Two years ago, the Minnesota Department of Transportation (MnDOT) installed a series of electronic speed limit advisory signs over I-94 between Minneapolis and St. Paul. The variable speed limit (VSL) system is designed to reduce congestion and help prevent crashes by recommending lower speed limits to drivers during periods of high traffic.

The new technology has worked in other places, including China and Germany. In Minnesota, a similar VSL system on I-35W reportedly helped reduce congestion during the morning commute south of Minneapolis.

Improving work-zone safety for visually impaired pedestrians

Navigating sidewalks and intersections affected by road construction can be challenging for all pedestrians, but it's especially difficult for those who are blind or visually impaired.

To help these pedestrians find their way safely, University of Minnesota researchers have developed a smartphone app that can detect upcoming work zones and provide routing instructions. The project, funded by the Minnesota Department of Transportation (MnDOT), was led by senior systems engineer Chen-Fu Liao at the U's Minnesota Traffic Observatory.

Does the variable speed limit system on I-94 reduce crashes?

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Rail transit + neighborhood design = less auto ownership?

Rail transit and transit-oriented development (TOD) are often promoted as ways to reduce auto dependence and traffic congestion. It’s unclear, however, what causes the increased transit ridership that often follows a new development: Is it because travelers substitute one mode for another, or is it due to new demand? Furthermore, most studies do not disentangle the influences of two important factors—residents’ preferences and the built environment surrounding station areas—from the impact of rail transit itself. These knowledge gaps create blind spots that limit our understanding of the potential for using rail transit and neighborhood design to curb auto ownership.

To shed light on these questions, Humphrey School of Public Affairs researchers examined the effects of light-rail transit (LRT), neighborhood design, and resident self-selection on auto ownership using the Blue Line LRT (formerly known as Hiawatha) in the Minneapolis–St. Paul metropolitan area. They learned that rail development alone isn’t sufficient to reduce auto ownership—other factors are part of the picture.

Researchers led by associate professor Jason Cao found that several demographic variables play a significant role in auto ownership. Household income, the number of drivers in a household, and having a driver’s license are all associated with increased auto ownership. Women tend to own fewer autos than men.

“Ultimately, we found that household income is the main determinant of auto ownership, and neighborhood characteristics have a marginal effect,” Cao says. “LRT development alone does not reduce auto ownership apart from the influences of neighborhood characteristics and resident self-selection.”

The researchers stress that people self-select where they live based on their predisposition toward travel and residence. The Blue Line allows those who want to live near rail transit but could not previously do so choose to live in the corridor and hence own fewer vehicles.

“Offering alternative development such as TOD will enable those who dislike driving to find a neighborhood to match their preference,” Cao explains. “The major takeaway for planners and transportation professionals is that neighborhood design is an important consideration in rail transit development.”

“Professor Cao’s study examining the effect of rail transit on auto ownership is another example of CTS’s useful real-world research that helps planners and others understand the role and influence of transit on the economy and the built environment,” says Donna Drummond, director of planning for the City of St. Paul.

Data collection for the research was supported by the Transitway Impacts Research Program (cts.umn.edu/research/featured/transitways). The study was also conducted under the auspices of the Natural Science Foundation of China.

In terms of neighborhood characteristics, lower parking availability, high job accessibility, and more businesses within a quarter-mile of the respondent’s home (a density measure) are associated with lower levels of auto ownership.

In addition, respondents with a pro-drive attitude and preferences for “large backyards” and “lots of off-street parking” owned a greater number of autos, whereas those with a pro-transit attitude and preference for transit access owned fewer autos.

/READ CATALYST
ONLINE
for links to research reports and other resources.

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In 2013, Dakota County asked CTS to lead an interdisciplinary team from the U of M in the development of a strategic action plan for Dakota County’s human service transportation.

The initiative aimed to assist the county with a previously identified lack of coordination as well as significant service gaps among its existing transportation options. Goals included making sense of a tangle of funding sources, providers, and rules that created confusion for users as well as providing clear direction for next steps.

The CTS-led team, which included Frank Douma and Guillermo Narvaez from the Humphrey School of Public Affairs, engaged Dakota County’s stakeholders through an advisory committee and a series of stakeholder input meetings. The team also collected and analyzed data about transit providers in the county, funding sources, potential regulatory barriers, user experiences, and emerging practices in other states. Finally, a strategic planning workshop with the advisory committee used this data to identify priorities for next steps.

