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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 & Planning**Legislature funds University study of 'value capture' for transportation finance**

David Levinson, Jerry Zhao, and Adeel Lari are the leaders of the new transportation finance study.

Large public investments in state transportation infrastructure—such as new freeway interchanges, highways, or transit stations—can increase the value of surrounding private land, sometimes substantially. Capturing the value of this benefit through various tools is gaining interest as a finance mechanism for infrastructure investments. But many questions remain: Does “value capture” promote or hinder economic development? How high should the tax rate be? How stable is the revenue? To answer these and other questions, the state legislature appropriated funding to CTS to study the public policy implications of value capture.

Similar to the [Reducing Greenhouse Gases study](#), CTS has assembled an interdisciplinary research team for this investigation. Principal investigators are **David Levinson**, the R.P. Braun/CTS Chair in Transportation Engineering and associate professor of civil engineering;

Zhirong (Jerry) Zhao, assistant professor in the [Humphrey Institute of Public Affairs](#); and **Adeel Lari**, research fellow in the Humphrey Institute. The team also includes Michael Iacono, a research fellow in the [Department of Civil Engineering](#). **Robert Johns**, **Linda Preisen**, and **Joe Barbeau** of CTS will provide study leadership and coordination.

The study will investigate the experiences of other states with value capture. Researchers will review the relationship between transportation and land values, including the measurement of benefits from a transportation improvement, as well as the legal and economic frameworks for capturing the value gains. They will explore the major financing techniques associated with value capture and some examples of their implementation. They will then evaluate several of the proposed policies and their suitability for implementation locally, based on the criteria of economic efficiency, social equity, adequacy as a revenue source, and feasibility.

“The project may provide suggestions for new financing methods that are not currently considered or are not available under current state statutes,” Levinson says. The project builds on another study—[The Economic Impact of Upgrading Roads](#)—that Levinson and Iacono are conducting for the [Minnesota Department of Transportation](#) (Mn/DOT), in which they are estimating the economic value of roadway capacity improvements.

Zhao says well-designed value-capture strategies could be a good way to supplement transportation finance in Minnesota. “Value capture may not only provide additional funding to meet underfunded transportation needs, it also may improve the allocation of societal resources by better linking social benefits and social costs of transportation improvement,” he says.

Preliminary findings are due to the legislature by March 1, 2009, and a full report by July 1, 2009. In addition, the appropriation requires CTS to offer a series of educational workshops for elected officials during the summer and fall of 2009. The study receives its funding through Mn/DOT.

Intelligent Transportation Systems

Motorcycles and alcohol: Research examines a dangerous combination



Deputy Secretary of Transportation Thomas Barrett (seated) discusses motorcycle safety with researchers Craig Shankwitz and Janet Creaser.

This summer, with gas prices at an all-time high and warm weather beckoning riders to hit the road, motorcycles and scooters are more popular than ever. But statistics from the [National Highway Traffic Safety Administration](#) (NHTSA) show that while motorcycles account for only three percent of motor vehicle registrations, they make up 11 percent of total motor vehicle fatalities.

Researchers from the [HumanFIRST Program](#) and the [Intelligent Vehicles Laboratory](#) recently collaborated to study the effects of alcohol on motorcyclists, taking advantage of the programs' access to unique research facilities and expertise in monitoring driver performance.

Deputy Secretary of Transportation [Thomas Barrett](#), during a recent visit to the University of Minnesota, had the opportunity to take a close look at the specially equipped motorcycle at the heart of the project. On hand to brief Barrett were principal investigator [Janet Creaser](#) of the HumanFIRST Program and Intelligent Vehicles Lab director [Craig Shankwitz](#).

Most testing of alcohol impairment has been done in passenger vehicles and has not focused on the unique skills required to ride a motorcycle, according to Creaser. However, due to the increased number of motorcycle riders and the known crash risk for alcohol impaired riders, it is important to study the effects of alcohol on riding skills.

With funding from NHTSA, the Minnesota study aimed to fill a significant gap in research on the effects of alcohol consumption.

Studying safety, safely

While a large body of research has been devoted to detailed analysis of how alcohol interferes with automobile operation, relatively little work has been completed on the question of how alcohol affects the skills required to operate a motorcycle. One factor in this discrepancy is the difficulty in accurately evaluating motorcycle operation skills without endangering the safety of the rider. Realistic driving simulators based on motorcycles rather than four-wheeled vehicles are virtually unknown, and in-vehicle testing is restricted by the obvious hazards facing an impaired rider, as well as strict laws prohibiting vehicle operation while intoxicated.

