

CTS Catalyst

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Accelerating the pace of transportation innovation

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Travel behavior study shows drivers are spending less time traveling and more time at home

Something unprecedented has happened to Americans' travel patterns. Even before the recent recession, total distance traveled per person had started to decline, and the rate of total vehicle travel had begun to steadily decrease as well.

In a new five-part series of research reports sponsored by the Minnesota Department of Transportation and the Metropolitan Council, U of M researchers are delving into a set of rich data encompassing more than four decades of travel behavior surveys to enable the region's

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Transportation and supply chain decisions play a key role in reducing carbon emissions

Reducing carbon emissions has become a growing concern for governments and companies worldwide. Firms are taking action to reduce their carbon footprint because of regulatory requirements and pressure from their own consumers and shareholders. Most of the carbon-cutting measures taken by companies, however, have focused on often-costly strategies such as replacing equipment, redesigning products and packaging, finding less-polluting sources of energy, or instituting energy-savings programs.

"While there is clearly value in these efforts, they tend to overlook a potentially significant source

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MnDOT appoints first scholar-in-residence



Professor Greg Lindsey was recently appointed as the first scholar-in-residence at the Minnesota Department of Transportation (MnDOT).

Lindsey, who is spending his sabbatical from the U of M's Humphrey School of Public Affairs on bicycle and pedestrian counting research projects, will be working in the MnDOT Office of Transit's Bicycle and Pedestrian Section until June 2016.

Since Lindsey was going to be spending much time at MnDOT conducting his research, the agency invited him to be a scholar-in-residence and also to office at MnDOT part time.

"We'll be working on institutionalizing bicycle and pedestrian counting—so local engineers and planners have evidence for planning and investing in new facilities and establishing priorities for investments to increase safety," Lindsey says.

Lindsey will help MnDOT develop a district-based plan for permanent and long-term bicycle and pedestrian monitoring following new guidance in the Federal Highway Administration's *Traffic Monitoring Guide*.

Lindsey's appointment expands on MnDOT's existing partnership with CTS and builds on his work for the Minnesota Bicycle and Pedestrian Counting Initiative, a collaborative effort between MnDOT and the U of M (see article in the October 2014 *Catalyst*).

"We are excited about this new collaboration with the University and believe it establishes an important precedent for the future," MnDOT Commissioner Charles Zelle stated in a letter to Lindsey.

This is believed to be the first time MnDOT has appointed an in-house scholar.

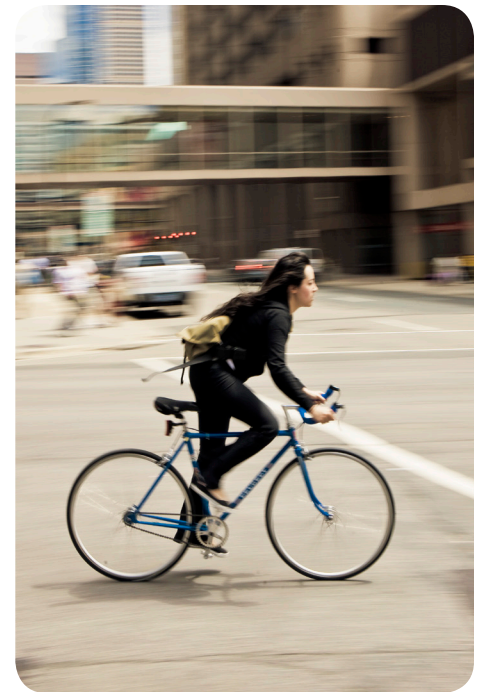
Lindsey specializes in environmental and transportation planning, policy, and management. His current research involves nonmotorized transportation systems. Partners in his research include MnDOT, the Minneapolis Department of Public Works, Transit for Livable Communities, and the Minneapolis Parks and Recreation Board.

"I'm excited about this opportunity to work more closely with the transportation professionals who are working hard to provide transportation

options that are safe and efficient," Lindsey says. "My residency at MnDOT will advance a variety of initiatives, including my work for the Roadway Safety Institute on nonmotorized transportation monitoring and measurement of exposure to risk. One of our goals is to develop tools that practitioners can use to prioritize investments for infrastructure to increase biking and walking safety."