Four main goals emerged from the strategic planning effort:

- **One-call/one-click access to information:** Customers and providers have a one-call, one-click touch point to ask questions and get information about transportation options and to help eliminate barriers.
- **Consistent data:** Data collection and reporting among providers is consistent, transparent, and shared.
- **Land-use connection:** Transportation services and needs are factored into city and county development and land-use decisions.
- **Awareness:** Customers and providers are aware of available options and how to access them. County leaders are aware of the need for and use of services.

Based on the needs, goals, and strategies identified in the stakeholder engagement process, the team developed several recommendations for the county. They included forming a county coordinating collaborative, identifying funding options for coordination activities, implementing a communications and marketing plan, and launching a travel training program.

The recommendations have been shared with the Dakota County Board of Commissioners, and work on planning the structure for the suggested county coordinating collaborative is already under way.

“This process was a true community-engaged journey,” says Kelly Harder, director of community services at Dakota County. “The stakeholders were heard and their input was essential to the strategic plan that we’re now implementing.”

Overall, the results of the planning initiative will provide a road map for Dakota County to improve its human service transportation in time to meet the needs of its growing population of older adults, as well as individuals with disabilities and lower incomes. In addition to serving these target populations, improved coordination will help Dakota County provide better transportation services to all of its residents, enabling greater access to jobs, medical care, school, and other services.

Unmanned aircraft systems: read in-depth coverage of April forum

A proceedings of the unmanned aircraft systems (UAS) forum, held on April 30, is now available for download. Speakers discussed UAS technology and how Minnesota can adapt for its public and commercial use. Additional forum materials are available on the event web page as well.

The forum was sponsored by the Airport Technical Assistance Program, a part of CTS. Cosponsors were the Minnesota Department of Transportation, the Minnesota Department of Employment and Economic Development, and MnDRIVE.

Read more at airtap.umn.edu.
Alternative surface treatment for bridge decks quick…and sticky

Sometimes solutions to age-old problems like maintaining the driving surface of a bridge can get sticky. Literally.

Civil engineering researchers at the University of Minnesota Duluth have been testing alternatives to a traditional concrete or asphalt surface layer by adhering a variety of small aggregates to the decks of 11 bridges in Minnesota using a thin layer of epoxy.

The resulting ultra-thin bonded wear courses measure a half-inch or less in thickness compared to conventional concrete or bituminous overlays of 2 inches or more. (The wear course is the separate, thinner layer added on top of a bridge deck or pavement that can be easily removed for replacement after traffic wears down its friction values.)

The ultimate goal is to develop a surface treatment that improves driving safety with higher surface friction and better protects the bridge structure by sealing out damaging moisture and deicing chemicals.

According to UMD civil engineering student Rob Kostick, epoxy overlay systems offer much higher surface friction created by the macrotexture of aggregates, provide a protective seal to keep out water and soluble chlorides, and have faster cure times that allow traffic within a couple of hours of construction.

As part of the MnDOT-funded project, the researchers made visits to the 11 bridge sites located around the state; conducted field testing to measure the bond, seal, and strength of each epoxy overlay system; tested the quality of the aggregates used with each system; and analyzed crash data involving each of the sites.

Overall, the researchers found that all overlay systems are performing satisfactorily. “It’s properly sealing the deck,” Kostick says. “You’re not getting the water infiltration that you’d see with conventional overlays.” In addition, they found sufficient bond strength between bridge decks and the overlay systems.

Immediately after installation, the friction numbers for the overlay surface at each bridge increased significantly (some so high they didn’t register). But the numbers have steadily decreased in the five years since due to wear and tear, especially from damage caused by snowplow blades.

The research team also analyzed 10 years of crash data from the Minnesota Department of Public Safety for each site. The data included dates as well as weather and surface conditions.

The researchers found a noticeable reduction in crashes on most of the bridges, but they were unable to link the drop to the installation of the epoxy overlays. For the most part, crashes were reduced to a rate similar to bridge decks without these systems.

They also discovered that snow and ice can diminish the effectiveness of the system. “As the snow accumulates and is packed down by cars, it takes away the ability of the system to function with its high friction because the macrotexture is filled with snow,” Kostick says.

The hope, Kostick adds, is that analysis of the field performance, durability, and associated costs of the system will enable the research team to conclude whether ultra-thin bonded wear courses are a sustainable and cost-worthy investment for use in cold-weather climates such as Minnesota.

