

# CTS Catalyst

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Accelerating the pace of transportation innovation

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Photo: David Gonzalez, MnDOT

## Evaluating pedestrian and bicyclist risk in Minnesota roundabouts

Once rare in the United States, roundabouts are becoming more common in Minnesota and across the country. Although research has shown that roundabouts can successfully ease congestion and reduce serious crashes, there are concerns about roundabout accessibility and safety for pedestrians and bicyclists.

In a study funded by the Minnesota Department of Transportation, researchers from the Minnesota Traffic Observatory (MTO) examined the experience of pedestrians and bicyclists at two roundabouts in the Twin Cities. Led by MTO director John Hourdos, the team used video

*Roundabouts continued on page 7*

## Reinventing the user experience: can Apple point the way?

"The user is getting a bad deal in our transportation world," said Professor Hani Mahmassani at a special CTS seminar on October 11. "To see what users go through to get from point A to B—couldn't it be better?"

Mahmassani described how it could—by drawing on lessons from successful companies like Apple and putting the user experience front and center.

Mahmassani, director of the Northwestern University Transportation Center, is leading

*Reinventing continued on page 5*



# Intelligent lane control signals help direct driver behavior

As part of a larger effort exploring the effects of roadway signage on driver behavior, researchers from the College of Design have conducted a study on the effectiveness of intelligent lane control signals (ILCS).

The research team, led by Kathleen Harder, director of the Center for Design in Health, used a driving simulator to test ILCS that displayed merge, speed control, and lane-closure warnings over freeway lanes. The researchers were specifically interested in determining which type of merge signs—diagonal arrows, words, or dynamic chevrons—had the most effect on drivers' behavior. The study was funded by the Minnesota Department of Transportation.

Study participants drove on a six-lane divided highway in a driving simulator, where they were presented with five sets of ILCS prompting them to reduce their speed and merge out of the center lane. The researchers collected lane position and driving speed data

from each participant to determine how effectively the signs conveyed their intended messages.

Overall results indicate that the ILCS are effective at directing driver behavior. Most participants reduced their speed when they approached the speed signs, and the majority of drivers merged out of the center lane as they approached the first ILCS displaying a lane closure warning.

"This research [allowed] MnDOT to determine how well motorists understand the messages used on our ILCS," says Brian Kary, freeway operations engineer at MnDOT. "The Active Traffic Management System on I-35W is one of the first in the nation, so there had been little guidance as to the types of messages to display."

Specifically, the researchers found that drivers responded to the diagonal arrow merge signs much earlier than to the merge signs with words or chevrons. Participants changed lanes 266 feet



before reaching the arrow merge sign, compared to 123 feet before the chevron and 54 feet before the words. The simplicity of the arrow sign was probably a factor, the researchers say. The arrow was larger and simpler than the other two sign types and likely took less time for drivers to process.

The study also included a survey that asked participants for their opinions of ILCS and other changeable message signs. Most participants had positive opinions of the signs, particularly those that display information on travel time, traffic problems, and roadway maintenance schedules.

## Can mileage-based user fees benefit the freight industry?



Although mileage-based user fees (MBUF) have seen increasing support from a number of groups in recent years, many entities still oppose their implementation as a supplement or alternative to the fuel tax. The freight industry, in particular, has concerns about the disadvantages of MBUF.

In a recently completed study, University of Minnesota researchers explored how MBUF could potentially benefit the freight industry. They also conducted interviews and focus groups with freight industry representatives to identify specific industry concerns. Research fellow Ferrol Robinson of the Humphrey School of Public Affairs led the project, which was sponsored

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# Living snow fence calculator helps MnDOT save money and lives

As part of a study of living snow fences, U of M researchers created a benefit-and-cost-analysis tool that enables the Minnesota Department of Transportation (MnDOT) to further its living snow fence program.

The study predicts that MnDOT could see net economic returns of more than \$1.3 million per year by expanding the use of living snow fences to guard roads from drifting or blowing snow.

Living snow fences are plantings of trees, shrubs, grasses, or crops used as windbreaks to manage high winds and drifting snow before it reaches roads. Clearer roads mean lower maintenance costs for local agencies and safer conditions for motorists.

The tool evaluates the costs of living snow fences to landowners and helps calculate the global and site-specific economic, transportation, and environmental benefits. Gary Wyatt, an agroforestry professor with the University of Minnesota Extension in Mankato, led the study.



