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CTS Research E-News brings you the latest research project milestones, published reports, and seminar coverage.

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## Policy &amp; Planning

## Transitioning from fuel taxes to mileage-based user fees



University of Minnesota researchers recently examined whether replacing the existing gas tax with mileage-based user fees (MBUF) would be a more sustainable system for funding the nation's surface transportation system. Although MBUF—also referred to as vehicle-miles traveled (VMT) fees—rank strongly in the study's five transportation finance principles, the major obstacle for implementation may be convincing the public.

**David Coyle**, a graduate student in the Department of Applied Economics, led the study, which examined the rationale, technology, and transitional issues involved in shifting from fuel taxes to MBUF. The research team—which also included research fellow **Ferrol Robinson**, assistant professor **Zhirong (Jerry) Zhao**, senior research fellow **Lee Munnich**, and research fellow **Adeel Lari** of the Humphrey School of Public Affairs—says the study's findings set the stage for a policy discussion on these issues and lay the groundwork for a public outreach effort. The study was sponsored by the [ITS Institute](#).

The research team compared a fuel-tax-based system and an MBUF-based system against five transportation finance principles: efficiency, equity, revenue adequacy and sustainability, environmental sustainability, and feasibility. Gas taxes ranked strongly in feasibility, but were weak in terms of efficiency. And although MBUF ranked well in the other categories, it received a weak rating in administrative and political feasibility—largely due to high implementation, operation, enforcement, and compliance costs.

One way to address these issues would be to ensure that MBUF costs are kept at acceptable levels. In light of this, the team reviewed eight different mileage-tracking technologies—several of which proved promising. The study also includes an action plan for the design and administration of MBUF that addresses pricing and revenue collection, revenue allocation, system cost and management strategy, and transitional issues.

Since many implementation scenarios would require fuel-tax collection to coexist with MBUF over a significant period of time, the researchers suggest creating a new transitional tax structure that incorporates three components: a lower base rate for fuel taxes, a compensatory mileage-based charge to fund road and bridge construction (including right-of-way acquisition), and a local VMT charge option to replace the patchwork of local sales taxes used to fund local roads.

While transportation leaders have long discussed why fuel taxes are no longer a sustainable transportation funding system—and recommendations by two national commissions established by Congress have already led to pilot tests across four states—public support still has a long way to go. The researchers recommend that proponents of MBUF understand not only the difficult transitional issues and questions involved, but also the education and outreach efforts that will be needed to move forward the implementation of a mileage-based fee system.

A final report on the project, *From Fuel Taxes to Mileage-Based User Fees: Rationale, Technology, and Transitional Issues* (CTS 11-16), is

available on the ITS Institute website.

## Symposium shares latest on mileage-based user fees

Professionals in the field of road user fees gathered in Breckenridge, Colorado, on June 13 and 14 for the [2011 Symposium on Mileage-Based User Fees](#) (MBUF). The symposium was hosted by the University Transportation Center for Mobility (UTCM) at the Texas Transportation Institute (TTI), the [Humphrey School of Public Affairs](#) at the University of Minnesota, and CTS, with additional sponsorship from [Move Colorado](#).

Symposium co-chairs **Ginger Goodin**, senior research engineer with TTI, and **Lee Munnich**, director of the State and Local Policy Program at the Humphrey School, gave the symposium opening and welcome. Munnich also moderated two panels, one about public and political acceptance and the other on national initiatives related to MBUF.

**Ferrol Robinson**, research fellow with the Humphrey School, moderated a panel on user perspectives that included **Ken Buckeye**, program manager for value pricing with the Office of Policy Analysis, Research and Innovation at the Minnesota Department of Transportation (MnDOT).

Other panel discussions addressed specific topics such as legislative and policy issues, potential technology applications, and institutional issues. The symposium incorporated interactive discussion sessions on logical next steps as well as the associated challenges and opportunities.