"[Lindsey's] work to institutionalize bicycle and pedestrian monitoring throughout Minnesota is central to our efforts to establish the evidence we need to maximize the efficiency of our investments in infrastructure and the safety of our transportation facilities," Zelle wrote.

(Adapted from an article published on the joint MnDOT/CTS Crossroads blog.)



Better job accessibility drives MnPASS subscriptions

In recent years, many metropolitan-area highway systems have created high-occupancy toll (HOT) lanes. Typically, the use of these lanes is restricted during peak periods to carpools and those paying a toll for access, which commonly requires enrollment in an electronic tolling program and the use of an electronic transponder.

To better understand why drivers enroll in Minnesota's MnPASS electronic tolling system, University of Minnesota researchers investigated the factors that drive subscriptions. Their findings indicate that households are more likely to have MnPASS subscriptions in areas where the MnPASS system provides a greater increase in accessibility to jobs.

"While there has been a great deal of research into what causes travelers to select a toll lane during a single trip, there is very little information available regarding the first decision a potential HOT lane user must make—the decision to enroll in an electronic tolling program and become an eligible HOT lane user," says Andrew Owen, director of the U's Accessibility Observatory.

The MnPASS system was created in 2005 with the opening of HOT lanes on I-394 west of downtown Minneapolis; in 2009, the system was expanded to include HOT lanes on I-35W south of downtown Minneapolis. During peak periods, the lanes are restricted to vehicles carrying two or more occupants and to travelers paying a toll that varies from \$0.25 to \$8.00 based on HOT lane utilization at the time. To use the HOT lanes, vehicles must enroll in the program online, by mail, or in person and



Photo: MnDOT

pay \$1.50 a month to carry a MnPASS transponder provided by the Minnesota Department of Transportation (MnDOT).

"Though enrolling in a HOT lane program is usually low-cost or free, it always requires some user expense in the form of time spent processing enrollment forms and managing accounts," says Owen. "In addition, it involves some risk because there is typically a charge for lost or damaged transponders. Because of these costs and risks, it's reasonable to expect people who would receive little or no benefit from the ability to use HOT lanes won't enroll in the program, while a person who would receive a very large benefit would be very likely to enroll."

To test this theory, researchers calculated the job accessibility benefit of the MnPASS system by determining the

areas where using MnPASS HOT lanes would lead to the greatest increase of jobs reachable with a commute of 30 minutes or less. They found that the areas with the highest concentrations of MnPASS-holding households—the western and southern suburbs of the metro area—were also the areas where the MnPASS system provided the greatest accessibility benefit.

"These findings will serve as a useful tool for transportation planners as they work to determine where to implement HOT lanes in the future," says Owen. "By evaluating the incremental job accessibility benefits created by a planned HOT lane, planners can more effectively model participation in toll lane programs and more accurately weigh the costs and benefits of creating new HOT lanes."

NEW RESEARCH REPORTS

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

LIGHTING FOR ISOLATED INTERSECTIONS

(MnDOT 2015-05)

PLANNING & ECONOMIC DEVELOPMENT

(MnDOT 2015-02)

SALT-TOLERANT SOD FOR USE AS ROADSIDE TURF

(MnDOT 2014-46)

Research reports are available at cts.umn.edu/Publications/ResearchReports.

Research identifies a better-performing patch for concrete pavement repair



Concrete pavements can be challenging to patch effectively. Patching mixes must rapidly gain strength to allow the roadway to be reopened to traffic quickly while bonding well with the existing pavement to prevent separation between the pavement and the patch, says Eshan Dave, associate professor of civil engineering at the University of Minnesota Duluth.

In a recent project, researchers led

by Dave developed improved guidelines for evaluating concrete patching mixtures. Using a series of laboratory tests, Dave's team tested 13 different patching mixtures for key properties including strength, shrinkage, bonding, and durability.

"The impact of our research will be a better-performing patch material," Dave says. "The performance criteria we developed can be used to compare the

materials tested in this project with new materials that will certainly be developed in the future."

