

# Research Digest

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### Southwest Region University Transportation Center Reports

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## *Item 1*

### **Assessing the Potential for Gulf Coast NAFTA Maritime Trade Corridors**

SOUTHWEST REGION UNIVERSITY TRANSPORTATION CENTER (SWUTC)

*U-NOLA SWUTC/15/600451-00118-1 • 2015*

The North American Free Trade Agreement (NAFTA) was enacted in 1994 with the expressed intent of reducing barriers to trade. Since that time, however, transborder congestion and delays between the United States (US) and Mexico threaten achievement of this goal. As a partial mitigation strategy, maritime shipping offers a modal alternative for NAFTA trade with the potential for not only strengthening the resiliency of the North American transportation system, but also alleviating congestion for traditional overland modes. To that end, Gulf Coast economies are preparing for increased shipping activity in both vessel size and commodity volumes upon completion of the Panama Canal expansion by 2016. This study assesses the potential for maritime shipping corridors in the Gulf of Mexico between the US, Mexico, and Cuba. We document current trade patterns and infrastructure, analyze potential opportunities for trade expansion, and analyze the policy barriers that need to be addressed to strengthen these maritime trade corridors. The prospect of reduced transborder congestion, increased system resilience, and expanded economic cooperation with Cuba has opened a policy window for more deliberate coordination between national and state governments to make the necessary infrastructure investments and policy changes to bolster maritime shipping capacity.

This report is available for free download (4.2 MB):

<http://swutc.tamu.edu/publications/technicalreports/600451-00118-1.pdf>

## *Item 2*

### **The Conceptual Mismatch: Transportation Stressors and Experiences for Low-Income Adults**

SOUTHWEST REGION UNIVERSITY TRANSPORTATION CENTER (SWUTC)

*U-NOLA SWUTC/15/600451-00115-1 • 2015*

Physical access to jobs has long been identified as a barrier to employment and earnings, with prior research identifying the “spatial mismatch” between suburban entry-level jobs and low-income workers. However, existing transportation research on physical access fails to adequately account for the complex role that transportation needs, stressors, benefits, and costs play in low-income households. Through qualitative analysis, this study examines the role of transportation in the lives of low-income adults in two medium-sized metropolitan areas and how their actual, lived transportation experiences function as stressors with potentially compounding impacts. The study finds that job accessibility models that only account for travel time and location may not reflect the transportation time tax associated with accessing employment for some low-income households.

This report is available for free download (445 KB):

<http://swutc.tamu.edu/publications/technicalreports/600451-00115-1.pdf>

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## *Item 3*

### **A Decision Support Tool for Selecting Traffic Control Devices**

SOUTHWEST REGION UNIVERSITY TRANSPORTATION CENTER (SWUTC)

*TTI SWUTC/15/600451-00008-1 • 2015*

The Federal Highway Administration (FHWA) and transportation profession continue updating and publishing the Manual on Uniform Traffic Control Devices (MUTCD). However, it is beyond the scope of the MUTCD to provide the breadth of knowledge necessary for evaluating traffic control devices (TCDs) as part of the larger transportation system. In this report, researchers use existing theory and a survey of transportation professionals to develop a decision support tool for use in selecting TCDs. To accomplish this, researchers first use a survey of transportation professionals to evaluate the relative importance of safety, mobility, environmental sustainability, and economic activity when selecting TCDs. This investigation leads researchers to conclude that the best solution meets local needs and desires, conforms to engineering principles and practice, and provides an engineering benefit. Additionally, this investigation finds that safety and mobility are the engineering benefits driving the selection of TCDs. Next, researchers use a portion of the same survey of transportation professionals to evaluate the importance of crashes, driver compliance, and mobility when ranking transportation alternatives. This investigation finds that compliance is a reasonable surrogate measure of safety in the absence of crash data. Additionally, within this evaluation, researchers identify performance measures for use in selecting traffic control devices. Finally, researchers use the relative importance of agency objectives evaluation and the identified performance measures to develop a decision support tool for use in selecting TCDs. Researchers demonstrate the use of this decision support tool with a case study.