The research team, led by assistant professor Eshan Dave and including assistant scientist Jay Dailey, will wrap up the study during the next year.

Speakers and dates announced for Roadway Safety Institute seminar series

The schedule has been released for the new Roadway Safety Institute seminar series. Seminars are being held Thursdays from 3-4 p.m. throughout the fall semester on the U of M’s east bank campus in Minneapolis. The seminars, which will also be streamed live on the web, feature safety-focused research related to the Institute.

Stay tuned to roadwaysafety.umn.edu/events for details.
Summer interns gain real-world transportation experience

Participants in the Summer Transportation Internship Program learned lessons in everything from concrete paving to bridge design to controlling roadside vegetation in their positions at the Minnesota Department of Transportation (MnDOT) this summer.

This year, eight undergrads from the U of M Twin Cities (UMTC) and U of M Duluth (UMD) spent 10 weeks getting hands-on transportation-related experience in MnDOT’s Engineering Services Division as part of the program.

Now in its third year, the program is designed to provide students with the opportunity to gain professional experience and skills that will complement their academic pursuits. It is offered in partnership by CTS and MnDOT.

This year’s participants included:
• Jonas Bauer (UMD) and Brandi Rajala (UMTC), who worked in the Office of Environmental Stewardship.
• Matthew Duff (UMTC) and Spencer Borchardt (UMTC), who were placed in the Bridge Office.
• Michael Quach (UMTC) and Justice Harvieux (UMTC), who spent the summer in the Office of Materials and Road Research.
• Samantha Bowman (UMD), who worked in the Office of Project Management and Technical Support.
• Lucas Kaari (UMD), who was placed in the Office of Land Management.

Many of the interns say they enjoyed seeing transportation-related concepts in action while also gaining valuable professional experience. Interns went on site visits to pavement, bridge, and other projects, built relationships with transportation professionals, and became familiar with contracts, bridge plans, new technologies, and more.

“I was able to see how stuff I have learned in class applies to real problems,” says Matthew Duff. “I have always known that I wanted to be a structural engineer, and working in the Bridge Office has further confirmed this.”

Other interns echo Duff’s comments, saying that the experience expanded their interest in transportation-related careers and will be helpful as they enter the workforce.

“The most valuable part of the internship was developing working knowledge and practical skills, specifically in concrete paving,” says Justice Harvieux. “Going forward, I’ll be prepared to take on more challenging projects related to this field and build on my basic knowledge.”

“I was never certain about what environmental engineering would include, but through this internship I witnessed it first-hand,” adds Jonas Bauer. “My great experience at MnDOT has made me seriously consider environmental engineering as a career field.”

Attracting students for the workforce of tomorrow

Meeting the transportation needs of tomorrow requires attracting students today to degrees in science, technology, engineering, and mathematics. Two programs this summer brought young people to the U of M campus to spark their interest in such degrees and learn about possible careers in transportation.

About 25 high school students from the Twin Cities metro area were part of the CSE Exploring Careers in Engineering and Physical Science Summer Camp, hosted by the University’s College of Science and Engineering. The week-long camp in July gave high school students a hands-on introduction to engineering, science, and mathematics opportunities. Nichole Morris, a research associate in the HumanFIRST Laboratory, introduced the field of human factors psychology and engineering to the group, highlighting transportation safety.

And on August 11, six middle-school students from the Red Lake Indian Reservation visited CTS as part of their Summer Transportation Institute. The program, funded by the Federal Highway Administration, introduces students to transportation-related careers while encouraging them to pursue higher education. During their visit, students conducted an experiment in the Soil Mechanics Laboratory, learned about traffic engineering, and studied real-world issues in the Minnesota Traffic Observatory.
The app builds on a previously developed smartphone-based system that was designed to provide visually impaired pedestrians with geometric and signal timing information at signalized intersections. Funding for the original project, also led by Liao, was provided by the Intelligent Transportation Systems Institute.

As part of their work developing the new work-zone component, the researchers surveyed a group of visually impaired pedestrians. The goal was to better understand their challenges and the information that would be most helpful to them when approaching a work zone. Results provided the researchers with guidelines as they determined what the app would communicate to users.

The app uses Bluetooth beacons—which can be attached to signs, posts, or construction barriers in a work zone—that communicate with the GPS receiver on a user’s smartphone. When a beacon is detected, the phone vibrates and provides an audio message. The message includes the pedestrian’s current location, the location of the work zone, and suggested routing instructions. The user can tap the smartphone to have the message repeated.

