented Development](#), is a companion piece to the guidebook mentioned above. The video summaries how communities can use transit-oriented development to revitalize historic neighborhoods around transit stations. Available at: <https://vimeo.com/183883823> (Product of SWUTC Project 600451-00116)

3. Participants & Other Collaborating Organizations

Organizations as SWUTC Partners:

See previous PPPRs for extensive list of organizations providing in-kind support in the form of personnel who serve as Project Monitors for active SWUTC research projects. SWUTC Project Monitors furnish in-kind support for SWUTC research by providing guidance to principal investigators to ensure that the research will produce useable results and to review of all reports emanating from the project.

- No new project monitors for this reporting period.

Partnerships/collaborations for this reporting period:

Houston/Galveston Area Council – Contribution: In-kind and financial support for SWUTC Project #600451-00050.

Uptown Houston Association – Contribution: In-kind support for SWUTC Project #600451-00050.

Central Houston Improvement District - Contribution: In-kind support for SWUTC Project #600451-00050.

Gulf Coast Rail District - Contribution: In-kind support for SWUTC Project #600451-00050.

HDR - Contribution: In-kind support for SWUTC Project #600451-00050.

Metropolitan Transit Authority of Harris County - Contribution: In-kind support for SWUTC Project #600451-00050.

The Wave (Houston’s Jitney Shuttle Service) - Contribution: In-kind support for SWUTC Project #600451-00050.

Texas Central Partners - Contribution: In-kind support for SWUTC Project #600451-00050.

Pres Kabacoff and Hal Fairbanks of HRI Properties – Contribution: In-kind and financial support for SWUTC Project #600451-00116

Marcel Wisznia of Wisznia Architecture + Development - Contribution: In-kind support for SWUTC Project #600451-00116.

Vincent Birdsong, Florida Division of Historic Resources - Contribution: In-kind support for SWUTC Project #600451-00116.

4. Impact

Impact on the development of the principal disciplines of the program for this reporting period:

Nothing to report.

Impact on other disciplines for this reporting period:

◆ **Applicable to Other Disciplines.**

- SWUTC Project #600451-00101: Mega-Region Traffic Modeling Project, and SWUTC Project #600451-00114: Analysis of Evacuation Clearance Time under Megaregion Disaster Threats – These two research projects impact the field of emergency planning and management. These projects demonstrated the interdependent nature of a megaregion during an evacuation. They illustrate that planning for such events should be considered as a holistic approach, instead of the current practice where individual cities and municipalities prepare and plan for emergencies as single entities and not as a cohesive megaregion.

Impact on the transportation workforce development for this reporting period:

- ◆ **Provide Opportunities for Students to Participate in SWUTC Research.** SWUTC requires that students be involved in a meaningful way in the conduct of all SWUTC research efforts. During this reporting period, 10 graduate students were involved in the SWUTC research activities.
- ◆ **Graduate Scholarships Provided.** The SWUTC graduate scholarship programs provide stipends to students to participate in classroom and sponsored research activities. Graduate students supported this reporting period: 12
- ◆ **Undergraduate Summer Fellowships Provided.** This program recruits juniors and seniors from other universities and from diverse academic backgrounds into a summer-long program in transportation research and education as a first step towards graduate study in transportation. Undergraduate students supported this reporting period: 2

Impact on physical, institutional, and information resources at the university or other partner institutions for this reporting period:

Nothing to report.