Symposium planning committee members from Minnesota were Munnich, Buckeye, Robinson, and **Gina Baas**, assistant director of education and outreach with CTS.

Several University of Minnesota researchers are involved in MBUF studies:

- ◆ Munnich is the principal investigator of a current project funded by MnDOT titled "[Mileage-Based User Fee Policy Examination](#)."
- ◆ Munnich is also the principal investigator of "[Implementing Distance-Based User Fees as a Replacement for the Fuel Tax](#)," with co-investigators Robinson and **Zhirong (Jerry) Zhao**, assistant professor in the Humphrey School.
- ◆ Baas was the principal investigator for the NCHRP-sponsored project "[Near-Term-Implementable Mechanisms for Collecting Road User Charges Based on Vehicle-Miles Traveled](#)." Co-investigators were **Max Donath**, director of the ITS Institute, and Munnich.
- ◆ Robinson is the principal investigator of "[Benefits of Distance-Based Fees for the Trucking Industry](#)," a project funded by MnDOT. His co-investigator is **Gerard McCullough**, associate professor of applied economics and a former CTS director.

A general summary of the symposium proceedings and a summary of the event's closing interactive discussion are now available on the [University Transportation Center for Mobility website](#).

*Reprinted from the August 2011 issue of the CTS Report.*

## Transport and land use research symposium attracts international participants

The inaugural meeting of the [World Symposium on Transport and Land Use Research](#) (WSTLUR) attracted more than 70 participants from countries across the globe, received 72 original research submissions, and served as the launch pad for a new World Society on Transport and Land Use Research. It was held July 28–30 in Whistler, British Columbia, Canada.

"This is the first time an organized group has gotten together with this particular focus," explains **Gina Baas**, CTS assistant director for education and outreach and a member of the organizing committee. "WSTLUR brings together multiple disciplines including planning, engineering, and economics."

The symposium followed on the successful [Access to Destinations](#) conferences sponsored by CTS in 2004 and 2007.

Welcoming remarks were given by **Laurie McGinnis**, director of CTS; Braun/CTS Chair **David Levinson**, associate professor in the Department of Civil Engineering; and **Kevin Krizek**, professor in the Department of Planning and Design at the University of Colorado (formerly with the Humphrey School of Public Affairs). Levinson and Krizek led the CTS-led Access to Destinations Study.

Symposium highlights included plenary presentations by **Ed Glaeser**, Fred and Eleanor Glimp Professor of Economics at Harvard University; **Robert Cervero**, professor of city and regional planning at the University of California, Berkeley; and **David Banister**, professor of transport studies at Oxford University.

Glaeser discussed ideas from his book, *Triumph of the City: How Our Greatest Invention Makes Us Richer, Smarter, Greener, Healthier, and Happier*. His presentation examined why, in an era in which transportation and communications costs are relatively low, cities are still so socially and economically important.

One reason, Glaeser suggested, is that cities are connectors of both people and ideas. Cities allow people to network more easily with others, provide cross-industry fertilization, and encourage innovation. "The combination of smart people in urban areas can often produce miracles—the remarkable intellectual breakthroughs that have really made human civilization," Glaeser said, citing the mass-produced automobile in Detroit as an example. This also helps explain how cities can become centers of a particular industry, he said, such as biotechnology in Minneapolis and Boston.

Glaeser also suggested that the development of new technology has made cities more, rather than less, important. Because of the complexity of new ideas, face-to-face contact and communication is more important than ever, he said. "Our greatest gift as a species is our ability to learn from the people around us. Cities still cater to that—cities make that happen."

Today's cities also face many challenges, Glaeser acknowledged, including poverty and congestion, but transportation and land-use policies can be instrumental in solving them. "Cities need management. The future of cities requires changes in policy and investment to make them more livable."

Cervero focused on connecting transportation and land use in developing countries. As populations increase and cities grow in the developing world, the focus should be on advancing mechanisms that encourage long-term planning, the improvement of public transit, and the creation of mixed-use corridors to balance travel patterns, he said. "We need to demonstrate that creating a clean city with good transport and good urbanism is part of a long-term strategy to promote economic success."

