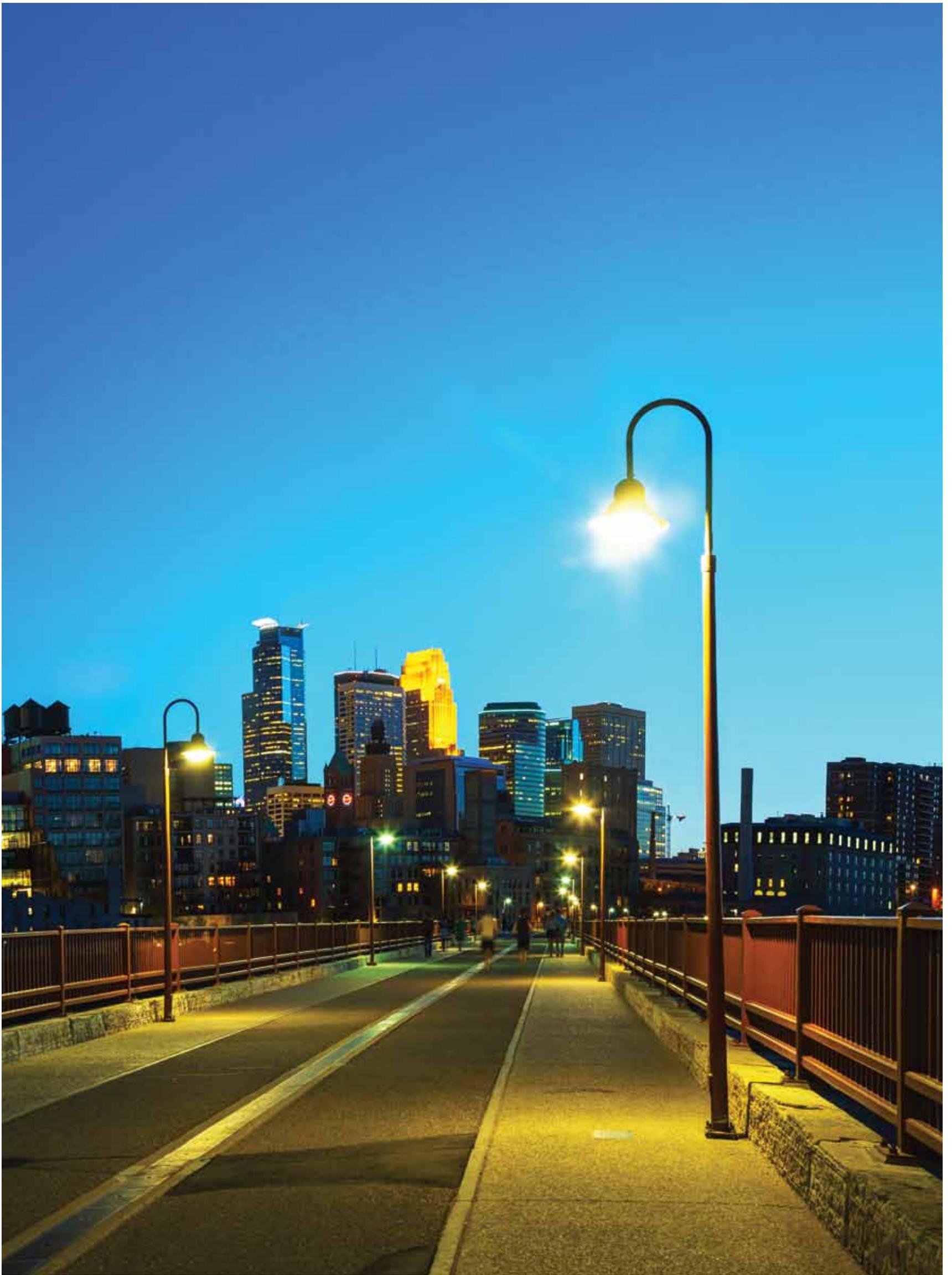


annual report

2013

transportation:

for everything you do



Innovation:

Making transportation work better for you.



Transportation may not always seem as pressing as some issues. It may get overlooked, or even taken for granted. But whether you think about it or not, transportation underlies everything you do. It gets you to work or daycare, puts products on the shelves, takes you to a movie, and much, much more.

And transportation doesn't just happen. It takes skilled professionals and practitioners, using the latest technology and knowledge to do their jobs most effectively.

That's where the University of Minnesota and CTS come in. Our researchers create the innovations that make transportation work better for everyone. We educate the workforce of today and tomorrow. And we bring together partners and stakeholders from many disciplines to share and implement the best solutions.

