



## Program Progress Performance Report

**Submitted to:** U.S. Department of Transportation  
Research and Innovative Technology Administration (RITA)

**Federal Grant:** #DTRT12-G-UTC06

**Project Title:** Southwest Region University Transportation Center (SWUTC)

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**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 – January 31, 2016

**Reporting Period End Date:** December 31, 2013

**Report Term:** Semi-annual – July 1, 2013 – December 31, 2013

*Melissa S Tooley*

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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 #161306: Developing the Hydraulics, Sedimentation and Erosion Control Laboratory to Become a Hands-on Training and Education Center - Texas A&M Transportation Institute's (TTI) Hydraulics, Sedimentation and Erosion Control Laboratory is a leading research, testing and educational facility in soil erosion and stormwater topical areas. The lab is continuously updating its expertise and services, and has lately moved into the new knowledge areas of low impact development (LID) techniques and green infrastructure. To expand the lab's current realm of activities, this project developed a master plan, course modules, training program promotional materials and two large-scale LID models that will enable the lab to provide hands-on training for transportation professionals in addition to high-impact education for students. The hands-on portion is unique and fills the gap in those continuing education seminars/webinars currently offered in the market.

Research results disseminated through:

- Final Technical Report: Developing the Sediment and Erosion Control Laboratory to Become a Hands-on Training and Education Center, Ming-Han Li, Pengzhi Li, Jett McFalls, Beverly Storey and Galen Newman, Texas A&M University (TAMU), November 2013, 149 pp.
- Future presentations planned to the International Erosion Control Association and the Transportation Research Board (TRB) Annual Meeting.

♦ SWUTC Project #600451-00006: A Comprehensive Characterization of Asphalt Mixtures in Compression - Asphalt mixtures that are used in pavement construction are under compression when a rolling tire passes over them. Under such a high compressive load, irrecoverable deformation occurs and contributes to rutting which can trap water and lead to wet weather accidents. The behaviors of asphalt mixtures have not been characterized completely due to the complexity of the material. This project overcame the shortcomings of the existing models and provides a comprehensive mechanistic model and characterizing testing methods for asphalt mixtures in compression.

Research results disseminated through:

- Final Technical Report: A Comprehensive Characterization of Asphalt Mixtures in Compression, Yuqing Zhang, Rong Luo and Robert L. Lytton, TAMU, August 2013, 79 pp.
- Presentations: 4 (citations in Products Section of this report and previous PPPRs)
- Journal Articles Submitted for Review: 2 (citations in Products Section of this report)
- Published Journal Article: 1 (citation in Products Section of this report)

♦ SWUTC Project #600451-00007: A Comprehensive VMT Fee Equity Impact Analysis - One proposed alternative to the gas tax is the creation of a mileage-based user fee (MBUF), which would then shift how revenues are collected. This research examined the potential equity impacts of three MBUF and disbursement of transportation funds scenarios. Each scenario was run both statically and dynamically under the assumption

that the MBUF would replace the state gas tax. The results of this research will provide DOTs a better understanding of how transportation is funded and the consequences of new funding mechanisms.

Research results disseminated through:

- Final Technical Report: Equity Evaluation of Sustainable Mileage-based User Fee Scenarios, Mark Burris, Sunghoon Lee, Tina Geiselbrecht and Trey Baker, TAMU, October 2013, 87 pp.
- Presentation to the 2014 Annual Meeting of the TRB.
- Publication of research findings in the *Journal of the Transportation Research Forum*.

♦ SWUTC Project #600451-00012: Fatigue Modeling of Hot Mix Asphalt Using Field Samples to Ensure a State of Good Repair - Fatigue cracking is a primary form of distress in hot-mix asphalt. The long-term nature of fatigue due to repeated loading and aging and its required tie to pavement structure presents challenges in terms of evaluating mixture resistance. This project focused on comparing stiffness and fatigue life output from two recently developed approaches that use repeated direct tension tests to evaluate fatigue resistance of hot mix asphalt. Through the comparison of these two approaches, this study provides insight to their similarities and shortcoming in terms of both testing and analysis.

Research results disseminated through:

- Final Technical Report: Comparison of Fatigue Analysis Approaches for Hot-Mix Asphalt to Ensure a State of Good Repair, Amy Epps Martin, Edith Arambula, M. Emin Kutay, James Lawrence, Xue Luo, and Robert Lytton, TAMU, October 2013, 36 pp.
- Slide Presentation: Uniaxial Fatigue Testing incorporated into graduate course at TAMU and also sent to Texas Department of Transportation (TxDOT).
- Technical Note: submitted to *ASCE Journal of Materials in Civil Engineering*.

♦ SWUTC Project #600451-00013: Improvements to the Urban Mobility Report Methodology - This research documented an updated methodology for incorporating public transportation benefits into TTI's *Urban Mobility Report*. This new methodology will be implemented into the upcoming *2013 Urban Mobility Report* to be released in February 2014.

The results of this research strongly suggest there are differences in temporal volume distributions of trucks compared to all vehicles. While the sample size is low, the results were telling and researchers plan to investigate these findings with larger sample sizes in the future.

Research results disseminated through:

- Final Technical Report: Investigation of Improvements to Truck Volume Assignments and Public Transportation Benefits Methodologies in TTI's Urban Mobility Report, William L. Eisele, David L. Schrank, Dong Hun (Don) Kang, Steven E. Polzin, and Xuehao Chu, TAMU, August 2013, 65 pp.
- Results to be disseminated in the February 2014 release of the *2013 Urban Mobility Report*.
- Website: <http://mobility.tamu.edu/ums/>

♦ SWUTC Project #600451-00015: U in the Driver Seat - With safety programs and interventions targeting very young drivers and very old drivers, the college student target audience has largely been overlooked in the past. This effort built a peer-to-peer (P2P) model targeted toward the college-age audience called "U in the Driver Seat" at two college campuses. The project produced a better understanding of risk awareness and attitudes of this target audience towards driving dangers, and measured the success of P2P messaging and activities developed for this audience. Through an increased understanding of which safety messaging and design elements proved effective with this target audience, an improved program model was developed for implementation at other campuses. The project also helped validate the value of (and need for) P2P outreach as part of an overall strategy to address roadway safety in a community – in this case a college campus.

Research results disseminated through:

- Final Technical Report: U in the Driver Seat – A Peer-to-Peer Pilot Program for Decreasing Car Crashes by College Students, Stacey M. Tisdale, TAMU, September 2013, 55 pp.

- Website: <http://www.u-driver.com>
- Social Media: Facebook: u-driver.com; Twitter: UntheDriverSeat
- The Teens in the Driver Seat Program, of which “U in the Driver Seat” is now a component, is approached frequently to make presentations at the regional, state and national levels.

♦ SWUTC Project #600451-00016: Decision-support Framework for Quantifying the Most Economical Incentive/Disincentive Dollar Amounts for Critical Highway Pavement Rehabilitation Projects - One innovative way of reducing construction duration is to reward contractors with an early completion incentive bonus and levy fines for delays. Although use of Incentive/Disincentive (I/D) is increasingly common, State Transportation Agencies often struggle to select the most appropriate I/D rates due largely to the lack of the proper analytical methods. This project addressed the immediate need to develop a holistic framework that is more general and applicable to a variety of transportation projects for the determination of optimal I/D rates.

This research developed a new seven-stage decision-support framework that determines optimal incentive/disincentive (I/D) dollar amounts for time critical highway pavement rehabilitation projects—an optimal value that allows the agency to stay within budget while at the same time effectively motivating contractors to use their ingenuity to complete the projects earlier.

