



CENTER FOR  
TRANSPORTATION STUDIES  
UNIVERSITY OF MINNESOTA

# BIG ISSUES BIG THINKERS BIG IDEAS

2014 ANNUAL REPORT





Big issues — Big thinkers — Big ideas.  
Real-world concerns — tackled by  
University of Minnesota researchers —  
who create knowledge and innovation.  
The result? A better transportation  
system — for a better quality of life.





## Something big's afoot.

Many transportation issues have been with us for years: safety, funding, and so on. But today, they seem to be getting bigger, faster, more urgent. Driverless cars have moved beyond test tracks; the Highway Trust Fund came close to insolvency. Lyft and Uber are attracting subscribers, not owners; extreme weather is prompting the design of resilient infrastructure. And right in front of our CTS offices, the Green Line opened light-rail service between St. Paul and Minneapolis. Combined with other trends and technologies, the implications of these developments are profound.

Such times demand big ideas—and the University of Minnesota has the big thinkers to create them. Our campuses are home to some of the brightest minds in transportation, in disciplines from engineering to planning to public policy. Their research generates the real-world solutions and out-there vision needed to tackle the transformative issues of today and tomorrow.

CTS brings these thinkers together to cross-pollinate disciplines and enable new ways of understanding. We connect world-class scholars with funders and stakeholders to ensure that research meets short-term and big-picture needs. We also support and educate the students who will be the thinkers and doers in the future workforce.

As always, our success depends on the support of our partners, sponsors, and committee members. A big thanks to you all for your commitment.

Sincerely,

A handwritten signature in black ink that reads "Laurie G. McGinnis". The signature is fluid and cursive.

Laurie G. McGinnis, Director



Google

self-driving car

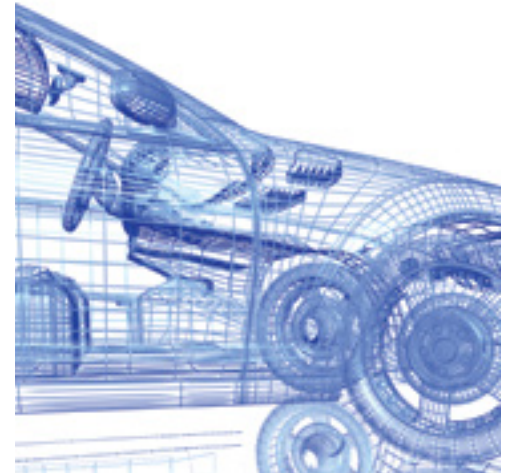
## Self-driving vehicles could spark big changes in roadways and travel

Self-driving vehicles will be on the road sooner than you think—and their presence could spark widespread and transformative changes. Two researchers in the Humphrey School of Public Affairs are working to shed light on what this means for Minnesota and our transportation system.

Much of the current discussion of self-driving vehicles focuses on their promise to eliminate driver error and avoid crashes, says Adeel Lari, but there are many more implications. For example, hyperlinked self-driving vehicles would be able to follow each other closely on narrower lanes—enabling changes to long-standing roadway designs and increasing capacity. “Could it be,” he asks, “that we have too much infrastructure?”

Other impacts, however, could increase travel. The elderly, people with disabilities, and children would gain mobility, and commuters who could sleep or work en route might choose to live farther away from their jobs, Lari says.

Frank Douma studies the legal implications of self-driving vehicles. Current law is unclear, he said, but as vehicles assume more control, lawsuits are likely to shift from the driver to the manufacturer. Given this shifting ground, Minnesota law may need attention. It explicitly defines the driver as having physical control and states that “any person driving a vehicle shall be liable.” As technology moves forward, Douma says, “the law needs to move with it.”



Up to 75 percent of all vehicles could be autonomous by 2040.

—Institute of Electrical and Electronics Engineers



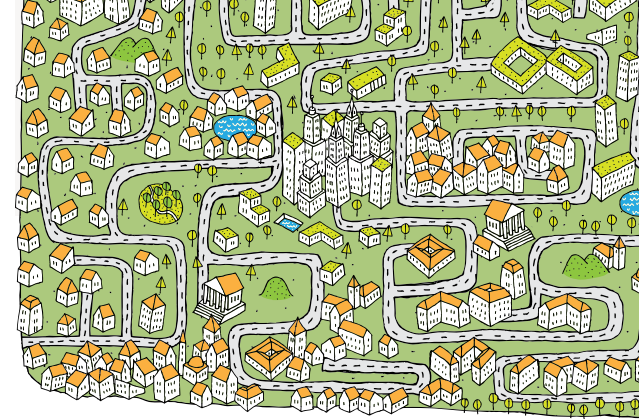
## Bike sharing: understanding station choice and job accessibility

Although bike-share systems are becoming more popular across the United States, little is known about how people make decisions when integrating these systems into their daily travel. For example, when more than one bike-share station is located nearby, how do users choose where to begin their trip, and what factors affect their decision?

In a study funded by CTS, researchers from the Department of Civil, Environmental, and Geo- Engineering sought to answer this question by investigating how people use the Nice Ride bike-share system in Minneapolis and St. Paul. RP Braun/CTS Chair David Levinson and graduate student Jessica Schoner examined how Nice Ride affects accessibility to jobs and developed a model to predict station choice.