Banister examined how transport and land-use planning can be used to achieve sustainability. According to Banister, one of the most important factors for increasing transportation sustainability is reducing travel distances. In addition to reduced congestion and decreased fuel consumption, shorter distances could also result in quieter urban spaces and better air quality. Land use and development can be used to promote these shorter travel distances by improving the quality of the pedestrian network and placing more emphasis on proximity, Banister said.

Three University of Minnesota researchers gave concurrent-session presentations:

- ◆ Levinson, "An Agent-Based Model of Worker and Job Matching"
- ◆ **Yingling Fan**, assistant professor, Humphrey School of Public Affairs, "Impact of Light-Rail Implementation on Labor Market Accessibility: A Transportation Equity Perspective"
- ◆ **Jason Cao**, assistant professor, Humphrey School, and **Daniel Chatman**, University of California, Berkeley, "How Will Land Use Policies Affect Travel? The Importance of Residential Sorting"

The symposium was organized by CTS with support from the Georgia Transportation Institute, University of California Transportation Center, UC Davis Sustainable Transportation Center, University of Connecticut Center for Transportation and Livable Systems, University of Vermont Transportation Research Center, University of Colorado Boulder College of Architecture and Planning, University of Colorado Denver College of Engineering and Applied Science, and Transport Canada.

The organizing committee was chaired by Krizek and included Levinson, McGinnis, Baas, and **Stephanie Malinoff** of CTS.

Symposium PowerPoints and selected recordings are available on the [WSTLUR website](#). Select papers from WSTLUR will also be published in upcoming issues of the *Journal for Transportation and Land Use*, a peer-reviewed journal launched by Levinson and Krizek following the 2007 conference and published by CTS.

The symposium steering committee is also forming the World Society for Transport and Land Use Research to further promote the understanding and analysis of the interdisciplinary interactions of transport and land use. The society will also organize a second symposium in 2014. To learn more about the society or to become a member, visit the [WSTLUR website](#).

### **New Journal of Transport and Land Use issue published**

CTS is pleased to announce the publication of Volume 4, Issue 2 of the *Journal of Transport and Land Use*, now the official journal of the World Society for Transport and Land Use Research.

The *Journal of Transport and Land Use* is an open-access, peer-reviewed online journal publishing original interdisciplinary papers on the interaction of transport and land use. Domains include: engineering, planning, modeling, behavior, economics, geography, regional science, sociology, architecture and design, network science, and complex systems.

Contents:

- ◆ *The Coevolution of Transport and Land Use: An Introduction to the Special Issue and an Outline of a Research Agenda*  
David M. Levinson
- ◆ *The Impact of Access to Rail Transportation on Agricultural Improvement: The American Midwest as a Test Case, 1850-1860*  
Jeremy Atack and Robert A. Margo
- ◆ *Developing Densely: Estimating the Effect of Subway Growth on New York City Land Uses*  
David King
- ◆ *Montréal's Roots: Exploring the Growth of Montréal's Indoor City*  
Ahmed El-Geneidy, Lisa Kastelberger, and Hatem T. Abdelhamid
- ◆ *Does First Last? The Existence and Extend of First Mover Advantages on Spatial Networks*  
David M. Levinson and Feng Xie

## **Intelligent Transportation Systems**

### **Position estimator helps guide vehicles during GPS disruptions**



The position estimator is currently in use on 10 Minnesota Valley Transit Authority buses on the Cedar Avenue bus rapid transit corridor.

Many roadway applications, such as lane-departure warning systems, require the constant availability of high-accuracy, in-lane-level vehicle position information. In environments where underpasses, tree canopies, or urban canyons block or disrupt global positioning system (GPS) signals, obtaining this information can be a challenge.