Research results disseminated through:

- Final Technical Report: Decision-Support Framework for Quantifying the Most Economical Incentive/Disincentive Dollar Amounts for Critical Highway Pavement Rehabilitation Projects, Kunhee Choi, Eun Sug Park, and Junseo Bae, TAMU, November 2013, 97 pp.
- Academic Course Material: Research results incorporated into the curriculum for the graduate course Advanced Infrastructure Planning and Management in the Construction Science Department at TAMU.
- Journal Articles in Preparation: To *ASCE Journal of Computing in Civil Engineering*, *Elsevier Journal of Automation in Construction*, and *ASCE Journal of Construction Engineering and Management*.
- Planned Presentations: TRB 2015, International Symposium on Automation and Robotics in Construction (ISARC) 2014, CRC 2015, and International Conference on Construction Engineering and Project Management (ICCEPM) 2014.

♦ SWUTC Project #600451-00017: Travel Surveys: Moving from Tradition to Innovation - The objective of this effort was to provide a venue for those involved in travel surveys to assess what has been learned in the past decade, come to consensus on where we are headed, identify how to stay current in travel survey advances and what research is needed, and perpetuate best practices.

The SWUTC Travel Survey Symposium was held in Dallas on November 8 and 9. This event was attended by more than 70 travel survey professionals from across the United States

Research results disseminated through:

- Final Technical Report 2012 Household Travel Survey Symposium: Conference Summary and Final Report, Stacey Bricka, Ben Ettelman, and Chris Simek, TAMU, December 2013, 55 pp.
- Website: <http://tti.tamu.edu/conferences/tss12/>
- Future Scheduled Presentation: The Future of Travel Surveys, C. Simek and S. Bricka, to be presented at the 2014 TRB Planning Applications Conference, May 2014, Columbus Ohio.
- Submitted Presentation: U.S. Household Travel Surveys: Trials, Tribulations, and the Future, S. Bricka and E. Murakami, submitted to the 10<sup>th</sup> International Conference on Transport Survey Methods, November 2014, Leura, New South Wales, Australia.
- Informal Presentations: Travel Symposium Results, C. Simek and S. Bricka, presented to the following committee meetings of the TRB 2013 Annual Meeting. ABJ40 *Travel Survey Methods*, ABJ40(1) *Household Travel Survey Subcommittee of Travel Survey Methods*; ADB40 *Travel Demand Forecasting*; and ABJ30 *Urban Data and Information Systems*.

◆ SWUTC Project #600451-00062: Workability of Asphalt Binders at Mixing Temperatures for Hot and Warm Mix Asphalt - Asphalt mixtures are produced by heating the asphalt binder until it turns to a low viscosity liquid and then using the liquid binder to coat mineral aggregate particles (stones of various sizes). Warm mix asphalt (WMA) is a new technology that allows the production of asphalt mixtures at temperatures that are lower than those used to produce conventional hot mix asphalt (HMA). The benefits of using WMA include energy savings, reduced emissions and extended service life of the pavement. However, chemical additives are needed in the asphalt binder in order for the binder to flow and coat the aggregate particles at these lower temperatures. These chemical additives claim to lower the surface tension of the binder and allow mixture production at reduced temperatures. Although there are several commercially available chemical additives, there is no study that documents the reduced surface tension achieved using these additives. This study, perhaps for the first time, measured the surface tension of asphalt binders with and without these additives at typical mixing and compaction temperatures.

Research results disseminated through:

- Final Technical Report Wetting Characteristics of Asphalt Binders at Mixing Temperatures, Patricia Hennig Osmari, Zelalem Arega, and Amit Bhasin, University of Texas at Austin (UT-Austin), October 2013, 48 pp.
- Journal Articles Submitted for Review: 1 (citation in Products Section of this report)
- Planned Presentations: Surface Tension of Asphalt Binders with and without Warm Mix Additives at Typical Mixing and Compaction Temperatures, to be presented to producers of asphalt binders and additive manufacturers, State DOT and FHWA personnel.

◆ SWUTC Project #600451-00063: The Transportation-related Causes and Consequences of Land Use Change It is important to model future land-use patterns as a function of potential land-use and transportation policies to promote sustainable travel patterns. This research effort estimated a grid-level land-use model that explicitly accounts for the underlying individual landowner level behavioral processes using the City of Austin land use database for multiple years.

Research results disseminated through:

- Final Technical Report: A New Spatial Multiple Discrete-Continuous Modeling Approach to Land Use Change Analysis, Subodh K. Dubey and Chandra R. Bhat, UT-Austin, September 2013, 73 pp.
- Presentations: 4 (citations in Products Section of this report and previous PPPRs)
- Journal Articles Submitted for Review: 1 (citation in Products Section of this report)

◆ SWUTC Project #600451-00064: Local Infrastructure to Support the Widespread Use of Hybrid/All Electric Vehicles: What Programs and Public Policies are Likely to Work to Promote Environmental Sustainability and Livable Communities? - Current experimentation with both hybrid and all-electric vehicles (passenger cars, buses, light delivery trucks) is taking place within several metropolitan areas. The deployment of new battery technologies, network routing systems, methods of recharging, and repair shops were evaluated to ascertain which hold the greatest promise for reducing greenhouse gas emissions and fossil-fuel consumption. This research also discusses a variety of state-level incentives designed to influence consumer behavior with respect to decisions to purchase more fuel efficient and environmentally sound vehicles, especially for urban travel.

Research results disseminated through:

- Final Technical Report: Electric Vehicles and Public Charging Infrastructure: Impediments and Opportunities for Success in the United States, Eric Borden and Leigh Boske, UT-Austin, July 2013, 53 pp.

◆ SWUTC Project #600451-00065: Game Theory and Traffic Assignment: Refinements, Stability, and Tractability - Traffic assignment is used to determine the number of users on roadway links in a network. While this problem has been widely studied in transportation literature, its use of the concept of equilibrium has attracted considerable interest in the field of game theory. With this research effort, the approaches used in both transportation and game theory disciplines were explored, and the similarities and dissimilarities between them were studied. In particular, treatment of multiple equilibrium solutions using equilibrium refinements and

learning algorithms which convergence to equilibria under incomplete information and/or bounded rationality of players are discussed in detail.

Research results disseminated through:

- Final Technical Report: Game Theory and Traffic Assignment, Tarun Rambha and Stephen D. Boyles, UT-Austin, September 2013, 46 pp.
- Presentations: 1 (citation in Products Section of this report)
- Journal Articles Submitted for Review: 1 (citation in Products Section of this report)
- Course Materials: Study findings incorporated into graduate courses CE392C (Transportation Network Analysis) and 293DD (Dynamic Traffic Assignment) at UT-Austin.

♦ SWUTC Project #600451-00066: Multistate Megaregion Freight Planning Benefits: Evidence from Louisiana-Texas - The Moving Ahead for Progress in the 21st Century Act includes a number of provisions advocating improving the condition and performance of the national freight network through targeted investments and policies by the Department of Transportation and state agencies. Critical to this network are freight corridors which serve as major trade gateways connecting multiple cities and regions. However, transportation planners and policy makers are limited by the number of tools available to assess the performance and condition of these corridors. Most current tools and models require data which is unavailable, outdated or insufficient for analysis. To address this need, a truck-rail intermodal toolkit was developed for multimodal corridor analysis and enables planners and other stakeholders to examine freight movement along corridors based on mode and route characteristics. The methodology described by this research can be used in other multistate corridors and serve as an initial assessment of the condition and performance of the national freight network.