This annual report presents highlights of our work in FY13. It's one of the places where we translate research results into short, engaging stories for a broad audience. Ultimately, our goal is to make new knowledge easily accessible to those who can use it—to inform public debate, and to make things happen.

As always, our success depends on the support of our partners, sponsors, and committee members, and we thank them for their commitment.

Sincerely,

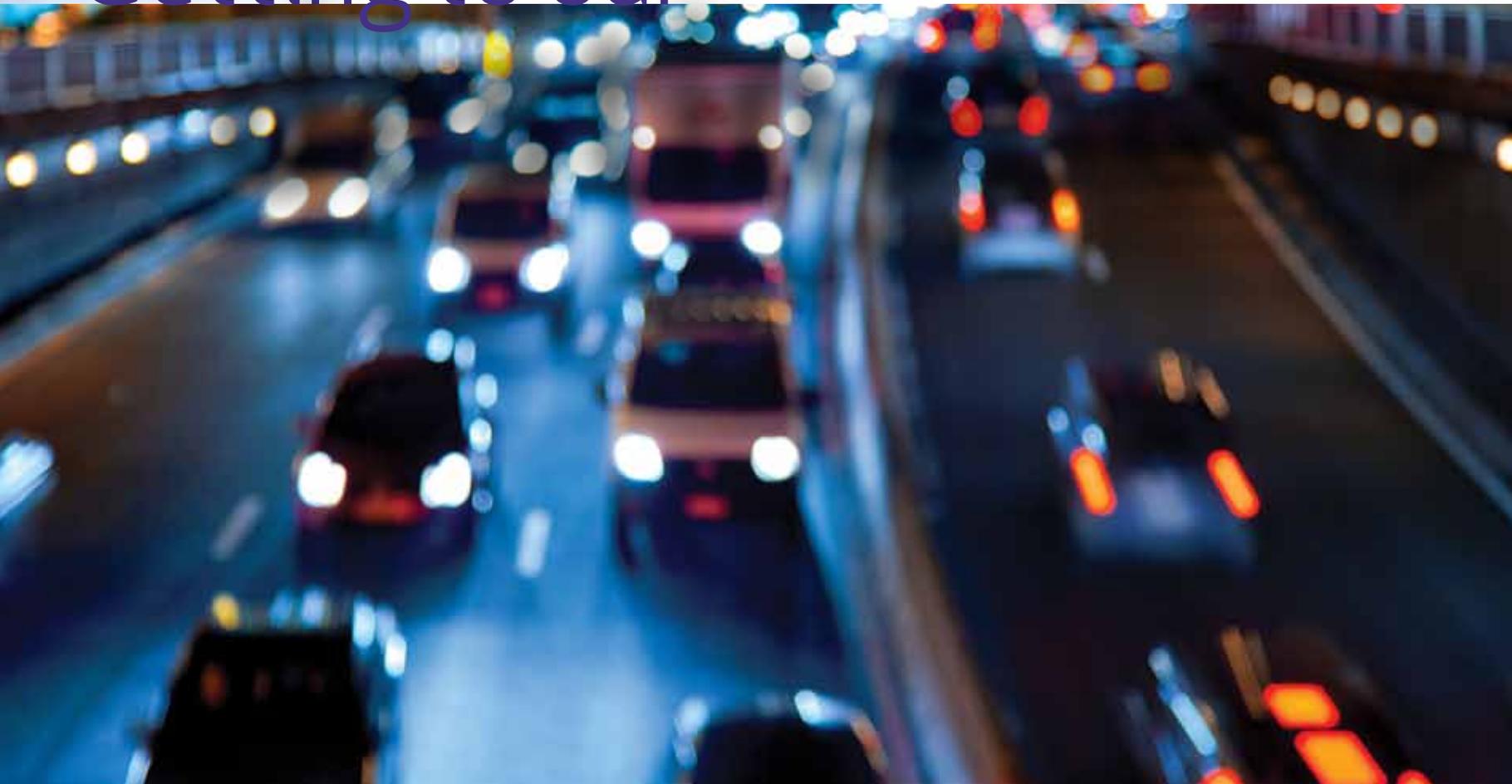
A handwritten signature in black ink that reads "Laurie G. McGinnis".

Laurie G. McGinnis, Director

You want to live in a prosperous community with good jobs.
You want to get to your job—and everything else—on time.
You want options so you can leave the car at home.

At the U of M, **we study the big picture of transportation** and land use, analyze traffic flow, and invent technologies to help people get where they need to go.

Getting to our



Measuring accessibility—not just congestion—paints fuller picture

Every year, major American cities get a report card on their traffic congestion. These reports focus almost exclusively on mobility—how quickly travelers can move between any two points via automobile or transit. But according to a University of Minnesota study, there's much more to the story.