Researchers from the ITS Institute's [Intelligent Vehicles Laboratory](#) (IV Lab) have developed a real-time position estimator to help calculate vehicle position with centimeter-level accuracy, even during periods of GPS signal disruption. IV Lab director **Craig Shankwitz** and research fellows **Eddie Arpin** and **Bryan Newstrom** designed the estimator primarily for use in lane-guidance systems on buses traveling on bus-only shoulders. The project was sponsored by Hennepin County, the Minnesota Valley Transit Authority (MVTA), and the ITS Institute.

For buses traveling in narrow bus-only shoulder lanes, GPS disruptions are most commonly caused by highway underpasses that block satellite signals. During an average 6- to 15-second underpass-induced outage, a vehicle traveling 30 miles per hour will go 80 to 200 meters. The position estimator allows a lane-guidance system that relies on vehicle position measurements to remain functional and accurate during this outage period.

The position estimator fuses dual frequency, carrier phase differential GPS (DGPS) measurements, high-accuracy vehicle heading measurements, yaw rate measurements, and two-dimensional velocity sensor measurements. Its three main components—a heuristic filter, heading estimators, and a position propagator—use available DGPS, velocity, and yaw rate measurements to determine the vehicle's heading

and estimate its position on the roadway.

The research team evaluated the position estimator on 10 MVTA buses operating on Minnesota State Highway 77 (Cedar Avenue). Data were collected during 460 bridge-induced DGPS outages to identify any performance sensitivity in the system resulting from small differences in installation. Results indicate that the estimator performed well regardless of differences in vehicles, sensor and computation hardware, and varying sensor locations and orientations.

The position estimator is currently in use as part of the [Bus 2.0 driver-assist system](#) (DAS) installed in 10 MVTA buses operating on the Cedar Avenue bus rapid transit corridor. The estimator allows the DAS system—which uses vehicle position information to provide bus drivers with lane-keeping assistance—to operate continuously, even if GPS is unavailable, Arpin said.

Current work on the position estimator includes the use of more sophisticated and costly sensors to provide higher position accuracies. Although it is unlikely that these more expensive sensors would be installed on Bus 2.0 buses, Arpin said that related improvements to the original position estimator system could be added to the existing bus computers.

A final report on the project, [Dual Frequency, Carrier Phase Differential GPS Augmentation](#) (CTS 11-09), is available on the ITS Institute website.

## ‘CrashHelp’ to improve emergency medical response for rural crashes



Tom Horan



Ben Schooley

Over the past five years, researchers with the [ITS Institute](#), [Center for Excellence in Rural Safety](#) (CERS), and [Claremont Graduate University](#) have investigated the role that information technology plays in improving emergency medical response to victims of rural automobile crashes. The goal of this work is to reduce the adverse health impacts of automobile crash trauma, especially those in rural areas, where crashes account for a high percentage of trauma injury and death.

As part of this research, CERS research director [Tom Horan](#) and his colleague [Ben Schooley](#), research associate at Claremont Graduate University, have led the development of the CrashHelp prototype. The prototype was designed to facilitate a more seamless transfer of patient and incident information from emergency medical services (EMS) pre-hospital practitioners to hospital emergency room/trauma centers as a means of improving patient care following a traffic crash. Funding was provided by the ITS Institute.

In the first phase of the project, the researchers conducted case studies of EMS systems in San Mateo County, California, and Rochester, Minnesota, to study best practices of rural trauma systems. The case studies included analysis of EMS response data, interviews, and focus group discussions with EMS and emergency room practitioners.

Through these efforts, the team found that information collection and handoff from ambulance providers to hospitals is fragmented. “Evidence from literature suggests that more timely patient information could significantly impact patient care,” Schooley notes. The case studies also confirmed that new and emerging mobile- and map-based technologies could be used to address this information-handoff challenge, leading the group to develop the CrashHelp prototype.