Research results disseminated through:

- Final Technical Report: A Transportation Corridor Analysis Toolkit, Dan P. K. Seedah, Rydell Walthall, Garrett Fullerton, Travis Owens and Robert Harrison, UT-Austin, October 2013, 51 pp.
- Presentations: 1 (citation in Products Section of previous PPRs)
- Journal Articles Submitted for Review: 1 (citation in Products Section of this report)

♦ SWUTC Project #600451-00067: Life-cycle Costs and Benefits of Different Land Use and Transportation Patterns - This work expanded knowledge of relationships between the built environment, energy consumption, and greenhouse gas emissions. While much research has considered the role of neighborhood design on energy use (by way of travel behavior and at-home energy use), very little work has also considered the “embodied” energy and emissions of those neighborhoods and their supporting infrastructure. This research created a framework and provided numeric details for analyzing and comparing energy sinks and emission sources in a holistic manner, taking into account multiple energy sources over the lifetime of buildings and infrastructure systems (such as roads, water and wastewater pipes, sidewalks, public lighting, driveways, and parking surfaces).

Research results disseminated through:

- Final Technical Report: Life-cycle Energy Implications of Different Residential Settings: Recognizing Buildings, Travel, and Public Infrastructure, Brice Nichols and Kara Kockelman, UT-Austin, August 2013, 37 pp.
- Presentations: 1 (citations in Products Section of this report)
- Journal Articles Submitted for Review: 1 (citation in Products Section of this report)

♦ SWUTC Project #600451-00069: Development of an Interactive GIS Based Work Zone Traffic Control Design Tool - This project developed a traffic control planning tool package to enable smarter planning of work zone traffic control schemes and demonstrated how available technology can be incorporated by most transport agencies to produce a similar tool kit. The package brings together elements of geographic information systems (GIS), data bases containing geometric characterizations of roadways, traffic volume data and traffic control information. The resulting package provides users with a conveniently available tool for developing or checking work zone traffic control plans.

Research results disseminated through:

- Final Technical Report: Development of an Interactive GIS Based Work Zone Traffic Control Tool, Jack Bringardner, Mason Gemar and Randy Machemehl, UT-Austin, August 2013, 90 pp.
- Study results have already been shared with the Dallas TxDOT district and research team anticipates application of the technology by that agency and potentially other State DOT entities.

♦ SWUTC Project #600451-00070: Developing a Research Agenda to Increase Cycling in the African American Community: A Case Study of Austin, TX - This research effort developed an innovative cycling training program for Austin, Texas which is documented in the final report. Results of pre/post surveys show that the training was successful in changing perceptions within the African American community which the research team believes is the first step in increasing the number of African Americans who cycle. The training program can be transferred to other cities where there is a desire to diversify the cycling community.

Research results disseminated through:

- Final Technical Report: Cycling in the African American Community: Safety Training Guidelines and Findings, Talia McCray, Teri Durden, Eileen Schaubert, UT- Austin, August 2013, 32 pp.
- Presentation: 1 (citation in Products Section of this report)
- Future Invited Presentation: Urban Affairs Conference, San Antonio, TX, March 19-22, 2014.
- YouTube video: <http://www.youtube.com/watch?v=2kndhLt931E> (presentation of study results)

♦ SWUTC Project #600451-00072: Private vs. Public Financing of Transportation Systems - The use of public-private partnerships (PPPs) for transportation infrastructure delivery has increased in the U.S. However, concerns about and opposition to these agreements exist due to a variety of factors. This research explored the perceptions that a variety of PPP stakeholders have about PPP usage to deliver transportation infrastructure in the U.S., including stakeholders from fields at times overlooked in PPP literature but that are key to these transactions, such as professionals in legal, banking, finance, and concessionaire organizations. Results of a survey taken by 101 professionals indicate that stakeholders' perceptions about benefits, barriers, and valuation of PPPs vary—at times greatly—depending upon the respondent's work type, location, and especially whether they had previous experience with PPPs. While this is not surprising, in some cases, such variations in perceptions were unexpected in both type and magnitude. It is understandable that some misperceptions still exist among PPP stakeholders due to various reasons, yet some responses showed deep misunderstandings, fears, or unrealistic expectations about PPPs. The fact that respondents were targeted because of their assumed familiarity with these transactions is worrisome and it indicates the need to educate decision-makers, staff, and the general public about what PPPs really are, why they are needed, and what they can and cannot do.

Research results disseminated through:

- Final Technical Report: Public-Private Partnerships in Transportation Infrastructure: Survey of Experiences and Perceptions, Sergio E. Martinez, Andrea Hall, and C. Michael Walton, UT-Austin, September 2013, 77 pp.
- Poster Presentation: 93<sup>rd</sup> Annual Meeting of the TRB, January 2014.

♦ SWUTC Project #600451-00073: Transportation Funding for a Changing Light-Duty Vehicle Fleet: Pricing Model and Evaluation of Impacts on Society - Advanced fuel economies in both traditional internal combustion engine vehicles (ICEs) and electric vehicles (EVs) have a strong influence on transportation revenue by reducing fuel consumption per vehicle and ultimately drawing down the amount of fuel tax revenue received. It is expected that more ICE vehicles with advanced fuel economies and EVs, especially gasoline hybrid EVs, will enter the roadway in coming years, and fuel tax revenues and the Highway Trust Fund will increasingly become more affected. This study estimated the impact that increased sales of advanced ICEs and EVs will have on future fuel tax revenues by drawing on industry estimates of future EV and ICE market shares and anticipates future fleet mix and fuel economy for both vehicle technologies. An estimation process overview is provided and assumptions are described.

Research results disseminated through:

- Final technical report: Transportation Revenue Impacts from a Changing Light-Duty Vehicle Fleet, Andrea Hall, C. Michael Walton and Peter J. Jin, UT-Austin, September 2013, 87 pp.
- Poster Presentations: 2 (TRB Annual Meeting, Washington, D.C., January 2013; and the Center for Transportation Research Symposium, Austin, TX, April 2013)

♦ SWUTC Project #600451-00074: Future Mobility Demand in Megaregions: A National Study with a Focus on the Gulf Coast - This study developed an alternative approach to megaregional transportation planning based on forecasting future income and population growth. It produced an aggregate technique to forecast future mobility demand, particularly the demand for high-speed travel (e.g., by the mode of air and high-speed rail). It offers recommendations for planning and policy-making for megaregional transportation development (for both passenger and freight), with specific attention to the Gulf Coast Megaregion in conjunction with the Texas Triangle Megaregion.

Research results disseminated through:

- Final Technical Report: Future Mobility Demand in Megaregions: A National Study with a Focus on the Gulf Coast, Ming Zhang and Wenjia Zhang, UT- Austin, September 2013, 65 pp.

♦ SWUTC Project #600451-00075: Develop a System to Support Preparation of Life-Cycle Budget Needs for Highways - The results of this project contribute significantly to the estimate of budget needs and scenario analyses of budget allocations for large-scale highway infrastructure networks. Information obtained from budget needs analysis and budget allocations can assist state DOT decision makers at various levels make more informed decisions. For example, some of the results based on the work of this project have helped develop information that was presented to the Texas Legislature for policy decisions on funding appropriations. Specifically, it helped TxDOT with its implementation of a 4-year pavement management plan program which resulted in TxDOT being selected to receive the 2011 Global Road Achievement Award (GRAA) by the International Road Federation (IRF).

Research results disseminated through:

- Final Technical Report: Simulation of Investment Returns of Toll Projects, Weiyuan Yuwen and Zhanmin Zhang, UT- Austin, August 2013, 53 pp.
- Presentations: 2 (citations in Products Section of previous PPRs)
- Journal Articles Submitted for Review: 1 (citation in Products Section of this report)

#### **Plans for Next Reporting Period to Accomplish Research Goal:**

- Provide support, guidance and assistance to project Principal Investigators to facilitate the achievement of individual research project objectives in compliance with approved work plans.