“Focusing solely on mobility and traffic delay doesn't provide a complete

picture of how the traffic system is functioning,” says Professor David Levinson. “Travelers in many of these cities have the ability to reach their desired destinations, such as shopping, jobs, and recreation, in a reasonable amount of time despite congestion and slower travel because these cities have greater density of activities. In short, these travelers enjoy better access to destinations.”

The study, Access Across America, was the first systematic comparison of trends in accessibility to jobs by car within the nation. By comparing accessibility during the morning peak period for 51 metropolitan areas, the study shows which cities are performing well and which have seen the greatest change.

To generate the rankings for this study, Levinson created a weighted average of accessibility, giving a higher weight to closer jobs. Based on this measure, the 10 metro areas that provide the greatest average accessibility to jobs are Los Angeles, San Francisco, New York, Chicago, Minneapolis, San Jose, Washington, Dallas, Boston, and Houston.

The rankings will be updated annually through the work of the new Accessibility Observatory, created by CTS and the Department of Civil Engineering in the fall of 2013. The Observatory will focus on the research and application of accessibility-based transportation system evaluation, including analysis of smaller cities.



Strategies spur development along transitways

The success of the Twin Cities' transitway network, which is now in the midst of a major build-out, will hinge on ridership from near housing and businesses. What can policymakers do to help spur transit-oriented development network? University researchers interviewed developers and business leaders to find out

The interviews revealed that there is pent-up demand for transit-oriented development, but regulatory and cost barriers inhibit the market from responding to this demand.

"Developers will sacrifice transit access if a site is more expensive or presents more complex regulatory hurdles than traditional auto-oriented design," says Assistant Professor Yingling Fan.

Employers said that providing a desirable location is critical to recruiting highly skilled young professionals who are likely to desire or demand walkable living and access to transit.

"This study affirms that there is interest in and demand for development that incorporates transit and for transit that incorporates development," says Metropolitan Council Chair Susan Haigh.

Based on their findings, the researchers created policy recommendations—such as zoning reforms—aimed at promoting housing and jobs near transit corridors.



Regardless of where you live or how you travel, **you expect to reach your destinations safely.**

At the U of M, **we work on the full gamut of engineering, technology, and policy approaches** to help prevent crashes and save lives.

Getting there



Understanding drivers' mental workload improves safety for left-turning buses

Between 1999 and 2005, more than 40 percent of all U.S. pedestrian fatalities occurred as a result of collisions with transit buses. The risk of collision is highest for buses making left turns, which are four times more likely to collide with pedestrians than buses passing straight through an intersection.

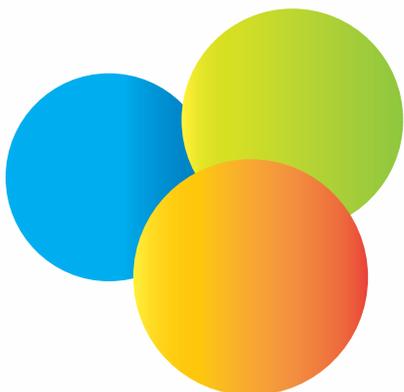
According to researchers from the HumanFIRST Program, left turns are more dangerous because of the

increased mental workload experienced by bus drivers during the turning maneuver. The research team conducted an in-depth analysis of the tasks completed by bus drivers to identify countermeasures to reduce bus-pedestrian collisions.

The researchers divided the left-turn process into six separate stages, beginning with intersection approach and ending with the post-turn exit of the intersection. They then created a chart illustrating the specific tasks performed by drivers in each segment of the intersection, allowing them to see exactly how much drivers were doing and where. Results show that drivers have the highest mental workload when entering the intersection and when completing the turning maneuver.

Identifying driver tasks in this stage-by-stage analysis was the most valuable aspect of the study for Metro Transit, according to Steve McLaird, assistant director of garage operations. "It confirmed that there was an overload concerning the brain's ability to process information," he says. "Knowing that, the message we want to get to bus operators is that you cannot be distracted by conversation, radio use, or looking at pieces of paper at that point in time."

Metro Transit has incorporated the research findings into a training session for intersection awareness, McLaird says. The session is part of the agency's professional operator development program; 1,500 operators are being trained. Metro Transit also used the findings to review and revise its standard operating procedures.



New warning system could improve work-zone safety

Many crashes in work zones happen when drivers disregard or don't notice traffic warning and control devices as they approach and enter a work zone. This can be especially dangerous for work-zone flag operators.

To help reduce these dangerous situations, researchers from the U of M have developed the Intelligent Drum Line (IDL) system prototype. The portable, dynamic system provides visual and auditory warnings to drivers who may have ignored or missed previous warning devices and pose a danger to the work-zone crew.