“There are about 4,000 problem sites across the state, and we don’t have the resources to address all of them,” says Dan Gullickson, MnDOT’s Living Snow Fence program coordinator. The tool helps MnDOT determine operating costs and prioritize highways that warrant treatment. Living snow fence contracts with landowners are currently in place at only 2.3 percent of those sites.

“On average about eight people die on Minnesota roads per year because of blowing and drifting snow,” Gullickson

The number of crashes on superelevated curves has fallen

**40**  
**PERCENT**

since living snow fences were implemented.

said. “This tool helps us support the Toward Zero Deaths initiative by making highways safer for the traveling public.”

## Freight from page 2

by the Minnesota Department of Transportation.

For the purposes of the study, the research team assumed that any implementation of MBUF would be a long-term effort, with complete benefits occurring only after the system was fully implemented. The researchers also assumed that all vehicles would be included and that congestion pricing would be an added component of the MBUF system.

Under these assumptions, the researchers identified several potential industry benefits of MBUF. These include travel time reductions and more predictable travel times, mainly resulting from the effects of possible congestion pricing. Freight costs associated with unexpected time delays and extra fuel used on congested roadways could both be reduced.

If MBUF revenue is dedicated

to roadway maintenance and improvements, the freight industry would also experience benefits related to improved road quality. A smoother ride could cause less damage to fragile cargo and result in less maintenance for heavy trucks.

Representatives of the freight industry, however, are concerned that the fees could be used for other purposes. They also point out that billions of dollars would go to installing new equipment to make an MBUF system work before any infrastructure investments are made. The likely high costs of collection, enforcement challenges, and privacy issues are also industry concerns.

Most focus group participants also objected to MBUF because they think trucks are already paying their fair share—including a series of taxes, fuel charges, tolls, licensing fees, and other

**ON AVERAGE, EACH  
HEAVY TRUCK TRAVELS**

**69,000**  
miles per year in the U.S.

regulatory charges. Several participants were concerned about having to pay a distance-based fee to use the roads when they already pay vehicle registration fees based on weight. “The freight industry cannot afford this,” one participant said.

Although most focus group participants were generally opposed to MBUF, one participant did recognize that they could help with the transportation funding shortfall. “The gas tax is a dinosaur,” the individual said. “MBUF [could provide] funding help for the decaying transportation system.”

# Snowplow simulator provides realistic training

Keeping motorists safe on Minnesota's roads is the first priority of snow and ice removal operations. This requires effectively training the snowplow drivers who operate them.

Starting last fall, the Minnesota Local Technical Assistance Program (LTAP), a part of CTS, is teaming with the Minnesota Department of Transportation (MnDOT) to host simulator training for local agencies. The training was offered again this fall in five sold-out sessions.

MnDOT's training program uses state-of-the-art simulators, each with three 42-inch plasma screens that provide a 180-degree view, a touch-screen control display, and multiple computers that together replicate the driver's cockpit.

The simulator, complete with realistic graphic images of buildings, roadways, and other vehicles, provides a true-to-life yet safe environment in which students can experience hazardous weather conditions as well as varied road and difficult maneuvering situations.

"The simulators give the drivers a chance to improve upon skills they use



daily as well as develop skills they use less frequently," explains Brad Swartz, MnDOT simulator lead trainer. "With a combination of classroom discussion, computer-based training, and hands-on application, we see drivers retaining in excess of 85 percent of what they've learned."

A decline in the number of snowplow roadway crashes over the past few winters points to the positive effect these training programs, along with other safety initiatives, are having.

More about the training is on the Minnesota LTAP website.

## 'Maximizing transitways' study: attracting jobs yields biggest benefits

A study led by Yingling Fan found that locating employers near transitways yields more economic benefits than other types of development do.

Fan, an assistant professor in the Humphrey School of Public Affairs, explored how the Twin Cities region, which is planning a network of 14 transitways by 2030, can maximize the return on this investment to improve job accessibility and strengthen the region's economic future.

Fan's team found that integrated policies that support jobs and housing in and near the Twin Cities metro core will increase the return on investment in transitways. "Locating new jobs near transitways is especially important for maximizing the positive impact," she says.

A 12-page summary of the research project is available on the CTS website. More about the study also ran in the July issue of *Catalyst*.