#### **SWUTC Goal #2: Education and Workforce Development Programs**

With this grant, SWUTC will promote excellence and the preeminent status 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 July 1, 2013 – December 31, 2013:**

♦ SWUTC graduate scholarship programs continue uninterrupted from old grant to new grant. The ultimate goal of the SWUTC graduate program is to prepare a highly qualified cadre of new professionals into transportation science. These programs provide stipends 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.



Current Status:

Transportation Scholars Program at TAMU - Number of students currently in program: 7 (full tuition, fees and stipend support)

Advanced Institute at the UT- Austin – Number of students currently in program: 19 (receiving full tuition, fees and stipend support) 9 (just tuition and fees)

Graduate Stipend Program at Texas Southern University (TSU) – Number of students currently in program: 4 (receiving stipend support)

◆ **Summer Undergraduate Fellows Programs**

The SWUTC Summer Undergraduate Fellows Programs at the UT- Austin and TAMU continue to be extremely successful recruiting endeavors to attract a diverse group of students into the graduate programs in transportation. Each year, the Summer Undergraduate Fellows Programs recruit 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. The students at both UT-Austin and TAMU 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. At TAMU, the papers are published annually as a *Compendium of Student Papers* and posted on the SWUTC website.

Current Status:

Undergraduate Transportation Scholars Program (UGTSP) at TAMU. 2013 program completed August 2, 2013. Number of students participating: 5. Program summary available online at <http://swutc.tamu.edu/2013/08/20/2013-tamu-summer-undergraduate-program-concludes/>

Undergraduate Summer Internship in Transportation (USIT) at UT- Austin. 2013 program completed August 15, 2013. Number of students participating: 8. Program summary available online at <http://swutc.tamu.edu/2013/08/20/2013-ut-austin-undergraduate-summer-internship-in-transportation-program-concludes/>

◆ **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 (and listed in the previous PPR), five are now complete. (Citations in Products Section of this report)

2013 PhDCA Program

Six proposals selected for FY13 funding – all efforts initiated September 1, 2013 and are currently in progress.

**FY13 Efforts Selected**

| <b>Study Title</b>  | <b>Student Name</b> |
|---|---------------------|
| Link Travel Time Estimation Based on Network Entry/Exit Time Stamps of Trips                        | Wen Wang            |
| Mechanism Design for Ridesharing Services   | Wei Lu              |
| Flexible Base Course Performance Prediction of Roadway Infrastructures through Nondestructive Tests | Hakan Sahin         |
| Real Options Analysis to Value Managed Lanes  | Sunghoon Lee        |

| Study Title   | Student Name          |
|---|-----------------------|
| Incorporating Risk and Uncertainty into Pavement Network Maintenance and Rehabilitation Budget Allocation Decision-Making | Jose Menendez         |
| Arterial Signal Coordination with Multi-class Macroscopic Modeling and Dedicated Short Range Communications               | Kamontheop Tiaprasert |

◆ **Development of New Collaborative Transportation Statistics and Microsimulation Distance Learning Course** at TAMU and University of Nebraska-Lincoln (UNL). (SWUTC Educational Initiative #600451-00032)

This course is a collaborative effort between TAMU and UNL to provide a practice-based statistics distance-learning course for transportation engineering students. This course is based on Statistics 658 (TAMU) taught by Distinguished Professor Cliff Spiegelman and CIVE 898-Transportation Microsimulation & Statistics (UNL) taught by Dr. Larry Rilett. The transportation statistics textbook previously developed by the SWUTC and authored by Spiegelman, Park, and Rilett will be utilized in the course.

The course will cover topics important for transportation engineers that are not usually covered in general engineering statistics courses. Topics include microsimulation, discrete regression, and design of experiments. The focus will be on actual transportation problems and will utilize a number of case studies based on SWUTC and MATC research. The course will be taught jointly at TAMU and UNL via web link. During each lecture, Dr. Spiegelman will be present in the TAMU classroom, with Dr. Rilett in the UNL classroom.

Current Status:

Course outline developed during fall 2013. Course will be taught to both TAMU and UNL students beginning spring 2014. In spring 2015 the course will be made available to the consortium members of SWUTC and MATC. It will be also available to students participating in the USDOT Regional Centers Certificate Program. It is anticipated that there will be sufficient demand for the course to make it self-funding by spring 2016.

◆ **Transportation and Security Institute (TSI): Recruiting Next Generation Professionals** at TSU.

This program focuses on the mission and objectives of transportation security professionals and introduces a pre-selected group of high school students to the various career opportunities within the profession of transportation security. The objective of the TSI is to provide the framework that would expose high school students to the transportation security industry via hands-on technical activities, field trips to transportation facilities, lectures by transportation professionals, and on site seminars. Industry professionals will reinforce the importance of mathematics, science, and technology skills. Students will also observe how public/private partnerships work to strengthen the link between today's students and future transportation security needs.

Current Status:

The 2013 program was completed July 19, 2013. Number of students participating: 25. 2013 Program summary report: Transportation Security Institute: Recruiting Next Generation Professionals, Khosro Godazi and Alexandra Miller, TSU, August 2013, 30 pp.

◆ **TxDOT Undergraduate Summer Internship** at TAMU.

This pilot TxDOT program, coordinated by the SWUTC, was a paid 10-week program for undergraduate engineering or planning students with an interest in transportation research. After a competitive selection process, two students were chosen to participate in this year's program. Gabriel Landaverde and Hunter Smith are both TAMU students with an interest in transportation. They are studying construction management and urban planning, respectively. The interns were mentored by senior transportation professionals as they participated on sponsored research efforts at TTI's Austin office. The interns also spent two days each week at TxDOT headquarters and gained a behind-the-scenes look into the operations of a major state agency.

Current Status:

Program completed August 16, 2013. Program summary available at: <http://swutc.tamu.edu/2013/09/05/txdot-swutc-collaborate-on-new-educational-opportunity-for-summer-2013/>

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

- Continue support of graduate scholarship programs at TAMU, UT-Austin and TSU, and the Ph.D. Candidate Assistantship Program at TAMU.
- Support summer 2014 Undergraduate Fellows Programs at TAMU and the UT-Austin.
- Support spring offering of Transportation Statistics and Microsimulation distance learning course.

### **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:**

- Continue to update website with recent center activities and accomplishments.
- Publish final technical reports as individual research projects are completed.
- Continue to support researchers as they present their research results through peer-reviewed publications and professional presentations.

## **2. Products:**

### *SWUTC Publications/papers/presentations for this reporting period:*

#### **Publications Submitted for Review:**

A New Spatial Multiple Discrete-Continuous Model for Land Use Change Analysis, S. K. Dubey and C. R. Bhat, UT- Austin, to the *Journal of Regional Science*. (Product of SWUTC Project #600451-00063)

Transportation Systems and the Built Environment: A Life-Cycle Energy Case Study and Analysis, Kara Kockelman, UT- Austin, to *Energy Policy*. (Product of SWUTC Project #600451-00067)

Policy Implications of Automated Vehicles on Texas Highways, Ginger Goodin, TAMU, to TRB for inclusion in book about automated vehicle policy implications. (Product of SWUTC Project #600451-00029)

Effects of Varying Work Zone Configuration, Distances Between Traffic Signs and Individual Differences on Drivers' Perceived Workload, M. Shakouri, K Punniaraj, F. Aghazadeh, L. Ikuma and S. Ishak, Louisiana State University (LSU), to the *Transportation Research Record: Journal of the Transportation Research Board*. (Product of SWUTC Project #600451-00103)

Anisotropic Modeling of Compressive Crack Growth in Tertiary Flow of Asphalt Mixtures, Y. Zhang, R. Luo and R. Lytton, TAMU, to the *Journal of Engineering Mechanics*, American Society of Civil Engineers (ASCE). (Product of SWUTC Project #600451-00006)