To overcome these restrictions, the Minnesota team incorporated three critical components into their research methodology: a purpose-built mechanical safety system to safeguard the test subjects; a remote data-acquisition system to gather detailed information on all relevant aspects of the subjects' performance; and a testing facility that could legally and safely accommodate inebriated riders.

The motorcycle selected for research use, a model typical of the bikes chosen by many riders today, was first equipped with a system of mechanical outriggers capable of preventing it from falling sideways in the event that a rider lost his balance. During normal operation, the outriggers are free to move up and down as the cycle turns; if the cycle leans too far to either side, however, they prevent it from tipping over completely.

Capturing the complex data needed to characterize driver performance was the task of the Motorcycle Data Acquisition system, or MoDAQ. Based on a system developed by the Intelligent Vehicles Lab for automotive research, the MoDAQ is an onboard, mobile system that integrates data from a range of sensors. The system includes sensors that monitor the operation of the cycle's controls—throttle, brakes, and steering; accelerometers that measure forward and lateral movements; and a helmet equipped with a miniature video camera and inertial measurement units. Synchronizing the outputs from all these sensors gives researchers a complete picture of driver performance and vehicle response.

Even with its added safety features, operating the motorcycle with alcohol-impaired research participants would still have been prohibited by Minnesota law, which applies to private driving courses and tracks as well as to public roads. Fortunately, one driving course in Minnesota is specifically exempt from the state law: the Minnesota Highway Safety and Research Center in St. Cloud. The facility is one of several closed courses used in HumanFIRST research.

The research team recruited 24 male study participants who had a minimum of five years of motorcycling experience and drank alcohol at least once a week but had no history of alcohol dependence. After training designed to familiarize the riders with the research motorcycle, the riders participated in three half-day test sessions during which they drank alcohol to reach a blood-alcohol concentration of .02, .05, or .08 g/dL (the legal limit in all 50 states), or were given a placebo (alcohol applied to the rim of a glass containing a non-alcoholic beverage).

After consuming the alcoholic beverage or the placebo, the participants rode through a test course developed in collaboration with motorcycle instructors from the Minnesota Motorcycle Safety Center. The course included a variety of tasks, ranging from routine riding situations to emergency maneuvers. Data from both baseline (non-alcohol) rides and rides after consuming alcohol were gathered for each participant, enabling the researchers to compare the effects of different amounts of alcohol consumption.

Analysis of data from these tests revealed that some impairment was evident in motorcycle riders at the .05 blood-alcohol level, below the .08 level that constitutes intoxication in the eyes of the law. And while self-reports by the test subjects indicated that many riders may realize when alcohol is affecting their riding performance, the researchers caution that the evidence does not mean that self-regulation is sufficient to mitigate the increased crash risk due to riding after drinking.

The study was funded by the [National Highway Traffic Safety Administration](#) and the [ITS Institute](#).

Transportation and the Environment

Roadside trash – the latest Minnesota crop?

Trash along the edges of highways is both an eyesore and a safety concern. Removing trash by hand, the most common method, is a time-consuming and labor-intensive endeavor for maintenance agencies like the [Minnesota Department of Transportation](#) (Mn/DOT)—costing roughly two million dollars a year in the Twin Cities metropolitan area alone. Associate professor [Jonathan Chaplin](#) and graduate student [Emmanuel Magisson](#) of the University of Minnesota's [Department of Bioproducts and Biosystems Engineering](#) are working with Mn/DOT to develop a "trash harvester" that will reduce the number of workers needed to remove trash from road margins, and help keep Minnesota's roads looking good.

According to the researchers, few efforts have been made to develop machines capable of harvesting trash off roadway margins. Caltrans, the California transportation agency, has developed machines to remove large pieces of litter like barrels using an articulated arm; however, Minnesota



A prototype trash harvester developed at the University of Minnesota is transported to a testing site.

wanted a machine that can sweep large grassy areas rather than pinpointing individual large items.