With CrashHelp, emergency responders use a mobile smartphone on-scene to collect multimedia data about crash victims—including digital pictures, audio recordings, and videos—as well as other basic patient and incident information. These data are sent directly into the emergency/trauma department to a web-based interface practitioners can view on demand. This gives hospitals advance notification of crash severity and related information that can be used to best prepare for a patient’s arrival. EMS agencies responsible for oversight can view aggregate information over time and conduct spatial (map-based) analyses of EMS response trends across the region and state.

According to Schooley, special attention was paid in the design phase to make a user-friendly, electronically secure tool. “We knew we had to make it simple and secure or it wouldn’t be used,” he says. “CrashHelp is as easy to use as a flip phone...it does not require hospitals to install new systems or even to manually download the information sent from EMS personnel.” Additionally, the team has put an important emphasis on system security so that CrashHelp will comply with the Health Insurance Portability and Accountability Act (HIPAA) of 1996 and other electronic healthcare data security requirements.

The next phase of the research project, currently under way, includes a pilot test of CrashHelp with EMS agencies and hospitals in the Boise, Idaho, area. During a three-month pilot study, researchers will evaluate any improvements made in information collected by on-scene EMS personnel, communication between pre-hospital transport and hospitals, care decision making by hospital personnel (for some incidents), and resource use by hospital personnel. Preliminary results from the pilot will be available in late 2011.

A final report on the development of the CrashHelp prototype, [ITS and Transportation Safety: EMS System Data Integration to Improve Traffic Crash Emergency Response and Treatment – Phase II](#) (CTS 11-19), is available on the ITS Institute website.

*Adapted from the ITS Institute 2010-11 Annual Report.*

## Transit, Bicycling, and Walking

### Using data analysis to improve transit planning



Photo by Jonathan Chapman

Many U.S. transit vehicle fleets are instrumented with automatic data-collection systems (ADCS) that monitor and improve transit services. Due to limited resources, however, the massive amounts of data gathered—including vehicle location, passenger counts, and electronic fare payment transactions—are typically analyzed only on an as-needed basis.

During a six-month sabbatical at the University of Minnesota, [Nigel Wilson](#), professor of civil and environmental engineering at the Massachusetts Institute of Technology, provided guidance and expertise on transit data analysis and modeling to researchers at the ITS Institute’s [Minnesota Traffic Observatory](#) (MTO). Wilson worked with MTO senior systems engineer [Chen-Fu Liao](#) to develop a methodological data analysis framework able to process an extensive amount of ADCS transit data. The researchers hope the framework will provide insight on improving transit performance and productivity. The study was sponsored by the ITS Institute.

Metro Transit currently serves more than 200 routes daily, including 100 express routes that connect suburban communities to the central business districts in downtown Minneapolis and St. Paul. Using data mining and fusion techniques on a route-based trip time model, the researchers focused on scheduling and planning improvements for bus route 10 along Central Avenue between downtown Minneapolis and Northtown, a mall in Blaine, Minn.

Usually, trip time points are virtually placed on a transit route to monitor bus schedule adherence and system performance. A time point (TP) is the time boundary from bus check-in to checkout around a TP zone (typically about 200 feet before and after a stop). Inter-TP link travel time is the time between the departure from the current TP checkout boundary to the arrival at the downstream TP check-in boundary.

TP-based models consider key parameters (such as number of passengers boarding and alighting, fare payment type, bus type, seat availability, stop location, traffic signal, and volume) that affect bus travel time. This study used the outputs from a previously developed transit data-processing framework to develop a route travel time model. The researchers also analyzed TP and inter-TP link travel times of bus route 10 to describe the relationship between trip travel time and primary independent variables. They then calibrated and validated regression models by comparing the simulation results with the existing schedule using adjusted travel times derived from data analyses.

In 2010, Metro Transit initiated a study on 11 local bus routes to upgrade current operations to bus rapid transit or equivalent services as another way to improve ridership and quality of service. The route-based transit simulation model produced in this study can support Metro Transit in evaluating different schedule plans, stop consolidations, and other strategies, providing an opportunity to predict and evaluate different transit strategies prior to deployment.