Development and Validation of a Generalized Viscoplastic Yield Surface Model for Asphalt Concrete, Y. Zhang, M. Bernhardt, G. Biscontin, R. Luo and R. Lytton, TAMU, to the *Journal of Engineering Mechanics*, ASCE. (Product of SWUTC Project #600451-00006)

Surface Tension of Asphalt Binders with and without Warm Mix Additives at Typical Mixing and Compaction Temperatures, Amit Bhasin, UT- Austin, to the *International Journal of Pavement Engineering*. (Product of SWUTC Project #600451-00062)

Preparing a Nation for Autonomous Vehicles: Opportunities, Barriers and Policy Recommendations for Capitalizing on Self-Driven Vehicles, Kara Kockelman, UT-Austin, to *Eno* for public release. (Product of SWUTC Project #600451-00081)

Effect of Phased Evacuations in Megaregion Highway Networks, Z. Zhang, K. Spansel and B. Wolshon, LSU, to the *Transportation Research Record*, August 2013. (Product of SWUTC Project #600451-00101)

Preparing a Nation for Autonomous Vehicles: Opportunities, Barriers and Policy Recommendations for Capitalizing on Self-Driven Vehicles, Kara Kockelman, UT-Austin, to *Transportation Research Part A*. (Product of SWUTC Project #600451-00081)

Environmental Implications of Shared Autonomous Vehicles using an Agent-Based Model, Kara Kockelman, UT-Austin, to *Transportation Research Part C*. (Product of SWUTC Project #600451-00081)

Commentary on the Transportation Investment Generating Economic Recovery Program, K. Lowe, University of New Orleans (UNO), to *Public Works Management and Policy*. (Product of SWUTC Project #600451-00106)

Game-Theoretic Learning Models in Traffic Assignment, T. Rambha, S. Boyles and K. Yin, UT-Austin, to *Networks & Spatial Economics*. (Product of SWUTC Project #600451-00065)

Controlling Electrical Conductivity and Mechanical Performance of Asphalt Concrete with Conductive Additives, Phillip Park, TAMU, to *Construction and Building Materials*. (Product of SWUTC Project #600451-00025)

Controlling Electrical Conductivity of Asphalt Binder Using Graphite, Phillip Park, TAMU, to *Construction and Building Materials*. (Product of SWUTC Project #600451-00025)

Performance Characteristics of Megaregion Traffic Networks During Mass Evacuations, Z. Zhang, K. Spansel, V. Dixit and B. Wolshon, LSU, to the *International Journal of Transportation*. (Product of SWUTC Project #600451-00114)

A Transportation Corridor Analysis Toolkit, Dan P.K. Seedah, Rydell D. Walthall, Carrett Fullerton, Travis D. Owens and Robert Harrison, UT-Austin, to *Transportation Research Part E: Logistics and Transportation Review*. (Product of SWUTC Project #600451-00066)

Infrastructure Performance Modeling: A Discrete Logit Model Approach, Z. Zhang and L. Gao, UT- Austin, to the *ASCE Journal of Infrastructure Systems*. (Product of SWUTC Project #600451-00075)

#### **Journal Submissions Published:**

Exposing Minority Students to Transportation and STEM-related Careers through Summer Education Programs. K. Godazi, R. Goodwin, F. Qiao, TSU, published in the *Journal of Transportation Research Record*, No. 2328, pp. 16-24. (Product of SWUTC Project #161340)

Characterization of Viscoplastic Yielding of Asphalt Concrete, Y. Zhang, R. Luo and R. Lytton, TAMU, published technical paper in *Construction and Building Materials*, 47, 671-679, 2013. (Product of SWUTC Project #600451-00006)

Estimation of Design Lengths of Left-turn Lanes, Yi Qi, L. Guo, L. Yu and H. Teng, Texas Southern University, published in *ASCE Journal of Transportation Engineering*, Volume 138, Issue 3, pp. 274-283, 2012. (Product of SWUTC Project #600451-00044 – citation not captured in previous PPPRs)

#### **Products of SWUTC Ph.D. Candidate Assistantship Program at TAMU:**

Dissertation: Fatigue Resistance of Asphalt Mixtures Affected by Water Vapor Movement, Yunwei Tong, December 2013, 71 pp. (Product of SWUTC Project #600451-00019)

Dissertation: A Multivariate Analysis of Freeway Speed and Headway Data, Yajie Zou, December 2013, 70 pp. (Product of SWUTC Project #600451-00020)

Dissertation: Examining Decision-Making Surrounding the Use of Managed Lanes by Katy Freeway Travelers: A Prospect Theory Approach, Chao Huang, December 2013, 184 pp. (Product of SWUTC Project #600451-00023)

Dissertation: Performance Analysis of Isolated Intersection Traffic Signals, Kai Yin, October 2013, 142 pp. (Product of SWUTC Project #600451-00021)

Dissertation: A Methodology for Developing Performance-related Specifications for Pavement Preservation Treatments, Litao Liu, September 2013, 189 pp. (Product of SWUTC Project #600451-00022)

**Presentations (new citations since last reporting period):**

Life-cycle Energy Impacts of Different Neighborhood Types: Identifying Critical Design Levers for the Short and Longer Terms, Kara Kockelman, UT-Austin, to the 60<sup>th</sup> Annual North American Meetings of the Regional Science Association International, Atlanta, GA, November 13-16, 2013. (Product of SWUTC Project #600451-00067)

Environmental Implications of Shared Autonomous Vehicles using an Agent-Based Model, Kara Kockelman, UT-Austin, to the 60<sup>th</sup> Annual North American Meetings of the Regional Science Association International, Atlanta, GA, November 13-16, 2013. (Product of SWUTC Project #600451-00081)

A New Spatial Multiple Discrete-Continuous Modeling Approach to Land Use Change Analysis, C.R. Bhat, S.K. Dubey, UT-Austin, to 60<sup>th</sup> Annual North American Meetings of the Regional Science Association International, Atlanta, GA, November 2013. (Product of SWUTC Project #600451-00063)

Diverge Nodes and Traffic Equilibria, S. Boyles J. Duthie, C. Melson and T. Rambha, UT-Austin, to the Annual Meeting of the Institute for Operations Research and Management Sciences, Minneapolis, MN, October 2013. (Product of SWUTC Project #600451-00079)

Game-Theoretic Learning Models in Traffic Assignment, T. Rambha, S. Boyles and K. Yin, UT-Austin, to the Annual Meeting of the Institute for Operations Research and Management Sciences, Minneapolis, MN, October 2013. (Product of SWUTC Project #600451-00065)

Findings and Methodologies from the Urban Mobility Report and Congested Corridors Report, David Schrank, TAMU, to the 5<sup>th</sup> METRANS International Freight Conference, Long Beach, CA, October 2013. (Product of SWUTC Project #161302)

Stochastic Geomechanics for Optimal Risk-Based Decision-Making, Zenon Medina-Cetina, TAMU, to the technical session – *Working with Uncertainty and Complexity in Modern Engineering Geology* at the 56<sup>th</sup> Annual Meeting of the Association of Environmental and Engineering Geologists AEG, Seattle, WA, September 8-15, 2013. (Product of SWUTC Project #600451-00027)

Federalism, Politics & Economic Development: The Port of Gulfport as Transportation Histrionics, Bethany Stich and Kyle Griffith, UNO, to the Southeastern Conference of Public Administration, Charlotte, NC, September, 25-28, 2013. (Product of SWUTC Project #600451-00118)

Modeling Evacuation Megaregion Traffic Networks, B. Wolshon, LSU, to the session on: *Evacuation and Emergency Transportation Planning Tools, Methods, and Guidebooks*, 2013 Transportation Hazards and Security Summit, Irvine, CA, August 2013. (Product of SWUTC Project #600451-00101)