The IDL system consists of two instrumented work-zone drums that detect approaching vehicles traveling at unsafe speeds. Each drum includes a visual and auditory warning system: emergency flasher units mounted on the outside of the drum and a powerful air horn mounted inside that projects toward the roadway.

The drums are positioned a few feet outside of the shoulder line 300 to 400 feet apart. The first drum measures the speed and location of approaching vehicles. If the speed is higher than the safe threshold, the system activates the visual warning in both drums. When the vehicle is about one second away from the first drum, the auditory warning is activated. As soon as the vehicle passes, the auditory warning is stopped and the visual warning is deactivated. The auditory warning process is then repeated for the second drum.

The prototype system was tested in three locations in Minnesota with vehicles ranging from passenger vehicles to a heavy three-ton truck. "Results indicated that the audible and visual warnings successfully attracted the attention of drivers," says John Hourdos, the lead researcher. However, because drivers were aware of the system beforehand, further testing under real conditions is needed to verify the system's success.



You want to reach your destinations without construction delays or needing to realign your wheels.

At the U of M, **we get down to the nuts and bolts**—and asphalt and concrete—of infrastructure, finding ways to make it last longer and cost less.

Getting there



Better asphalt pavement means a smoother ride

Thermal cracking is the number one distress in asphalt pavements, not only in Minnesota but in all northern U.S. states and in Canada. Extreme temperature variations that include severe lows, combined with frequent application of deicing salt and repeated freeze-thaw cycles, are the main contributors to distress in our asphalt pavements.

For most of the past decade, six state DOTs and four research universities—led by the Minnesota Department of Transportation and the University of Minnesota—joined forces to battle this problem. The resulting pooled-fund research partnership represents the most comprehensive effort to date investigating low-temperature

cracking in asphalt materials and asphalt pavement.

The main outcome of this research has been the development of new testing methods, specifications, and models for selecting asphalt materials that are resistant to thermal cracking. Upgrades to a national design guide are under consideration and could be implemented within a few years. The research has already been implemented informally in a number of projects around the state, and MnDOT is using the results in several pilot projects.

“We’re going to greatly reduce thermal cracking,” says MnDOT engineer Tim Clyne. “And then, ultimately, that

results in [lower] maintenance costs, [fewer] user delays, and longer life cycle for these pavements.”

The team’s work was honored with the 2013 CTS Research Partnership Award. The award was presented at the CTS Annual Meeting and Awards Luncheon in April.

'Smart bridge' technology monitors I-35W bridge

Since the completion of the I-35W St. Louis Bridge in September 2008, University researchers have been using "smart bridge" technology to collect and analyze data about the bridge's behavior.

During its construction, the bridge was equipped with more than 500 sensors that monitor strain, temperature, potential for corrosion, and other factors on the bridge. Other sensors were installed to control automatic anti-icing and lighting.

A team of civil engineering researchers has been interpreting data gathered by these sensors during the bridge's first four years of operation. The team has used the data to investigate changes in behavior caused by vehicle and environmental loading, evaluate load-rating assumptions, and determine the effectiveness of the "smart bridge" monitoring technology. The information could potentially impact future bridge designs and long-term monitoring plans, say Professors Cathy French and Carol Shield.