This report is available for free download (3.7 MB):

<http://swutc.tamu.edu/publications/technicalreports/600451-00008-1.pdf>

## *Item 4*

### **Developing a Methodology for Projecting Intercity Commuting**

SOUTHWEST REGION UNIVERSITY TRANSPORTATION CENTER (SWUTC)

*TSU SWUTC/15/600451-00043-1 • 2015*

Texas agencies are investigating passenger rail options in several corridors connecting people between the state's major cities. Popular thinking is that there is commuter travel between a number of these markets. In specific, Austin to Houston and Dallas to Houston rank as highly desirable connections to be made by passenger rail. There has been significant study of corridors linking Austin, Dallas and San Antonio; but little research considers the State Highway 290 corridor that would link Houston to Austin. A tool to project the commuter travel between these cities would be beneficial for Metropolitan Planning Organizations (MPOs) and local transit authorities. This research seeks to assess existing methodologies, and then modify, develop and recommend for testing a methodology to determine the volume and frequency of commuter travel between these markets.

This report is available for free download (717 KB):

<http://swutc.tamu.edu/publications/technicalreports/600451-00043-1.pdf>

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## *Item 5*

### **The Gulf Coast Megaregion: In Search of a New Scale to Understand Freight Transportation and Economic Development**

SOUTHWEST REGION UNIVERSITY TRANSPORTATION CENTER (SWUTC)

*U-NOLA SWUTC/15/600451-00108-1 • 2015*

Jane Jacobs famously wrote, “The economic foundation of cities is trade.” Increased global connectivity and expanding domestic markets around major city hubs have led to a spatial reorganization of regional economies towards a higher level of scale referred to as the megaregion. These trade networks rely on a complex mix of freight and telecommunications infrastructure, low trade barriers, as well as international business and social networks. Policymakers have a responsibility to recognize the vital relationship between economies and freight, and it is imperative that national policies reflect the domestic and global environments in which megaregions must now compete. The United States (US) lacks a national freight strategy and most metropolitan areas fail to implement comprehensive trade strategies, indicating disconnect between policy and practice. In this research, we determine the status of freight planning strategies at the megaregion scale of an economically integrated section of the United States Gulf Coast.

This report is available for free download (2.1 MB):

<http://swutc.tamu.edu/publications/technicalreports/600451-00108-1.pdf>

## *Item 6*

### **Link Travel Time Estimation Based on Network Entry/Exit Time Stamps of Trips**

SOUTHWEST REGION UNIVERSITY TRANSPORTATION CENTER (SWUTC)

*TTI SWUTC/14/600451-00033-1 • 2015*

This dissertation studies the travel time estimation at roadway link level using entry/exit time stamps of trips on a steady-state transportation network. We propose two inference methods based on the likelihood principle, assuming each link associates with a random travel time. The first method considers independent and Gaussian distributed link travel times, using the additive property that trip time has a closed-form distribution as the summation of link travel times. We particularly analyze the mean estimates when the variances of trip time estimates are known with a high degree of precision and examine the uniqueness of solutions. Two cases are discussed in detail: one with known paths of all trips and the other with unknown paths of some trips. We apply the Gaussian mixture model and the Expectation-Maximization (EM) algorithm to deal with the latter. The second method splits trip time proportionally among links traversed to deal with more general link travel time distributions such as log-normal. This approach builds upon an expected log-likelihood function which naturally leads to an iterative procedure analogous to the EM algorithm for solutions. Simulation tests on a simple nine-link network and on the Sioux Falls network respectively indicate that the two methods both perform well. The second method (i.e., trip splitting approximation) generally runs faster but with larger errors of estimated standard deviations of link travel times.

This report is available for free download (886 KB):

<http://swutc.tamu.edu/publications/technicalreports/600451-00033-1.pdf>

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## *Item 7*

### **Manual Traffic Control for Planned Special Events and Emergencies**

SOUTHWEST REGION UNIVERSITY TRANSPORTATION CENTER (SWUTC)

SWUTC/15/600451-00113-1 • 2015

Manual traffic control is a common intersection control strategy in which trained personnel, typically police law enforcement officers, allocate intersection right-of-way to approaching vehicles. Manual intersection control is a key part of managing traffic during emergencies and planned special events. Despite the long history of manual traffic control throughout the world and its assumed effectiveness, there have been no quantitative, systematic studies of when, where, and how it should be used or compared to traditional traffic control devices.