How do Travelers Perceive and Value Travel Time Reliability – Initial Findings, Mark Burris, TAMU, to the 13<sup>th</sup> Chinese Overseas Transportation Association International Conference of Transportation Professionals, Shenzhen, China, August 13-16, 2013. (Product of SWUTC Project #161304)

The Impact of Sign Placement, Traffic Density and Merge Type on Driving Behavior in Construction Zones, M. Shakouri, K. Punniaraj, L. Ikuma and F. Aghazadeh, LSU, to the 2013 Industrial and Systems Engineering Research Conference, Puerto Rico, 2013. (Product of SWUTC Project #600451-00103)

The Impact of Sign Placement, Traffic Density and Merge Type on Driving Behavior in Construction Zones, M. Shakouri, LSU, to the 12<sup>th</sup> MIE graduate student conference, LSU, Baton Rouge, LA, 2013. (Product of SWUTC Project #600451-00103)

Findings and Methodologies from the Urban Mobility Report and Congested Corridors Report, David Schrank, TAMU, to ITE Annual Meeting, Boston, MA, August 2013 (Product of SWUTC Project #161302)

Bayesian Forecasting of Energy Developments, Zenon Medina-Cetina, TAMU, to the Texas Census Research Data Center, College Station, TX, July 2013. (Product of SWUTC Project #600451-00027)

Constitutive Modeling of Anisotropic Viscoplasticity of Asphalt Concrete, Y. Zhang, R. Lytton, TAMU, to the 12<sup>th</sup> US National Congress for Computational Mechanics, Raleigh, North Carolina, July 22-25, 2013. (Product of SWUTC Project #600451-00006)

Modeling Asphalt Concrete in Compression, Y. Zhang, R. Luo and R. Lytton, TAMU, to the 49<sup>th</sup> Petersen Asphalt Research Conference, Laramie, WY, July 9-11, 2013 (Product of SWUTC Project #600451-00006)

A New Spatial Multiple Discrete-Continuous Modeling Approach to Land Use Change Analysis, C.R. Bhat, S.K. Dubey, UT-Austin, to the International Choice Modeling Conference, Sydney, Australia, July 2013. (Product of SWUTC Project #600451-00063)

Policy Implications of Automated Vehicles on Texas Highways, Ginger Goodin, TAMU, poster presentation at TRB Automated Vehicle Conference, Stanford University, CA, July 15-19, 2013. (Product of SWUTC Project #600451-00029)

Developing a Research Agenda to Increase Cycling in the African-American Community, T. McCray, T. Durden, M. Waters and E. Schaubert, UT-Austin, to the joint AESOP/ACSP Congress Dublin: Planning for Resilient Cities and Regions, Dublin, Ireland, July 15-19, 2013. (Product of SWUTC Project #600451-00070)

Findings and Methodologies from the Urban Mobility Report and Congested Corridors Report, David Schrank, TAMU, to the Expedite Association of North America – Annual Meeting, San Antonio, TX, July, 2013. (Product of SWUTC Project #161302)

Environmental Implications of Shared Autonomous Vehicles Using an Agent-Based Model, Kara Kockelman, UT-Austin, to the TRB Automated Vehicle Conference, Stanford University, CA, July 16-19, 2013. (Product of SWUTC Project #600451-00081)

Calibration of the Louisiana Highway Safety Manual, B. Robicheaux and B. Wolshon, LSU, interim report to the Louisiana Department of Transportation and Development, July 2013. (Product of SWUTC Project #600451-00102)

Findings and Methodologies from the Urban Mobility Report and Congested Corridors Report, David Schrank, TAMU, to West Houston Leadership Institute, Houston, TX, July 2013. (Product of SWUTC Project #161302)

A New Spatial Multiple Discrete-Continuous Modeling Approach to Land Use Change Analysis, C.R. Bhat, S.K. Dubey, UT-Austin, to the Indian Institute of Technology, Kanpur, India, June 2013. (Product of SWUTC Project #600451-00063)

Findings and Methodologies from the Urban Mobility Report and Congested Corridors Report, David Schrank, TAMU, to Greater Houston Partnership, Houston, TX, June 2013. (Product of SWUTC Project #161302)

Capacity or Equity? Federal Funding Competition Across and Within Regions, K. Lowe, S. Reckhow, J. Gainsborough, UNO, to Building Resilient Regions Research Networks at the Urban Institute, Washington, D.C., May 31, 2013. (Product of SWUTC Project #600451-00106)

Environmental Implications of Shared Autonomous Vehicles using an Agent-Based Model, Kara Kockelman, UT-Austin, to the 2013 ITS America Annual Meeting, Nashville, TN, April 22-24, 2013. (Product of SWUTC Project #600451-00081)

Findings and Methodologies from the Urban Mobility Report and Congested Corridors Report, David Schrank, TAMU, to Civil Engineering Graduate Transportation Seminar Class – UT-Austin, April 2013. (Product of SWUTC Project #161302)

Data Challenges in Economic Impact Assessment of Transportation Infrastructure Projects, Bethany Stich, UNO, to the American Society for Public Administration, New Orleans, LA, March 13-16, 2013. (Product of SWUTC Project #600451-00108)

Findings and Methodologies from the Urban Mobility Report and Congested Corridors Report, David Schrank, TAMU, to North Houston Association, Houston, TX, March 2013. (Product of SWUTC Project #161302)

Calibration of Louisiana Highway Safety Manual, B. Wolshon, LSU, to Session 37: University Transportation Center-Safety and Policy Research, Baton Rouge, LA, February 2013. (Product of SWUTC Project #600451-00102)

Websites (other than SWUTC website) and other social media utilized for this reporting period:

Project 161302: <http://mobility.tamu.edu/ums/>

<http://mobility.tamu.edu/corridors>

Project 600451-00016: <http://faculty.arch.tamu.edu/kchoi/research.html>

Project 600451-00017: <http://trbappcon.org/program.aspx>

Project 600451-00027: <https://stochasticgeomechanics.civil.tamu.edu/efd/>

Project 600451-00063: [http://www.cae.utexas.edu/prof/bhat/full\\_papers.htm](http://www.cae.utexas.edu/prof/bhat/full_papers.htm)

Project 600451-00081: <http://www.cae.utexas.edu/prof/kockelman>

Project 600451-00082: <http://www.trb.org>

Project 600451-00101: <http://www.evaccenter.lsu.edu>

Project 600451-00103: [http://www.rita.dot.gov/utc/publications/spotlight/spotlight\\_2013\\_07](http://www.rita.dot.gov/utc/publications/spotlight/spotlight_2013_07)

Project 600451-00105: <http://www.ltrc.lsu.edu>

Technologies or techniques for this reporting period:

◆ **Improved Methodology** – Updated methodology for incorporating public transportation benefits into TTI’s *Urban Mobility Report*. (Product of SWUTC Project #600451-00013)

◆ **Increased Safety Awareness** – SWUTC Project #600451-00015 - *U in the Driver Seat* developed peer-to-peer outreach protocol as part of an overall strategy to address roadway safety in a community – in this case a college campus.

◆ **Improved Technique** – SWUTC Project #600451-00016 – *Decision-Support Framework for Quantifying the Most Economical Incentive/Disincentive Dollar Amounts for Critical Highway Pavement Rehabilitation Projects* created, tested, and validated a novel framework that determines the most economical, realistic incentive/disincentive (I/D) dollar amounts for high-impact highway rehabilitation projects. This framework serves as a foundation for a new decision-support computerized model for I/D contracting.

◆ **New Methodology** – SWUTC Project #600451-00063 – *The Transportation-Related Causes and Consequences of Land Use Change* has developed a new methodology for modeling land use in urban areas.