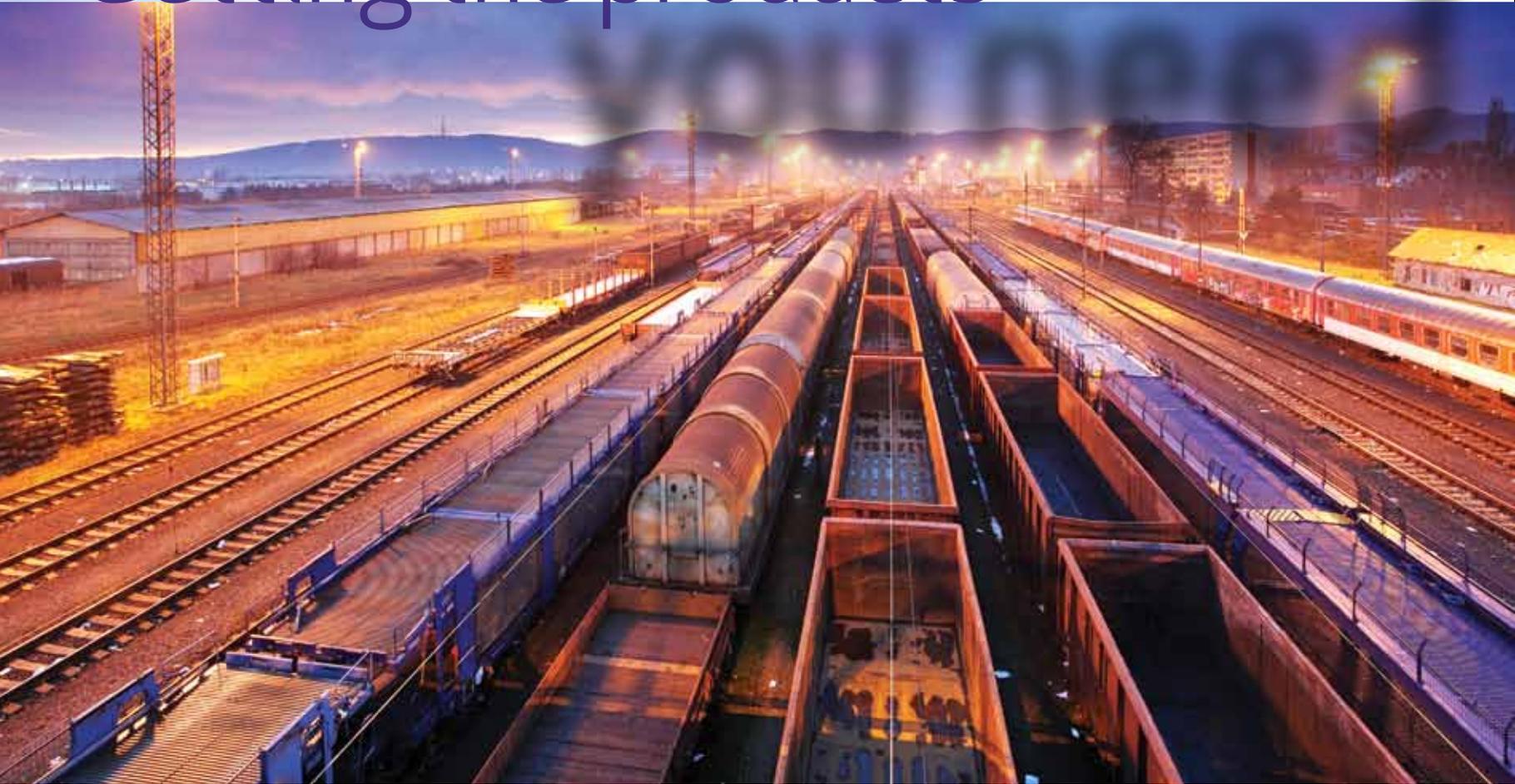
Overall results of the project indicate that the bridge is performing well and is meeting its design expectations. "The data that's been collected since the bridge was built is important because it's helping us understand how this type of structure behaves in this environment and under traffic loads," says Nancy Daubenberger, state bridge engineer at MnDOT. In addition, project results have helped MnDOT obtain a more complete, correct, and informative manual for rating the new bridge.



You want **products at a good price**, whether in the store or delivered to your doorstep.

At the U of M, we look at a **broad range of freight and logistics issues** to help keep goods and products—and the economy—moving.

Getting the products



Leveraging freight rail for a more competitive economy

Freight transportation is vitally important to jobs and economic competitiveness in Minnesota. This is one of the preliminary findings of a study by researchers from the Humphrey School of Public Affairs. The two-year project is exploring ways to understand and enhance the value

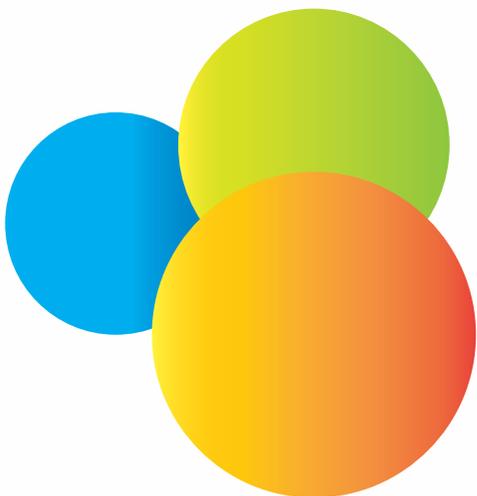
of freight transportation, particularly rail, to Minnesota's economy, local communities, and the surrounding region.

Through data analysis and interviews with national and regional experts, the research team found that freight rail plays an essential role for key Minnesota industries. Growth in Minnesota's Gross State Product, for example, has been stronger than the national average each year during the economic recovery in several key industries dependent on rail: agriculture, mining, and manufacturing.