Chaplin and Magisson studied roadside trash to determine what types of items are typically found along Minnesota's roads. The most common materials were determined to be paper, cans, plastic bottles, plastic scraps and tire retreads, and mufflers and hubcaps. Other common trash types included construction materials, clothing, dead animals, wheels and tires, nails, and glass bottles. Due to the diversity of sizes and materials, the researchers and Mn/DOT sponsors agreed to focus on the most common types of roadside trash, leaving aside very small objects such as nails and large objects like animals and wheels.

Based on specifications developed by Mn/DOT, Chaplin and Magisson evaluated several different design concepts for their harvester, including various technologies for picking up and gathering trash as well as various ways of storing the trash. The final concept moves the entire vehicle off the roadway and onto the area to be cleared, thus eliminating a potential traffic hazard. Based on a relatively small and maneuverable agricultural machine chassis, the concept lifts and collects trash using a combination of tines and a rotating broom. A blower and shredder reduce the collected material to small chunks and convey it to an onboard storage hopper, which can be unloaded into a truck on the road shoulder. The collection truck also pulls a trailer that carries the harvester from site to

site.

Designing the trash harvester around a small agricultural chassis results in a machine that has a narrow working width, but a high operational speed, and which can be relocated with relative ease. An additional advantage is that the chassis can be purchased "off the shelf" from commercial manufacturers, freeing the researchers to focus on developing the critical pick-up, gathering, and shredding functions. The research is supported by the Minnesota Department of Transportation.

Development of a Trash Harvester for Mn/DOT – Phase II (Mn/DOT 2008-21) is available from the CTS Web site.

Transit, Bicycling, and Walking

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:

[Employee Compensation Guidelines for Transit Providers in Rural and Small Urban Areas](#) (TCRP Report 127)

[Civil Rights Implications of the Allocation of Funds between Bus and Rail](#) (TCRP Legal Research Digest 27)

Transportation Infrastructure

Frost heave research targets ride quality in cold climates



The MnROAD facility's highway segment is an ideal setting to study the effects of winter weather on pavement performance.

Every year, harsh winter weather takes a heavy toll on northern roads. A University of Minnesota research team, including civil engineering faculty [Lev Khazanovich](#) and [Randal Barnes](#) and graduate students [Peter Bly](#) and [Atika Shamin](#), studied how wear associated with freezing temperatures affects ride quality over the course of several years at the Minnesota Road Research Facility. Their findings could lead to pavements that are better able to withstand the rigors of cold climates.

The research focused on frost heave, a phenomenon that occurs when water trapped within a porous solid freezes and expands, pushing apart the surrounding material. Repeated freezing and thawing can lead to deformation and deterioration of the road surface, and can ultimately shorten the life cycle of pavements.

The [Minnesota Road Research Facility](#), or MnROAD, incorporates a section of interstate highway carrying a high volume of normal traffic every day. Pavement test cells, constructed using a variety of materials and techniques, are installed along this highway section. Data on pavement performance is gathered by instruments embedded in the test cells, as well as by physical inspection when traffic is diverted onto an alternate roadway parallel to the test section.

In this study, the researchers embedded steel pins in pavement test cells and monitored the changes in their elevations over four years. As frost heave pushed the pins out of position, the researchers were able to analyze the amount and degree of frost heave uniformity within the cells. This data indicated changes in ride quality, both seasonally and over the long term.

In their final report, the researchers note that several design factors affect frost heave, including subgrade and base type, pavement thickness, and drainage. The report suggests that in order to mitigate damage from frost heave, hot mix asphalt specifications should be improved to reduce thermal cracking. In addition, because thicker test cells appeared to outperform thinner cells in this study, further investigation of the benefits of thick bases under concrete pavements is recommended. The research was supported by the [Minnesota Department of Transportation](#) and the [Minnesota Local Road Research Board](#).

Effects of Seasonal Changes on Ride Quality at MnROAD (Mn/DOT 2007-23) is available from the CTS Web site.

Safety

University of Minnesota researchers map out America's deadliest roads

Researchers at the University of Minnesota's [Center for Excellence in Rural Safety](#) (CERS) have mapped out every road fatality in the nation with details on each death, so now you can see the "dead man's curve" on your commute or the "devil's triangle" in your backyard. One of the most important aspects of the new tool also illustrates which life-saving public policies, such as strong seat belt laws, are in the chosen area.