◆ **Toolkit Enhancement** – SWUTC Project #600451-00066 – *Multistate Megaregion Freight Planning Benefits* produced an enhancement for planners evaluating modal corridors using the truck-rail intermodal toolkit (TRIT) which examines freight movement along corridors based on mode and route characteristics. The enhancement includes techniques to acquire data for simulating line-haul movements and models to evaluate multiple freight movement scenarios along corridors.

◆ **Emissions Analysis Toolkit** – SWUTC Project #600451-00067 – *Life-cycle Costs and Benefits of Different Land use and Transportation Patterns* built a spreadsheet-based energy and greenhouse gas emissions analysis toolkit for neighborhoods and cities. This spreadsheet allows planners and researchers to evaluate the life-cycle

costs and impacts of various built environments, at a holistic scale currently unavailable in any other tool. The software can guide early projects on energy, emissions, and cost impacts of land-use policies.

◆ **New Design Tool** – SWUTC Project #600451-00069 – Development of an Interactive GIS Based Work Zone Traffic Control Design Tool produced a planning tool that brings together elements of GIS, data bases containing geometric characterizations of roadways, traffic volume data and traffic control information. The resulting package provides users with a conveniently available tool for developing or checking work zone traffic control plans.

◆ **New Forecasting Technique** – SWUTC Project #600451-00074 – Future Mobility Demand in Megaregions developed an aggregate technique to forecast future mobility demand, particularly the demand for high-speed travel (e.g., by the mode of air and high-speed rail). It is based on forecasting future income and population growth.

Inventions/patent applications/licenses for this reporting period: Nothing to report at this time.

Other Products for this reporting period:

◆ **Educational Aids** – SWUTC Project #161306 – Developing the Hydraulics, Sedimentation and Erosion Control Laboratory to Become a Hands-on Training and Education Center produced three low impact development (LID) course modules to facilitate professional and student education. Subjects covered: Bioswales, Porous Pavements and Green Roofs.

◆ **Training Program** – SWUTC Project #600451-00070 – Developing a Research Agenda to Increase Cycling in the African American Community produced an innovative cycling training program which focuses on changing perceptions and increasing the number of African Americans who cycle.

◆ **Models:**

- SWUTC Project #600451-00075 – Develop a system to Support Preparation of Life-Cycle Budget Needs for Highways developed models for quantifying project costs.
- SWUTC Project #600451-00006 – A Comprehensive Characterization of Asphalt Mixtures in Compression developed a model that provides an innovative and straight-forward method to account for material properties and comprehensively characterize the asphalt mixture in compression.

### 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.

**New partnerships for this reporting period:**

Asbury Carbons – Contribution: in-kind support – provided various types of graphite samples and technical consulting on the selection and basic properties of graphite for SWUTC Project #600451-00025.

Lawrence Berkeley National Laboratory - Contribution – in-kind support – provided assistance on the implementation of the software SeTES to manage large databases on well data and to be used for the assessment of shale gas production – SWUTC Project #600451-00027.

Texas Census Research Data Center – Contribution – in-kind support – helped define a long-term collaboration strategy on the use of US Census data to link shale gas production with environmental and social risk assessments – SWUTC Project #600451-000027.

Grupo Plenum (Mexico) – Contribution – in-kind research contribution for leveling the use of spatio-temporal data assimilation via haptic technology – SWUTC Project #600451-00027.

Houston Transtar (Public Works & Engineering) – Contribution – in-kind support – provided assistance selecting locations for LED traffic light conversions and data for analysis – SWUTC Project #600451-00041.



Robert Leilich (noted rail consultant) – Contribution – in-kind support – helped in developing locomotive rail operating behavior based on the URCS model. – SWUTC Project #600451-00066

Union Pacific Railroad – Contribution – in-kind support - provided assistance on evaluating research approach – SWUTC Project #600451-00066.

TxDOT – Contribution – provided financial support to enlarge the project scope of work to capture other parts of the five-state GIWW – SWUTC Project #600451-00080.

Mellow Johnny’s Bike Shop – Contribution – in-kind support – provided rental bikes to study participants at a reduced rate, and a facility for research staff to meet with study participants. SWUTC Project #600451-00084.

Southwest Jiaotong University – People’s Republic of China – Contribution – In-kind support - Zhao Zhang served as lead researcher to develop the traffic model for the traffic loading and traffic management scenarios utilized in this research effort. SWUTC Project #600451-00101.

LSU – Dr. Helmut Schneider, Chair of Information Systems and Decision Science Department – Contribution – In-kind support – provided guidance and support for the statistical analysis for SWUTC Project #600451-00102.

Louisiana Transportation Center – Contribution – In-kind expertise and financial support to SWUTC Project #600451-00102.

Port of South Louisiana, Port of New Orleans and IFFCBANO (New Orleans based international freight forwarders and custom broker’s organization) – Contribution – In-kind support – representatives from these organizations reviewed and commented on project preliminary findings of SWUTC Project #600451-00105.

Bentley University – Contribution – In-kind support – Dr. Juliet Gainsborough – faculty time to assist in research effort. SWUTC Project #600451-00106.

Michigan State University – Contribution – In-kind support – Dr. Sarah Reckhow – faculty time to assist in research effort. SWUTC Project #600451-00106.

Building Resilient Regions Research Network – Contribution – financial. Provided travel funds and honorarium for presenting study findings at symposium. SWUTC Project #600451-00106.

#### 4. Impact

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

◆ **Civil Engineering/Urban Planning:**

- The research results of SWUTC Project #600451-00065: *Game Theory and Traffic Assignment* will lead to more accurate transportation planning forecasts, which are especially relevant when doing analyses related to social equity and environmental justice. In addition, a concept identified in this project, which is currently being explored in further research, may lead to revisiting some of the standard assumptions in traffic modeling.
- Results from SWUTC Project #600451-00074: *Future Mobility Demand in Megaregions: A National Study with a Focus on the Gulf Coast* provides improved transportation planning techniques that impact the urban and regional planning discipline.

◆ **Civil Engineering/Materials:**

- SWUTC Project #600451-00062: *Workability of Asphalt Binders at Mixing Temperatures for Hot and Warm Mix Asphalt (WMA)* produced results that provided indirect evidence for a model of asphalt binders that has been hypothesized for several years which will impact materials science.

*Impact on other disciplines for this reporting period:*

◆ **Study Impacts Multiple Disciplines.** The theories developed by SWUTC Project #600451-00006: *A Comprehensive Characterization of Asphalt Mixtures in Compression* applies to many other materials used in industry. Examples include:

- The compressive cracking theory can be employed to study the time-dependent cracking of rocks under high compressive earth pressures.
- The viscoplastic deformation theory including flow rule, yield surface and plastic potential can be used to predict the permanent deformation of many geo-materials such as soils, aggregates, sands, cement and concrete.
- The energy-based fracture method can be used to predict the time-dependent cracking of polymer-based materials used in the industries as diverse as aerospace, medicine, adhesives, and infrastructures.

♦ **Cross-discipline professional training** proposed by SWUTC Project #161306: *Developing the Hydraulics, Sedimentation and Erosion Control (SEC) Laboratory to Become a Hands-on Training and Education Center* described in the following Workforce Development Section will impact other disciplines.

♦ **Impact on Behavioral Economics.** SWUTC Project #600451-00007: *A Comprehensive VMT Fee Equity Impact Analysis* – Results of research applicable to the behavioral sciences, specifically behavioral economics.

*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, 89 graduate students and 43 undergraduate 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: 30

♦ **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: 13

♦ **Undergraduate Summer Internships Provided.** This program, supported by the TxDOT, is a paid internship for two undergraduate engineering or planning students with an interest in transportation research. Undergraduate students supported this reporting period: 2.