However, many economic benefits of freight rail—such as sustaining high-paying jobs—occur behind the scenes, which means that these

positive effects are less visible to the general public and local officials than other aspects of freight rail. "Very few members of the general public are exposed to trains on a daily basis, and when they do encounter them, they don't see the dollar signs as the trains go by," says Frank Douma, one of the researchers. Instead, the public often has negative responses to the associated noise or long wait times at crossings. "This can be a challenge for local officials, who hear these negative responses instead of the positive economic benefits freight rail may be providing to their area," Douma says.

Next steps in the study include creating policy recommendations and sharing them with partners, communities, and the public.



'Friend' a package, save the planet?

What if your cell phone and social network could help deliver packages for you? This may be more likely, easier, and more beneficial to the environment than you think, according to researchers at the U's Institute on the Environment (IonE) and Seoul National University.

The study used spatial and agent-based models to investigate the potential environmental benefits of enlisting social networks to help deliver packages. While sensitive to how often trusted and willing friends can be found close to both the package and the recipient within a day, results indicate that very small degrees of network engagement can lead to very large efficiency gains.

Online shopping may be economical and convenient from the shopper's standpoint, but it can carry a hefty environmental price. Particularly, the "last mile" of local delivery is the retail system's largest contributor to fossil fuel consumption, CO₂, and local air emissions. Replacing traditional home truck delivery with pickup locations can help in some instances. But in the suburbs, such systems can actually increase overall travel distances and emissions as personal vehicles detour from their normal daily activity to make the pickup—unless recipients can find a few good friends to help.

Compared to a typical home delivery route, greenhouse gas emission reductions from a socially networked pickup system were projected to range from 45 percent to 98 percent, depending on the social connectedness of the recipients and the willingness of individuals in their social networks to participate. Systemwide benefits could be significantly lower under assumptions of less than 100 percent market adoption, however. In fact, the study points out that many of the gains might be nullified in the short term as fewer home truck deliveries make existing delivery systems less efficient.

"What is important is that sharing be allowed in the system, not how many ultimately choose to share time or resources," says study researcher Timothy Smith. "We find that providing the relatively few really inefficient actors in the network the opportunity to seek the help of many better-positioned actors can radically improve performance." This is particularly relevant today, Smith says, as online retailers such as Amazon begin introducing delivery pickup lockers in grocery, convenience, and drug stores.



You want options to get out of your car. And you want to live in a world with clean air and water.

At the U of M, we look at the ways **transportation intersects with public health and the environment** to create sustainable solutions for today and tomorrow.

Getting to live in a healthy



Investigating air pollution risks for pedestrians and cyclists

Although active forms of travel such as bicycling and walking provide many health benefits, they may also increase travelers' exposure to air pollution—especially in urban areas, where the air pollutants that drive health concerns are typically at their highest concentrations.

To investigate the exposure of cyclists and pedestrians to these pollutants in the City of Minneapolis, researchers are developing a block-by-block analysis of air pollution levels. This information could ultimately be used to identify high-risk locations and shape decisions about new nonmotorized infrastructure.

In summer 2012, graduate student Steve Hankey collected particulate air pollution measurements in Minneapolis

using an instrumented bicycle trailer as he rode around the city on three 20-mile routes. Each route captured different levels of traffic and air pollution, and included a wide variety of road types and surrounding land uses.

Preliminary findings suggest that air pollution levels are 1.5 to 2.3 times higher in on-road locations than on off-street trails and 2 to 3.5 times higher in the morning than in the afternoon. Results also indicate that air pollution concentrations are associated with street classification and traffic intensity. "If you can choose to bike on a local road that's a block or two off an arterial collector, that would make a big difference in your exposure," Hankey says.

The project's next step is to tie the existing mobile measures to land-use variables so the data can be extrapolated to other parts of the city, Hankey says. The resulting model will show air pollution levels for every block in Minneapolis.



A large, dynamic splash of clear blue water against a white background, with many bubbles and droplets visible. The splash is angled from the top right towards the bottom left.

Is dissolved

Stormwater treatment removes suspended solids and particulates, but only about half of the pollutants in stormwater. Dissolved compounds, including nutrients such as phosphorus and nitrogen, are not settled or filtered in many existing stormwater treatment systems found across the region, state, and country.

Researchers at the U's St. Anthony Falls Laboratory identified techniques to remove the dissolved compound phosphate from stormwater, with excellent results. Their iron-enhanced sand filtration system, named the Minnesota Filter, has been installed in a number of locations around the Minneapolis–St. Paul metro region.

The Minnesota Filter is a new technique in which iron filings are added to a sand filtration system. When exposed to rainfall, the iron forms iron oxides (rust), which adsorb phosphate. The system can be used in many applications including surface sand filters, wet detention basins, permeable weirs, ditch check blocks, and rain gardens.