The team also developed a laboratory-testing-based acceptance procedure. The project's sponsor, the Minnesota Department of Transportation (MnDOT), plans to use the acceptance procedure for partial-depth patching materials.

"MnDOT will now have a more comprehensive qualification process and a series of tests that can be performed to determine the effectiveness of partial-depth patching materials," says Ron Mulvaney, MnDOT structural concrete engineer. "Improving the durability of these patching materials will help MnDOT realize significant future maintenance cost savings."

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for links to research reports and other resources.

U of M in the spotlight at TRB national conference



U of M researchers presented more than 40 papers and posters on topics ranging from accessibility to asphalt binders at the Transportation Research Board (TRB) annual conference in Washington, DC, on January 11–15.

Professor David Levinson was one of four panelists in a TRB Spotlight session. "Creating Ladders of Opportunity: USDOT's Efforts to Increase Access for the Future" was held January 12, with USDOT Secretary Anthony Foxx presiding. Access to reliable, safe, and affordable transportation is central to Secretary Foxx's agenda; the session focused on integrating measures for ladders of opportunity within existing planning processes and DOT programs.

Levinson, the RP Braun/CTS Chair in the Department of Civil, Environmental, and Geo-Engineering, is the principal investigator of the U of M's Accessibility Observatory.

Also, 22 graduate students received travel awards to attend the conference, 9 funded by CTS and 13 funded by the Roadway Safety Institute. Students presented research and networked with other participants.

Future drivers learn **safety lessons at Creativity Festival**

As part of its outreach and workforce-education efforts, the Roadway Safety Institute (RSI) presented a roadway safety lesson to 90 students in grades 3–4 during the Creativity Festival on January 14.

The Creativity Festival, a program of Success Beyond the Classroom, introduces students to the value of creative thinking across a wide array of

fields ranging from engineering to art.

During the RSI's lesson, students traveled on "roads" throughout a mock town, trying to reach various destinations. They were then given the opportunity to brainstorm and implement various ways to lower road "collisions" and congestion, such as changing the layout of the town, creating new navigational signage,

and installing traffic control officers.

Through this hands-on activity, students explored how engineers, planners, and policymakers work creatively to promote safe roadways.

The RSI is the Region 5 University Transportation Center, a consortium led by the U of M.



Students at the Creativity Festival explored ways to make roads safer.

Researcher serves as expert resource for TPT documentaries

"State of Repair: Industries of Constant Motion," a video co-produced by Twin Cities Public Television (TPT) and Minnesota 2050, began airing in January. Frank Douma, associate director of the Humphrey School's State and Local Policy Program, served as an expert resource for and is featured in the video. Douma also is a researcher with the U's Transportation Policy and Economic Competitiveness Program.

The new video travels the Mississippi River in St. Paul, films on the shoreline of Lake Superior, visits numerous airports, and catches glimpses of trains to learn how ports, rail, and airports keep Minnesotans and Minnesota's economy moving. It is one of three 26-minute videos co-produced by MN2050 and TPT on the infrastructure future in our state. "State of Repair: Liquid Assets" also began airing in January; "State of Repair: Roads & Bridges" began airing in September 2014. All three are available for viewing at tpt.org.

Minnesota 2050 is a collaborative, nonprofit partnership for infrastructure advocacy. To learn more, see mn2050.org.



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transportation planners to better understand how its residents make decisions about whether, when, where, and why to travel.

In the first study, researchers examined how changes in the accessibility of destinations—such as jobs, shopping, and leisure activities—have changed travel behavior in the past 20 years.

“We started with a detailed analysis of travel surveys conducted by the Metropolitan Council in 1990, 2000, and 2010,” says David Levinson, the study’s principal investigator and RP Braun/CTS Chair in the Department of Civil, Environmental, and Geo-Engineering. “We found that people are spending slightly less time in motion and more time at home. We also found that accessibility is a significant factor in determining not only travel behavior but overall time budgeting in general. In short, each person has to decide how they will use the time allotted to them each day, and many of those decisions are directly related to the transportation and land-use systems in place.”