♦ **Research Results Transferred to the Classroom.**

- SWUTC Project #600451-00016: *Decision-support Framework for Quantifying the Most Economical Incentive/Disincentive Dollar Amounts for Critical Highway Pavement Rehabilitation Projects*. Research results incorporated into the curriculum for the graduate course Advanced Infrastructure Planning and Management in the Construction Science Department at TAMU.
- SWUTC Project #600451-00065: *Game Theory and Traffic Assignment: Refinements, Stability and Tractability*. Study findings incorporated into graduate courses CE392C (Transportation Network Analysis) and 293DD (Dynamic Traffic Assignment) at the UT-Austin.
- SWUTC Project #600451-00012: *Fatigue Modeling of Hot Mix Asphalt using Field Samples to Ensure a State of Good Repair*. Slide Presentation: Uniaxial Fatigue Testing incorporated into CVEN 417/653 Bituminous Materials course at TAMU.

♦ **Promoting Careers in Transportation (K-12).** Transportation Security Institute (TSI): *Recruiting Next Generation Professionals* at TSU provided 25 high school students with the opportunity to learn about careers in the transportation security industry via hands-on technical activities, field trips to transportation facilities, lectures by transportation professionals, and on site seminars during its 2013 annual summer program.

♦ **Professional Development through Hands-on Training.** If the proposed master plan developed by SWUTC Project #161306: *Developing the Hydraulics, Sedimentation and Erosion Control (SEC) Laboratory to*

Become a Hands-on Training and Education Center is implemented, there will be physical changes to the SEC Lab. Examples include a porous paving station, sustainable planting demonstration, and bioretention best management practice demonstrations. The lab will provide high-impact education and hands-on training meant to bring various disciplines together in one training program so that cross-disciplinary interchanges can occur. Examples would include professionals in civil engineering, landscape architecture and soil sciences. The proposed plan provides facilities where participants will learn how to apply Low Impact Development (LID) techniques in transportation environments to better manage stormwater runoff.

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 #600451-00012: *Fatigue Modeling of Hot Mix Asphalt Using Field Samples to Ensure a State of Good Repair* This study provides, through a comparison of two recently developed approaches to evaluate fatigue resistance of hot mix asphalt, insight to their similarities and shortcoming in terms of both testing and analysis. By providing a better understanding of mixture resistance to fatigue cracking, this study will enable state departments of transportation and other transportation agencies to better plan and use the most economical methods for extending the life of the pavement to provide a safer, efficient, and sustainable transportation system.
- SWUTC Project #600451-000013: *Improvements to the Urban Mobility Report Methodology*. The results of the *Urban Mobility Report* are often cited for policy or decision-making by transportation professionals. While the methods developed as a part of this research will only influence portions of the *Urban Mobility Report* analyses, the refinements in the methodology improve the methods and, therefore, decisions made based on the data in the *Urban Mobility Report*.
- Research effort SWUTC Project #600451-00016: *Decision-Support Framework for Quantifying the Most Economical Incentive/Disincentive (I/D) Dollar Amounts for Critical Highway Pavement Rehabilitation Projects* is the first of its kind and expected to be a significant leap forward over current ad-hoc approaches that rely heavily on agency engineers' intuition, historical data, and judgment, made primarily on the impact of I/Ds on road users. The research results provide research communities and industry practitioners with the first holistic view that they can use to determine the most economical and realistic I/D dollar amounts for a given project. Use of the proposed framework can help agency engineers and decision makers make better-informed decisions and allocate more realistic incentives when they consider the implementation of an I/D provision, which will result in more favorable cost-benefit ratios and better use of public funds.
- The knowledge from SWUTC Project #600451-00062: *Workability of Asphalt Binders at Mixing Temperatures for Hot and Warm Mix Asphalt (WMA)* can be used to explain mechanisms that allow the production of WMA and assess the efficacy of different chemical additives. DOT engineers can use this knowledge to make more informed decisions while approving chemical additives for use in WMA.
- Results from SWUTC Project #600451-00066: *Multistate Megaregion Freight Planning Benefits: Evidence from Louisiana-Texas* will allow transportation planners and policy makers to make informed decisions on the impact of multimodal freight infrastructure improvements on users. The toolkit developed by this research provides an additional instrument that fills the freight data gap which currently limits available planning models.
- The toolkit developed by SWUTC Project #600451-00067: *Life-cycle Costs and Benefits of Different Land Use and Transportation Patterns* provides planners and researchers with an instrument to evaluate the life-cycle costs and impacts of various built environments, at a holistic scale currently unavailable in any other tool. The software can guide early projections on energy, emissions, and cost impacts of land-use policies.

- The work zone planning toolkit developed by SWUTC Project #600451-00069: *Development of an Interactive GIS Based Work Zone Traffic Control Design Tool* provides a convenient way for public agencies to plan construction activities to minimize highway user costs and improve safety. This will reduce societal costs of highway construction and re-construction activities.
- SWUTC Project #600451-00072: *Private vs. Public Financing of Transportation Systems* produced findings that extend the knowledge base about Public-Private Partnerships (PPP) for transportation infrastructure in the U.S. The study findings and conclusions will serve to improve public knowledge and attitudes, as well as changing behavior, practices for the development of future PPP agreements, decision-making and/or policies towards PPPs in the U.S
- SWUTC Project #600451-00073: *Transportation Funding for a Changing Light-Duty Vehicle Fleet: Pricing Model and Evaluation of Impacts on Society* is one the first studies to take a comprehensive view of the impact that advanced fuel economy and electric vehicles may have on transportation funding in the U.S. through reduced fuel consumption and fuel tax revenues. Study findings will be helpful for public transportation agencies that seek supporting arguments for development of alternative transportation revenue generation methods. In addition, the findings could serve to improve public knowledge and attitudes, as well as changing behavior, practices, decision-making and/or policies towards transportation funding in the U.S.
- Results from SWUTC Project #600451-00074: *Future Mobility Demand in Megaregions: A National Study with a Focus on the Gulf Coast* will inform MPOs and state DOTs on improving transportation planning at the regional and state-wide levels.
- SWUTC Project #600451-00075: *Develop a System to Support Preparation of Life-Cycle Budget Needs for Highways* produced results that contribute significantly to the estimate of budget needs and scenario analyses of budget allocations for large-scale highway infrastructure networks. Information obtained from budget needs analysis and budget allocations will assist state DOT decision makers at various levels make more informed decisions.

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

◆ **Influencing Traveler Behavior.** The results of SWUTC Project #600451-00007: *A Comprehensive VMT Fee Equity Impact Analysis* provides a deeper understanding of how future transportation funding decisions may impact equity. The research explored numerous funding allocations to understand the impact on various transportation policy decisions. By understanding how transportation is funded and the consequences of new funding mechanisms, DOTs and others may influence traveler behavior.

◆ **Influencing Consumer Behavior.** SWUTC Project #600451-00064: *Local Infrastructure to Support the Widespread Use of Hybrid/All Electric Vehicles* - A variety of state-level incentives discussed by this research are designed to influence consumer behavior with respect to decisions to purchase more fuel efficient and environmentally sound vehicles, especially for urban travel.

◆ **Changing Perceptions of Cycling.** The goal of SWUTC Project #600451-00070: *Developing a Research Agenda to Increase Cycling in the African American Community: A Case Study of Austin, TX* was to provide safety training intervention and to promote cycling as an alternative transportation mode, a way to achieve recommended exercise levels, and a way to build community. Study results found that perceptions of safety, comfort, and knowledge of cycling were positively influenced by increased education *and* encouragement in this activity. The “safety training” intervention developed by this project provides prospective cyclists with enough information and confidence needed to navigate the road by bicycle thereby increasing cycling rates.

## 5. Changes/Problems

Nothing to report.