Cliff Aichinger, district administrator for Ramsey Washington Metro Watershed District, says the Minnesota Filter has “worked extremely well.” Aichinger was a member of the technical advisory panel for the original project that developed this technology, and his district did the first field installation. “We have adopted it as a practice virtually every chance we get,” he says. “And the cost is minimal!”



You want confidence that transportation professionals are planning for the future and **doing what's best for Minnesota**.

At the U of M, we provide **objective analysis and new ideas to inform public policy**—and we bring people together to share those ideas and put them to work.

Getting ready for the



Research conference shares cutting-edge findings

Policymakers and practitioners came together to hear cutting-edge research findings at the 24th Annual CTS Transportation Research Conference in May. The event featured more than 75 presentations on a range of timely topics—from public health to pavement maintenance, car sharing to communications, transitways to toll lanes.

Driving better health through transportation

“Transportation is around us every day and influences everything we do, which makes it integral to creating the conditions for great health,” said Minnesota Department of Health Commissioner Edward Ehlinger in the conference keynote address.

Ehlinger advocates “health in all policies,” a collaborative approach that integrates health considerations into policymaking and programming across all sectors. He shared a list of community indicators for health and quality of life, including access to healthy foods, medical services, and public transit.

After Ehlinger’s keynote address, a panel of experts discussed what impacts and opportunities his message will have on the transportation community.

A new wave of technological change in transportation

From social media to intelligent transportation systems, technology is rapidly changing the transportation landscape to create “new mobility”—a trend that was the focus of Professor

Elizabeth Deakin’s luncheon presentation at the conference.

A number of transportation trends fall under the definition of new mobility, Deakin said, including car sharing, bike sharing, carpooling, smart transit, smart cars, and smart highways.

According to Deakin, the move toward new mobility may be a way to bring together diverse views of transportation’s future. “One vision of the future is cities that are transit-oriented, while others envision a new world of vehicles that basically drive themselves. New mobility may be the way we integrate those two visions by matching them to the local context to create a transportation system that goes beyond a one-size-fits-all approach.”

Legislators come to campus for transportation finance seminar

CTS held a special transportation seminar on January 31 for Minnesota state legislators and their staffs. In the educational seminar, “Future Approaches for Transportation Finance in Minnesota,” three scholars discussed their research and recent thinking on the following topics:

- Transportation Funding in Minnesota: Past, Present, and Future Prospects
- Potential for Public-Private Partnerships
- Utilizing Value Capture Strategies
- Pricing Strategies from the U.S. and Other Countries

Events bring latest thinking to Minnesota

CTS luncheons share trends and issues

CTS culminated its 25th anniversary with a look at the road ahead in a fall 2012 luncheon presentation. Frank A. Stasiowski, a futurist who predicts the direction of design and construction worldwide, described economic, political, social, and technological trends that could define the next decade and have a direct impact on transportation. He also addressed what research and actions are needed now to prepare for this future.

At the winter 2013 luncheon, Nokia’s Jane MacFarlane discussed what’s needed to leverage GPS and mobile technologies to better understand how drivers dynamically experience and adapt to road networks. “We’re on the cusp of being able to unlock vehicle information to capture the actual behavior of drivers,” she said. The result—a “behavioral map”—could give engineers and designers insight for creating a safer driving experience.

Freight symposium looks at impact of new energy

The rise of new energy sources is having a seismic impact on Upper Midwest transportation networks and goods movement, according to speakers at the 16th Annual Freight and Logistics Symposium in December. The boom in hydraulic fracturing has created significant challenges for the rail industry, including a lack of tank-car availability and higher lease rates, and is also having a major impact on county highways and local roads. Other symposium topics included the use of natural gas as a freight transportation fuel, energy-related cargo (such as wind turbine components) at the Port of Duluth-Superior, and efforts to “green” shipping using alternative fuels. The proceedings of the symposium is available online.



You want **topnotch people working for you**, with the skills to do their jobs in an ever-changing industry.

At the U of M, **we attract and honor brilliant minds**—the workforce and leaders of the future—**and we provide training and education** for current professionals.

Getting the best people



Internship program continues its success in second year

Participants in the 2013 Summer Transportation Internship Program gained valuable experience in the transportation industry and received a behind-the-scenes glimpse of what it takes for the Minnesota Department of Transportation to keep Minnesota moving.

This year, six students participated in 10-week internships at a variety of MnDOT offices. The program, offered in partnership by CTS, Howard University, and MnDOT, was designed to provide students with the opportunity to gain professional experience and skills that will complement their

academic pursuits. For this year's participants, that included working on research teams, using complex testing equipment, creating project reports, designing training protocols and plans, and giving professional presentations.