## AWARD AHEAD

### Research Partnership Award: **nominees sought**

CTS is accepting nominations for the 2013 Research Partnership Award. The award honors research projects within the CTS program that have resulted in significant impacts on transportation. The award will be presented at the CTS annual awards ceremony on April 17, 2013.

Please submit your nomination on the CTS website by January 25. Criteria and submission instructions are at [cts.umn.edu/about/awards/rpa](http://cts.umn.edu/about/awards/rpa).

## Reinventing from page 1

an initiative called Reinventing the User Experience in Transportation. In it, researchers are collaborating with a design firm, corporate partners, and transit agencies to rethink the transportation “product” and make it more desirable.

Improving the user experience starts with understanding the problem, Mahmassani said. Current performance measures focus more on the operators’ perspective than the users’—for example, the number of planes on time rather than the number of people delayed and for how long—and generally overestimate the delivered quality of service. And although intelligent technologies are collecting a growing amount of performance data, data mining is limited. Part of reinvention, Mahmassani said, is to mine the data to generate knowledge for better design and service planning.

Besides the technological aspects, Mahmassani continued, a key part of reinvention is incorporating design thinking and learning from successful consumer product and service concepts. What do Apple, Starbucks, and IKEA have in common? “They all expanded the definition of ‘product’ and redefined their industries in a way that placed the overall user experience at the center of the brand and its design,” he said, quoting the initiative’s design partner. Apple isn’t just a phone or tablet; Starbucks isn’t just coffee; IKEA isn’t just furniture—these brands offer a predictable retail environment, a holistic experience, even a culture.

The parallel in transportation, Mahmassani said, is to redefine the mobility product as the overall trip experience—not just the transit vehicle but also the stop (think heated bus shelters) and the neighborhood, the whole trip from door to door.

Improving urban mobility also means leveraging new technologies to offer personalized user information (where is *my bus, now*) and customized interfaces. Technologies are moving toward a “digital sixth sense,” Mahmassani said—smartphones and apps that sense location and nearby services, track behaviors and learn preferences, and offer



*Companies like Apple define their product as the overall user experience—a lesson for reinventing the transportation product.*

choices (the quickest or greenest trip home, perhaps). The sweet spot for system management is to obtain continuous feedback from these technologies—and thus improve system performance and the user experience, he said.

What can transit agencies do to facilitate these changes? Among other ideas, Mahmassani suggests these:

- Facilitate engagement of the private sector and application developers.
- Consider co-branding to take advantage of transit stops and traffic.
- Let users be part of redesigning the user experience.
- Experiment with new service and operational concepts.
- Be open to new service delivery models.
- Think mobility, not just transit.

Mahmassani also encouraged more interdisciplinary research and bringing in new skills such as communications, marketing, visual psychology, user behavior, and gaming.

Video of the seminar is on the CTS events page.

## CTS celebrates 25 years of innovation

Following Professor Mahmassani’s seminar, CTS continued celebrating its 25<sup>th</sup> anniversary by hosting a festive reception. Guests competed in a trivia contest of “fun facts” from 1987, and three winners received U of M prizes.

The 25<sup>th</sup> anniversary celebration culminates November 28 at the CTS Fall Luncheon.



**IN 1987, THESE WERE  
INSTALLED FOR  
THE FIRST TIME AS  
STANDARD EQUIPMENT  
IN THE PORSCHE 944  
TURBO AND THE 944S:**

Driver and passenger airbags

## Catalyst offers more choices for interactive reading

Since launching in July, the *Catalyst* has offered the choice of print or electronic (e-mail, PDF, website). But that was so four months ago.

We're now making the PDF version of the *Catalyst* interactive, which means you can click on story jumps and other links through your PDF reader.

We're also publishing *Catalyst* on Issuu, a free online newsstand with thousands of magazines, reports, and documents from around the world. Controls allow readers to flip pages and zoom into the documents. You can read and subscribe to *Catalyst* at Issuu.com or download it to your computer, tablet, or e-reader.

**READ  
CATALYST  
ONLINE**

for links to research reports  
and other resources.

**Linked in**

Check out current  
transportation-related job  
postings—or send us yours—on  
the CTS website or on LinkedIn.

## Shorter trips help the economy of small Minnesota cities

According to a recent project sponsored by the Center for Urban and Rural Affairs (CURA), smaller cities in Greater Minnesota are performing well economically—especially compared with larger neighboring cities. Findings suggest that consumers are taking fewer long-distance trips and doing more of their shopping closer to home.