The federal government strongly encourages states to provide either audible warnings or tactile maps at work zones where visually impaired pedestrians will likely be affected.

“The smartphone application is a step in that direction,” says Ken Johnson, a work zone, pavement marking, and traffic devices engineer at MnDOT and the project’s technical liaison. “It’s a way to see if this type of wayfinding device would work.”

The researchers also integrated the work-zone component with the intersection crossing information provided by the previously developed system. If a Bluetooth beacon contains both work-zone and intersection information, the app provides the work-zone message followed by the intersection and traffic signal information, based on the direction the smartphone is pointing.

Moving forward, the researchers plan to work with MnDOT and local cities to access real-time traffic signal information and work-zone construction information on a larger scale. Prior to the release of the app, additional testing will also be conducted.

In addition, the research team has received funding from the Roadway Safety Institute (RSI) to expand the project by creating a “condition aware” infrastructure that can be integrated with the smartphone app. The goal is a system that can self-monitor and keep the information it broadcasts to app users as up-to-date as possible.

The project will include the development of Bluetooth devices that can be installed anywhere, such as on a light post at an intersection or on a construction barricade or traffic cone. These devices, which will be able to sense other devices within their range, will help create a local map of the environment. A database that contains the location and message of each device will be integrated with the smartphone app to provide navigation information to visually impaired pedestrians.

“This mapping methodology will ensure that correct audio information is provided to app users at the right location,” Liao says. “It could be used anywhere—at traffic intersections, skyways, or underground tunnels—to provide directions for travelers.”

The team expects the app to be available to the public following the completion of the RSI-funded project.

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CTS HAS ISSUED A CALL FOR PRESENTATIONS
for the 26th Annual CTS Transportation Research Conference, May 20–21, 2015, at the Saint Paul RiverCentre.

DEADLINE FOR ABSTRACTS: NOVEMBER 12
Details: cts.umn.edu/Events/Conference
Further information: Nicole Freese, 612-624-3708

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20.6 MILLION AMERICANS 18 and older report experiencing SIGNIFICANT VISION LOSS.
Although the verdict on the system’s effects on I-94 congestion is still pending, a recent study by researchers at the U of M’s Minnesota Traffic Observatory (MTO) found that the VSL system has not made a measurable impact on crashes in a crash-prone stretch of freeway in downtown Minneapolis.

Why not? John Hourdos, MTO director, has a few theories. According to Hourdos, issues include a simple time lag in the VSL system, a requirement that all lanes display the same speed limit, and the complexity of the I-94 commons area itself. In addition, the driving public simply doesn’t understand what the signs are telling them.

“People do not know what the system really does,” Hourdos says. “There hasn’t been much education on it... and when they try to decipher it on their own, they get even more confused.”

The advisory speed limits are posted in response to varying traffic conditions as vehicles approach the commons area. If the traffic slows, the VSL system transmits a reduced advisory speed to drivers approximately 1.5 miles upstream from the slowdown.

Hourdos says many motorists mistakenly believe the speed displayed on the signs is either a reflection of the speed on the current stretch of highway or an indication of the speeds on the highway ahead, rather than a suggested speed for them to follow. The requirement to display the same speed limit on all signs also compounds the problem, Hourdos says. When drivers see that the slowdown is only occurring in certain lanes, they tend to ignore the signs altogether.

“In the lane that is congested, the real speeds drop much faster than what the VSL system can respond to, reducing the functionality of the system to the eyes of the drivers,” Hourdos says. “In the fast-moving lanes, it seems the system has no purpose at all.”

So is the I-94 VSL system useless? Not necessarily. For one, the new study didn’t measure the system’s impact on congestion—only its ability to reduce crashes on a small portion of I-94. Moreover, the area in question, the I-94 commons, is fairly unusual, having two major bottlenecks, the highest crash rate in the state, and five hours of congestion during the afternoon rush hour alone.

“The VSL system was designed for implementation on any freeway and may not have been well-suited for the I-94 commons area, which is a very complex corridor with high-volume weaves and significant shockwave activity,” says MnDOT freeway operations engineer Brian Kary.

But MnDOT and the MTO researchers aren’t giving up. A new project starting this year is focused on developing and deploying a queue warning system specifically for this location (see article in the May 2014 Catalyst for details).

Adapted from an article by Shannon Fiecke on the joint MnDOT/CTS Crossroads blog.