In the future, Liao hopes to investigate transferring the model to other urban local routes, the impact of wheelchair lift events, and transit riders' origin to destination patterns and travel behaviors.

[\*Data Driven Support Tools for Transit Data Analysis Scheduling and Planning\*](#) (CTS 11-15), a final report on the project, is available on the ITS Institute website.

### **TCRP research publications available online**

The federal Transit Cooperative Research Program (TCRP), administered by the Transportation Research Board, provides practical transit research to address technical and operational issues. TCRP emphasizes putting research results into the hands of organizations and individuals that can use them to solve problems.

Recent TCRP publications include:

- ◆ [\*Toolkit for Estimating Demand for Rural Intercity Bus Services\*](#) (TCRP Report 147)
- ◆ [\*Guidebook for Evaluating Fuel Choices for Post-2010 Transit Bus Procurements\*](#) (TCRP Report 146)
- ◆ [\*Public Participation Strategies for Transit\*](#) (TCRP Synthesis 89)
- ◆ [\*Video Surveillance Uses by Rail Transit Agencies\*](#) (TCRP Synthesis 90)
- ◆ [\*Legal Aspects Relevant to Outsourcing Transit Functions Not Traditionally Outsourced\*](#) (TCRP Legal Results Digest 38)

## **Upcoming Events**

### **Call for Papers: 2012 MBUF Symposium & Transportation Finance Summit**

The 2012 Mileage-Based User Fee Symposium & Transportation Finance Summit will be held April 22-24, 2012, in Philadelphia. The event, co-sponsored by CTS, will explore the latest studies and pilots in mileage-based user fees and the diverse range of financing tools available to toll agencies, state DOTs, and local governments.

Conference organizers are seeking abstract and paper submissions to be considered for inclusion as discussion topics, panel discussions, or presentations at the event. Submission deadline is October 7, 2011.

For submission guidelines, please download the [Call for Papers](#) (39 KB PDF).

### **Call for Abstracts: National Transportation Workforce Summit**

The National Transportation Workforce Summit, held April 24-26, 2012, in Washington, D.C., will foster a cross-cutting dialog on the transportation workforce of the future. The summit—presented by the Council of University Transportation Centers (CUTC)—will cover all modes of transportation, the range of occupations in transportation, and the variety of educational experiences to develop and improve individuals' competencies and skills. CTS is a sponsor of the event.

The Summit Steering and Program Committees invite abstracts on any discipline related to the transportation workforce from educators, researchers, practitioners, and organizations. Abstracts should address one or more of the following topics: transportation workforce needs now and in the future, career awareness, career preparation and advancement, or transportation professional and continuing education.

Abstracts must be submitted by October 17, 2011. To learn more about the event or to download the abstract submittal form, please visit the [event website](#).

### **Additional Upcoming Events**

#### **September 15**

[Advanced Transportation Technologies Seminar: The Role of Transportation Researchers in Rehabilitation Hospitals to Keep Patients Mobile](#), 3:30 p.m. - 4:30 p.m. CDT, [1130 Mechanical Engineering](#)

#### **September 29**

[Advanced Transportation Technologies Seminar: An Observational Study of Pedestrian and Bicycle Crossing Experience in Two Modern Urban Roundabouts](#), 3:30 p.m. - 4:30 p.m. CDT, [1130 Mechanical Engineering](#)

#### **October 4**

[TERRA Innovation Series: MnROAD Research Conference](#), Northland Inn, Minneapolis, MN

**October 6**

CTS Research Seminar: Exploring Models of Regional Sustainability Planning and Implementation, 3:30 p.m. - 4:30 p.m. CDT, 1130 Mechanical Engineering

**October 13**

Advanced Transportation Technologies Seminar: Snow and Ice Sensors, 3:30 p.m. - 4:30 p.m. CDT, 1130 Mechanical Engineering