The goal of this research was to quantify the effect of manual traffic control on intersection operations and to develop a quantitative model to describe the decision-making of police officers directing traffic for special events and emergencies. This was accomplished by collecting video data of police officers directing traffic at several special events in Baton Rouge, LA and Miami Gardens, FL. These data were used to develop a discrete choice model (logit model) capable of estimating police officer's choice probabilities on a second-by-second basis. This model was able to be programmed into a microscopic traffic simulation software system to serve as the signal controller for the study intersections, effectively simulating the primary control decision activities of the police officer directing traffic. The research findings suggested police officers irrespective of their location, tended to direct traffic in a similar fashion; extending green time for high demand directions while avoiding gaps in the traffic stream.

This report is available for free download (2.4 MB):

<http://swutc.tamu.edu/publications/technicalreports/600451-00113-1.pdf>

## *Item 8*

### **Optimization and Mechanism Design for Ridesharing Services**

SOUTHWEST REGION UNIVERSITY TRANSPORTATION CENTER (SWUTC)

TTI SWUTC/14/600451-00034-1 • 2014

This research studies operations research problems of ridesharing services. In the first part of the research, the large-scale ridesharing optimization problem (RSP) is formally defined with its complexity analyzed. A mixed-integer program is then developed to solve RSP to optimality. Since RSP is NP-hard, heuristic algorithms are developed to efficiently solve larger instances of RSP. The quality of heuristic solutions is evaluated by comparing with benchmark algorithms. Experimental results showed that the solutions produced by heuristic are good-enough approximation of the optimum and outperformed the matching solution by a non-trivial margin. The second part of this dissertation studies the fairness and stability problems in ridesharing. The fair cost allocation problem in ridesharing is formulated as a cooperative game. An algorithm based on coalition generation techniques is developed to efficiently find the nucleolus of this game. Experiments showed that this algorithm could save significant amount of computational resources compared to the enumeration method. The output of this research provides both insights and tools for understanding and operating large-scale ridesharing services.

This report is available for free download (916 KB):

<http://swutc.tamu.edu/publications/technicalreports/600451-00034-1.pdf>

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## *Item 9*

### **Project Consistency Guidance. Part B, Supplementary Information Document: Maintaining Project Consistency throughout the Project Development Process**

SOUTHWEST REGION UNIVERSITY TRANSPORTATION CENTER (SWUTC)

*TTI 0-6758 Supplement • 2014*

"This Supplementary Information Document (SID) was developed for transportation professionals responsible for project development and has a basic goal of providing an overview of the subjects that are deemed necessary for maintaining project consistency. It provides an overview of the transportation planning process, air quality conformity process, and environmental process under the National Environmental Policy Act (NEPA)—processes that either include or impact steps in the project development process—and identifies the entities responsible for advancing projects through the various steps in each process. To meet this goal, this document is organized as follows: Chapter 2 provides an overview of the transportation planning and transportation funding. Chapter 3 covers transportation conformity. Chapter 4 gives an overview of the Texas Department of Transportation (TxDOT) project development and environmental review processes." --page 1

This report is available for free download:

<http://swutc.tamu.edu/publications/technicalreports/0-6758-1Supplement.pdf>

## *Item 10*

### **Proposing Transportation Designs and Concepts to Make Houston METRO's Southeast Line at the Palm Center Area more Walkable, Bikeable, and Livable**

SOUTHWEST REGION UNIVERSITY TRANSPORTATION CENTER (SWUTC)

*TSU SWUTC/15/600451-00048-1 • 2015*

Over the years, the Palm Center (PC) in Houston, Texas, has been the beneficiary of several economic development endeavors designed to ignite economic and community growth and revitalization. While these endeavors brought forth initial success, they have failed to transform the PC into a lasting model of economic growth and prosperity and to inspire community pride and engagement. The development of METRO's Southeast Line light rail station at the Palm Center Transit Center presents the prime opportunity for meeting the needs of the community by implementing design concepts and principles that provide social, environmental, and economic benefits to those living within close proximity of the transit station.