"This tool sheds light on the importance of strong public policy that helps save lives in states across the nation," said [Lee Munnich](#), director of CERS. "When you can visually see how many lives can be saved, it really changes how the public and policy makers see our roads."



The Safe Road Maps Web site lets users map road fatalities anywhere in America.

The site is located at www.saferoadmaps.org/.

To view a video about [www.saferoadmaps.org](http://www1.umn.edu/urelate/newsservice/Multimedia_Videos/safe_road.htm), visit: http://www1.umn.edu/urelate/newsservice/Multimedia_Videos/safe_road.htm

"When drivers type in their most common routes, they're shocked how much blood is being shed on it," said **Tom Horan**, research director for CERS. "When it's the route you or your loved ones use, the need to buckle up, slow down and avoid distractions and drinking suddenly becomes much more personal and urgent."

Enter your address at www.saferoadmaps.org and you will see a map or satellite image of all of the road fatalities that have occurred in the area. Plus, users have the ability to narrow down their search to see the age of the driver, whether speeding or drinking was a factor, and if the driver was wearing a seatbelt.

CERS officials hope the tool will educate the public about road fatalities, especially those that live in rural areas.

U.S. Census figures show that 21 percent of Americans live in rural areas and the Federal Highway Administration has found that 57 percent of highway deaths happen on rural roads.

"We must take aggressive action to reduce needless deaths on our nation's roadways and saferoadmaps.org will give citizens and policymakers the information they need to improve travel safety," said U.S. Congressman **James Oberstar**, Chair of the U.S. House Transportation and Infrastructure Committee. "I applaud the Center for Excellence in Rural Safety for their leadership in developing tools that can help us all in our quest to improve the safety of our nation's roadways."

"By mapping out these fatalities, we can visually see what a large problem we have in our country," Munnich said. "It is time to start working towards prevention and each one of these dots on the map represents that."

Changeable Message Sign research aims to increase effectiveness



Part of the computer simulation used to test drivers' response to CMS messages.

University of Minnesota researchers **Kathleen Harder** and **John Bloomfield** of the Center for Human Factors Systems Research and Design have completed the second phase of an investigation into the effectiveness and safety of messages presented on changeable message sign (CMS) systems. Using a fully interactive PC-based driving simulator, the researchers conducted tests with 120 licensed drivers from different age groups to determine how drivers would respond to and remember different types of messages. This research was enhanced by a survey of driver attitudes toward CMS, analysis of real-world traffic data captured during CMS deployments, and observations of the decision making process for deploying CMS messages at the Minnesota Department of Transportation's [Regional Transportation Management Center](#).

In a [previous phase](#) of the research, Harder and Bloomfield measured how well drivers remembered the content of messages on CMS displays within a driving simulator. They determined that the way messages are stated can have a significant impact on how well drivers understand and remember them.

In the second phase, the researchers conducted experiments that were comparable to the phase one experiments in order to evaluate the effectiveness of new messages that were designed to be clearer and less ambiguous. The additional survey, traffic data analysis, and observation of traffic managers provided a more detailed picture of how CMS messages are deployed and received by drivers.

The study received funding from CTS, the [Minnesota Department of Transportation](#), and the University of Minnesota's [College of Design](#).

The Effectiveness and Safety of Traffic and Non-Traffic Messages Presented on Changeable Message Signs—Phase II (Mn/DOT 2008-27) is available from the CTS Web site.

Upcoming Events

September 23

[Advanced Transportation Technologies Seminar: Summary of Research Activities at the Center for Sustainable Mobility](#), 1130 Mechanical Engineering Building, Minneapolis

September 29–October 1

[Minnesota Public Transit Conference](#), St. Paul RiverCentre.

September 30

[Infrastructure Council Seminar: Intelligent Compaction Implementation](#), 1130 Mechanical Engineering Building, Minneapolis

October 7

[Advanced Transportation Technologies Seminar: Solar and Wind Hybrid Electric Generators for Rural ITS Applications](#), 1130 Mechanical Engineering Building, Minneapolis

October 14

[Planning and the Environment Council Seminar: Transportation Policy and Technology Options to Reduce Greenhouse Gas Emissions in Minnesota](#), 1130 Mechanical Engineering Building, Minneapolis

October 15

[Annual Conference on Policy Analysis](#), Continuing Education and Conference Center, St. Paul. Call 612-624-3708, e-mail cceconf5@umn.edu.