Impact of technology transfer for this reporting period:

◆ **Informing the Public and Decision Makers:**

- SWUTC Project #600451-00049: A Synthesis Report of Purpose and Need: Assessment of Event Egress for Houston's NRG Stadium – The project detailed concepts to potentially improve egress at NRG Stadium in Houston, particularly in consideration of Super Bowl XLIX to be held at NRG in 2017. The goal being to enhance the public's experience and safety at the venue by improving egress once events end. Egress improvement strategies were presented to Stakeholders during a Symposium held on December 3, 2015. Participants of the Symposium included representatives from the City of Houston, Harris County, Texas Department of Transportation (TxDOT), Houston TranStar and the Houston Livestock Show and Rodeo.
- SWUTC Project #600451-00050: High Speed Rail Distribution Study - Findings from this research are designed to assist area officials as they assess the physical facility needs to disburse transit connected passengers from high speed rail. This work lays a foundation for distribution

to the activity/employment centers and provides greater insight into sizing and locating bays for bus and private vehicles. With this information, agencies and transport providers will be better able to plan for interregional rail connectivity with their operation. Specific stakeholders include the Houston Galveston Area Council, Uptown Houston Association, Central Houston Improvement District and the Texas Central Partners. A meeting is scheduled for October 6, 2016 to discuss project findings.

- SWUTC Project #600451-00101: Mega-Region Traffic Modeling Project, and SWUTC Project #600451-00114: Analysis of Evacuation Clearance Time under Megaregion Disaster Threats – Findings from this two research efforts can lead to new regulatory policies for cities, counties, and states with regard to emergency planning requirements. Using the knowledge gained from this research, transportation planners can look at developing plans that address the mobility needs of the entire megaregion instead of individual cities.
- SWUTC Project #600451-00116: The Opportunities and Tensions of Historic Preservation and Transit Oriented Development: Developing a Policy and Tools for Preservation in TODs – This was the first national study that examined the relationship of TOD with historic preservation. This study established an important nexus to two distinct topics that are increasingly becoming connected as cities, transit agencies and developers seek to develop around railway stations. The results of this study could result in more innovative approaches to reuse historic buildings near train stations rather than to tear them down. This could have economic, environmental and social benefits for the entire community.

We expect that this project will have a significant impact once the results are disseminated to the proper audiences, through the planned webinar in October, and also through the video and Guidebook developed by this project.

Impact on society beyond science and technology for this reporting period:

♦ **New Methods to Aid Decision Makers:**

- SWUTC Project #600451-00071: Quantification of Infrastructure Consumption under Different Axle Configurations and Wheel Loads - The potential impact of the models and equations developed by this research is quite significant. They have the potential to affect pavement design, pavement management, cost allocation, safety, alternative sources of highway funding, planning and programming, etc.

The results of the study were also used in a TxDOT study that was presented to the State Legislature. It provided a better understanding to the legislators of the effects of increasing axle loads on Texas highway network. It also helped in the revision of several legislature bills and in some instances, provided TxDOT with objective tools for assessing proposed axle load increases proposed by certain industry sectors.

- SWUTC Project #600451-00085: Effect of Aggregate Micro- and Macro-texture on Pavement Skid Resistance – Researchers on this project conclude that accounting for both the macro- and the micro-texture components of the surface will significantly enhance the prediction of British Pendulum Number (BPN) of flexible pavements as oppose to accounting solely for the macro-

texture component. Such improvement will allow transportation agencies to better manage skid resistance and therefore to improve road safety.

◆ **Improving Road Network Performance:**

- SWUTC Project #600451-00090: Boundary Conditions Estimation on a Road Network Using Compressed Sensing - The results of this research may make an impact on socioeconomic conditions, since better estimation of origin-destination matrices may lead to reduced traffic congestion through better traffic control. The results from this study will aid traffic engineers as it provides a new technique to help solve the complex problem of estimating boundary conditions (demand and supply patterns) on a road network.

◆ **Improving Driver Safety:**

- SWUTC Project #600451-00112: Assessment of Vehicle Performance in Harsh Environments using Driving Simulator and Numerical Simulations - Vehicle performance on the freeway during harsh environments is critical to the success of the planning process. The accumulated knowledge, related to driver behavior and vehicle performance in harsh environments, produced by this research will help develop safer traffic management plans, which in turn will improve the safety of the driving public.

5. Changes/Problems

Nothing to report.