The objective of this study is to explore community partnerships and initiatives, Transit Oriented Development (TOD) and livable center concepts and principles, features from previously successful TODs, and lessons learned from past development initiatives designed to foster revitalization. The information gathered will be synthesized and presented as recommendations to help ensure the PC area reaches its full social, environmental and economic potential. The outcome of this project will provide communities, local government and transportation planning agencies with innovative ideas and planning strategies that will place the PC area on the path to sustainable growth and prosperity.

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<http://swutc.tamu.edu/publications/technicalreports/600451-00048-1.pdf>

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## *Item 11*

### **Queue Length Estimation and Platoon Recognition using Connected Vehicle Technology for Adaptive Signal Control**

SOUTHWEST REGION UNIVERSITY TRANSPORTATION CENTER (SWUTC)

*TTI SWUTC/15/600451-00038-1 • 2015*

This dissertation presents mathematical and analytical models for real-time queue length estimation and platoon recognition using the connected vehicle technology (CVT). Information on queue length and platoon is a crucial part of traffic signal control and is difficult to obtain accurately with traditional technologies such as loop detectors. The past studies are either limited to fixed-time signal control or lacked verification on the applicable range or evaluation of the performance of algorithms.

The proposed algorithms focused on estimating the queue length for adaptive signal control and platoon characteristics for signal coordination and adaptive signal control. For queue length detection, an algorithm was developed to determine the estimated value between the last stopped vehicle and the first moving vehicle for different market penetration ratios. Discrete wavelet transform is applied to the estimated queue lengths to improve accuracy and consistency. The platoon recognition model is developed based on time headway so that the arrival times can be computed directly from the estimated platoon data. First, the detected platoon is identified by a modified critical time-headway. Then, platoon size and starting and ending times are estimated. Lastly, a filtering process for “qualified” detection platoon is proposed to optimize detectability. The results show that the proposed algorithms can estimate well in various traffic conditions and under both fixed-time and actuated signal control without relying on inputs that are hard to obtain in practice. Furthermore, an analytical model to estimate the platoon detection rate is proposed and shown to be close to the numerical results. Therefore, traffic engineers can use the analytical model to estimate the required market penetration ratio for the application without field experiments or microscopic simulation. Accordingly, the proposed algorithms can be an important part of adaptive signal control focusing on real-time coordination.

This report is available for free download (2.8 MB):

<http://swutc.tamu.edu/publications/technicalreports/600451-00038-1.pdf>

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## *Item 12*

### **Real Option Analysis to Value Managed Lanes**

SOUTHWEST REGION UNIVERSITY TRANSPORTATION CENTER (SWUTC)  
*TTI SWUTC/16/600451-00036-1 • 2016*

Managed lanes (MLs) provide a backup option for travelers even when they do not use MLs. For example, travelers have the option to use MLs when they encounter unexpected congestion. The option value of MLs refers to travelers' willingness to pay for having the ML option for possible use in the future. Despite the potential benefit of MLs, earlier studies have only considered the actual use benefits of MLs, such as travel time savings. This research used detailed travel data from both MLs and general purpose lanes (GPLs) of the Katy Freeway (I-10) in Houston. From these data, revealed preferences between MLs and GPLs of all travelers with a transponder in 2012 were identified. This research examined two potential definitions of travelers who valued MLs as a travel option. These definitions included 1) travelers who used MLs at least once in 2012 and 2) all travelers with transponders (even those who never used MLs). This research found that the travelers who never used the MLs in 2012 were extremely unlikely to use the MLs in all of 2013. Thus, this research recommends ML option users to be defined as only those travelers who used MLs at least once in 2012.

This research used the Small-Rosen log sum method (1981) and the Black-Scholes option pricing method (1973) to estimate the option value of MLs. The log sum method estimates the option value by measuring change in consumer surplus between the situation where both MLs and GPLs are available and the situation where only GPLs are available. The Black-Scholes method was originally developed to price options in stock markets and was modified to estimate the option value of MLs in this research. This research found that the log sum method frequently provided a poor estimate of the option value. Thus, this research recommends the Black-Scholes method to estimate the option value of MLs. The option value of the MLs was found to be similar to the value of travel time savings from the MLs for the ML option users. Thus, the option value of MLs is an important component of the total value of MLs.

This report is available for free download (2.7 MB):

<http://swutc.tamu.edu/publications/technicalreports/600451-00036-1.pdf>