A deeper look into the data sheds additional light on the relationship between accessibility and travel

behavior. For example, trip durations for workers have gone up for all activities between 1990 and 2010. More noticeably, distances for trips have increased markedly: workers take jobs farther from their homes and shop farther from their homes. Travel speeds also increased for the average worker, due to more travel on faster suburban roadways that carry a larger share of all travel. In contrast, for non-workers, trip durations and overall travel time have gone down.

“Interestingly, although time, distance, and speed per trip has generally risen for workers, the number of those trips is declining,” Levinson says. “As a result, overall, fewer miles are being traveled and less time is being allocated to travel.”

Total time spent shopping also decreased for workers and for males, likely caused in part by an increase in online commerce. “The Internet has provided electronic accessibility, much as the transportation network has in the material world,” Levinson explains. “It helps to facilitate commerce, communication, education, and leisure. This may lead to a decreased need for people to travel, and account for more

time spent at home.”

Jonathan Ehrlich, planning analyst with the Metropolitan Council, says the research “helps us get more value from our travel surveys and will aid in understanding how travel is changing, and what the risks are in the assumptions and models we use for planning and forecasting.”

The findings will prove useful not just for Twin Cities transportation planners but for planners and engineers worldwide. “Our models can be easily adapted to data from other cities or for other activities besides work,” Levinson says. “This creates an approach that can be used to gauge the impact of a transportation project from an accessibility standpoint and determine how that project will translate into time allocation.”

Other parts of the study will look at changes in telecommuting behavior over time, the effect of transit quality of service on people’s activity choices and time allocation, changes in travel behavior by age cohort, and analysis of bicycling and walking in light of land-use and transportation system changes. The *Catalyst* will feature coverage of these projects as they are completed.



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of emissions driven by business and operational practices,” says industrial and systems engineering professor Saif Benjaafar. “For example, determining how frequently supply deliveries are

have a significant impact on the carbon footprint of a firm,” Benjaafar explains. “By extending supply chain models that typically focus on either minimizing cost or maximizing profit to include carbon

practitioners, they can also be used by policymakers looking to craft effective carbon emission regulations. “We found that different types of regulatory policies affect the value of collaboration within



U of M researchers found that firms could reduce their carbon footprint—without significantly increasing their costs—by changing business practices and operational policies, such as:

- Reducing the frequency of supply deliveries
- Using closer suppliers
- Choosing a more-efficient mode of transportation
- Locating facilities strategically
- Collaborating with other members of their supply chain

made could be as important in mitigating carbon emissions as the energy efficiency of the vehicles used to make these deliveries.”

In a paper published in the journal *IEEE Transactions on Automation Science and Engineering*, Benjaafar describes how relatively simple and widely used models can integrate carbon emission concerns into operational and supply chain decision making. By incorporating carbon emissions into existing supply chain models, Benjaafar and his co-authors offer a new way of thinking about the supply chain.

“Many popular business practices, such as just-in-time manufacturing and lean production, favor frequent deliveries with less-than-truckload shipments, small production runs, and multiple regional warehouses. These practices

footprint, the models can then be used to understand how accounting for carbon emission might affect operational decisions.”

Through the development and use of these updated models, researchers gained a series of important insights—most notably, that reducing carbon emissions need not be an expensive endeavor. “Conventional thinking is that reducing carbon emissions will require significant capital investments or a switch to more expensive sources of energy,” Benjaafar says. “We show that firms could effectively reduce their carbon emissions without significantly increasing their costs by making only operational adjustments and by collaborating with other members of their supply chain.”

Not only will the models outlined in this research prove useful to supply chain

the supply chain to reduce carbon emissions, with some policies providing greater benefits from collaboration than others,” Benjaafar says.

The journal article, coauthored by Yanzhi Li (City University of Hong Kong) and Mark Daskin (University of Michigan), is based on CTS-sponsored seed research. Since its publication in 2013, the paper has had a significant impact: it has been listed as a Highly Cited Paper by ISI Thomson Reuters for receiving enough citations to place it in the top 1 percent of the academic field of engineering, and it is listed by *IEEE Transactions on Automation Science and Engineering* as one of the top most downloaded papers in 2013 and 2014.

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can reduce
CARBON EMISSIONS.
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RESEARCHER
appointed as MnDOT's first
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Drivers are spending less time
traveling and more time at home.

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