The study was a follow-up to an earlier project conducted by CURA associate director William Craig and Bruce Schwartau, associate professor at the University of Minnesota's Extension Center for Community Vitality. As part of the original study, the researchers used sales tax data to organize Greater Minnesota cities into trade-center levels based on the number of goods and services available to customers.

In this project, Craig and Schwartau used a new set of data from the Minnesota Department of Revenue that included more than 80 additional cities with populations ranging from 1,000 to 6,000. This data set, which also included sales tax data for a wider range of goods and services, helped provide a more complete picture of the smaller trade centers in Greater Minnesota.

Findings indicate that smaller cities have been performing well, especially from 2003 to 2009. More than 40 percent experienced an increase in economic activity during that time, while the four largest outstate cities suffered a decline. In fact, overall sales tax receipts in Minnesota were down 14 percent during this period.

These results suggest that consumers are making more of their regular purchases locally and are less likely to drive to the nearest large cities for more unique purchases, according to Craig and Schwartau.

More information about the project is available in the Summer 2012 issue of the *CURA Reporter*.



## NEW RESEARCH REPORTS

Recently published reports on transportation-related research at the University of Minnesota explore:

**DETECTING DRIVER  
DROWSINESS**

(CTS 12-32)

**CULVERT PIPE SERVICE  
LIFE IN MINNESOTA**

(MnDOT 2012-27)

**ESTIMATING VEHICLE  
POSITION**

(CTS 12-31)

Research reports are available at [cts.umn.edu/Publications/ResearchReports](http://cts.umn.edu/Publications/ResearchReports).

## Roundabouts from page 1

surveillance equipment to collect data on driver and pedestrian behavior at each site.

The researchers deployed the video equipment at a two-lane roundabout in suburban Richfield and a one-lane roundabout in a residential area of Minneapolis. Between the two locations, the team captured video of more than 6,900 pedestrian crossings and 7,500 bicycle crossings.

Among the thousands of crossing events captured by the study, there were only three cases that could marginally be termed close calls. However, study findings do highlight the existence of friction between pedestrians and drivers at roundabout crossings.

One concern is that many drivers fail to yield to pedestrians and bicyclists, even though Minnesota law requires them to do so. In fact, findings show that drivers at the Richfield roundabout yield only about 45 percent of the time. The yielding rate in Minneapolis was higher, averaging about 83 percent.

The research team identified several factors that influence drivers' yielding behavior. Study results indicate the following trends:

- Drivers are more likely to yield to pedestrians or bicyclists beginning their crossing in the center island.
- Vehicles exiting the roundabout are less likely to yield than those entering it.
- Drivers are more likely to yield to larger groups.
- Vehicles entering the roundabout at the immediate upstream entrance are more likely to yield than those coming from other entrances.
- Drivers are less likely to yield if they encounter another vehicle merging into the roundabout immediately before the exit where the pedestrian is trying to cross.
- Yielding probability decreases with more vehicles present in the roundabout.

The team also examined the delays experienced by pedestrians waiting to cross at roundabouts,

and results indicate that their wait times are actually shorter than at signalized intersections. For example, a signalized intersection with daily traffic comparable to the Richfield roundabout has an average pedestrian delay of 30 seconds. The average delay at Richfield was nine seconds. At Minneapolis, the wait was even shorter—less than two seconds. However, the researchers suggest that the non-yielding behavior of drivers at roundabouts may intensify the experience of delay, making it seem longer than it actually is.

In addition, drivers' failure to yield creates a significant safety risk, particularly for pedestrians who are visually impaired. Although the researchers did not observe any visually impaired pedestrians in this study, the observed yielding rates demonstrate that such pedestrians cannot assume drivers see them or are willing to stop.

There are approximately  
**2,000**  
**ROUNDBABOUTS IN THE**  
**U.S.,**  
compared to  
**20,000**  
**IN FRANCE,**  
**15,000**  
**IN AUSTRALIA, AND**  
**10,000**  
**IN THE U.K.**



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## REINVENTING THE USER EXPERIENCE

could mean following the model of  
companies like Apple.

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Researchers explored

## DRIVER RESPONSE

to messages displayed on

## INTELLIGENT LANE CONTROL SIGNALS.

page 2

A study examined the potential benefits of

## MILEAGE-BASED USER FEES FOR THE FREIGHT INDUSTRY.

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## Evaluation of pedestrian and bicycle risk in Minnesota roundabouts finds some friction.

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