Education Awards

Matthew J. Huber Award (*honoring students in engineering, science, and technology fields*)

- **Xuan Di**, doctoral candidate, civil engineering; advisor: Henry Liu
- **Panagiotis Stanitsas**, master's candidate, civil engineering; advisor: John Hourdos

John S. Adams Award (*honoring students in policy and planning fields*)

- **Jessica Schoner**, master's candidate, civil engineering and urban and regional planning; advisors: Jason Cao and David Levinson

New online tutorial teaches work-zone safety skills

The Minnesota Technical Assistance Program (LTAP) developed a free online tool to provide work-zone safety training. The Work-Zone Safety Tutorial is designed for all sorts of workers: full-time or seasonal staff, contractors, utility or cable crews.

“The online tutorial is a good starter tool for those who are new to working in a work zone, such as summer hires, and for other staff as a reminder of the basic critical actions and awareness they need to work safely,” says Monica Beeman, traffic engineer for the City of St. Paul and a member of the advisory panel that guided the tutorial’s creation.



Practitioners learn about vehicle-based ITS technologies at short course

The Intelligent Transportation Systems (ITS) Institute offered a new short course in July 2012 for practitioners. The daylong course—ITS Technologies for Improving Highway Vehicle Safety and Crash Prevention—provided a detailed overview of the latest vehicle-based ITS technologies for improving highway safety and preventing crashes.

Practitioners learned how sensing and control technologies keep vehicles in their lanes, help avoid collisions, and prevent rollovers; how such technologies are being deployed; and what impact they will likely have on road safety and mobility. Attendees also used 3-D graphic simulations to experience the direct effects of these sensing and control technologies.



We thank those who contribute their time and effort to transportation innovation in Minnesota.

Getting everyone



Leaders honored at CTS Awards Luncheon

CTS presented the following awards at its Annual Meeting and Awards Luncheon on April 17.

Richard P. Braun Distinguished Service Award (outstanding leadership in research and innovation)

Nikolaos Papanikolopoulos, Distinguished McKnight University Professor, Department of Computer Science and Engineering, and director, Security and Transportation Technology Research and Applications (SECTTRA) Program

Ray L. Lappegaard Distinguished Service Award (outstanding leadership, mentorship, and support for the profession)

Julie Skallman, director, State Aid Division, Minnesota Department of Transportation, and steering committee chair, Minnesota Local Technical Assistance Program

William K. Smith Distinguished Service Award (leadership, mentorship, and education of future leaders in private-sector freight transportation)

Mark Berndt, freight program leader, Olsson Associates; previously with MnDOT's Office of Motor Carrier Service and the Office of Freight Railroads and Waterways

Distinguished Public Leadership Award (public leaders who have influenced innovative transportation policy directions)

Margaret Donahoe, executive director, Minnesota Transportation Alliance, and member, CTS Executive Committee



Nikolaos Papanikolopoulos



Julie Skallman



Mark Berndt



Margaret Donahoe

Executive Committee



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Executive Director,
Metropolitan Airports
Commission



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Representative, Minnesota
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Minnesota Transportation
Alliance



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Practice, Department of
Landscape Architecture,
University of Minnesota



Peter Frosch
Director of Strategic
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University of Minnesota



Susan Haigh
Chair, Metropolitan
Council



Brian Herman
Vice President for
Research, University of
Minnesota



Cheryal Lee Hills
Executive Director,
Region Five Development
Commission



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General Manager,
3M Traffic Safety and
Security Division



Brian J. Lamb
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Transit



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Eil Kwon, Professor and Director, Northland Advanced Transportation Systems Research Laboratories

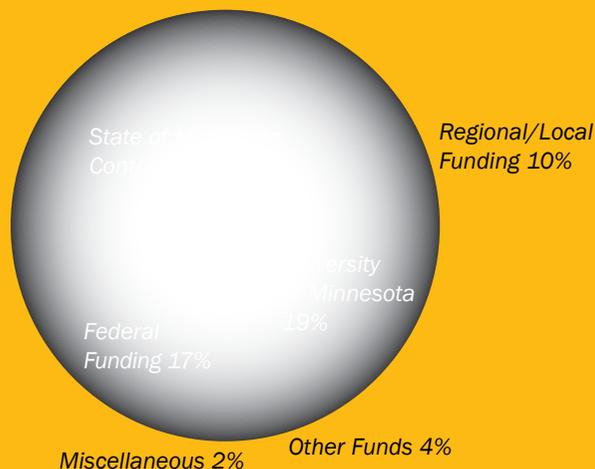
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'Friend a Package' reprinted courtesy Institute on the Environment
Photographers: Michelle Riedel, David Gonzalez, SAFL and Andrew Erickson, CTS staff and students

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