Their results pinpoint when and where Nice Ride had the strongest job accessibility advantage over walking. “This type of information can be used by bike-share system planners to identify where new stations could be built to maximize their impact on job accessibility,” Schoner says. “They could also look at accessibility to other destinations, like parks, grocery stores, or tourist attractions, depending on the goals of their system.”

Findings also show that people generally prefer to use stations that don’t require long detours to reach, but a station’s surroundings also play an important role. For example, stations located near a park and in neighborhoods with lower crime rates were more likely to be chosen as the starting point of a bike-share trip. Results also show that commuters tend to choose stations that minimize overall travel time, while users making non-work-related trips choose stations that allow them to spend more of their time biking, even if the total travel time is longer.



## big thinkers



### Plan a smaller network.

As we move toward a transportation system funded more efficiently and equitably through road pricing and an economy with vehicles as a service—think car sharing, ride sharing—we should expect significantly less travel demand.

Since infrastructure is long-lived, planning for a smaller network should begin now, to avoid irreversible investments that will later be seen as unnecessary.

—David Levinson, RP Braun/  
CTS Chair

## Accessibility Observatory provides rankings for cities

Cities have a new way of understanding their transportation systems thanks to the work of the Accessibility Observatory, launched in fall 2013 by CTS and the Department of Civil, Environmental, and Geo- Engineering.

The Observatory goes beyond congestion rankings to focus on accessibility: a measure that takes into account both land use and the transportation system.

Observatory researchers, led by director Andrew Owen and RP Braun/CTS Chair David Levinson, create reports summarizing trends in accessibility across major U.S. metropolitan areas.

The first such report, published in 2013, evaluated the accessibility provided by the road and highway systems in 51 cities. The second report, published in fall 2014, presented detailed transit accessibility values for 46 of the 50 largest metropolitan areas.

The findings have a range of uses and implications. Agencies can apply the evaluations to performance goals related to congestion, reliability, and sustainability. Evaluations can also help in selecting between project alternatives and prioritizing investments and reveal how the costs and benefits of investments are distributed.





## Light-rail transit revitalizes corridor and creates efficient neighborhoods

Many policymakers expect light-rail transit (LRT) investments to stimulate economic growth. Despite these expectations, however, a limited number of studies have explored the impacts of LRT on real estate development.

To help fill this gap, U of M researchers investigated the effects of two key announcements in the development of the Green Line—the preliminary engineering (PE) and the Full Funding Grant Agreement (FFGA)—to compare building activity in the LRT corridor with control corridors.

“We found that the announcement of preliminary engineering had no impacts on the count and overall value of building permits, but the announcement of the Full Funding Grant Agreement tended to increase the number of building permits by about 30 percent and the value by 80 percent,” says Jason Cao, assistant professor in the Humphrey School of Public Affairs.

The PE announcement in 2006 indicated that the Federal Transit Administration (FTA) had started to fund the line’s planning. The FFGA announcement in 2011 indicated that the FTA was committed to funding half of the Green Line and specified a service launch for 2014. “We assumed that the different levels of certainty associated with each of these two dates produced different impacts on building activities in the Central [Green Line] Corridor,” he says.

Cao warns that the research cannot prove whether the building activities represent a net growth or a redistribution of growth within the region. “Nevertheless,” he says, “the Green Line seems to revitalize neighborhoods in the Central Corridor and creates location-efficient neighborhoods. This is helpful for the City of St. Paul and the region as a whole.”



The Metropolitan Council highlighted \$2.5 billion in planned or completed development projects along the 11 miles of the Green Line as of its opening in June 2014.



## Uncovering manufacturers' perspectives of the transportation system

It's no secret that transportation is essential for the success of any manufacturing operation. What's been missing, however, is dialog between the transportation organizations that manage the network and the manufacturers themselves. A pilot study conducted by the Minnesota Department of Transportation (MnDOT), the Humphrey School of Public Affairs, and U of M Extension addressed this communication gap in order to learn about manufacturers' challenges, priorities, and needs.

The pilot project focused on 12 counties in southwest Minnesota that make up MnDOT District 8. "We interviewed manufacturing firms in the industry clusters most important to this area, as well as area freight carriers, about their specific transportation needs in efforts to come up with some low-cost improvement strategies that could be implemented in the short term," says Lee Munnich, director of the Humphrey School's State and Local Policy Program.

Researchers completed 75 in-person interviews with manufacturers, shippers, and carriers. The result was a wealth of new information and important findings in the areas of transportation infrastructure, operations and maintenance, communication, and policy. "Some of the industry-specific transportation issues were eye-opening, such as the critical need for smooth routes to transport delicate, high-tech equipment without breakage and the importance of keeping vehicles transporting live animals constantly moving to ensure air circulation," says Humphrey School research fellow Frank Douma.

A similar project for MnDOT District 4 in west central Minnesota is under way.



## big thinkers



### Get business leaders involved.

When we asked business leaders what it would take for them to create jobs near light-transit corridors, they said this: “We need to see more lines up and running.” It’s very important to have business leaders engaged in the build-out of the network.

—Yingling Fan, Associate Professor, Humphrey School of Public Affairs

## Program explores transportation policy and economic competitiveness

Gaining a better understanding of transportation innovations and their impacts is the purpose of the new Transportation Policy and Economic Competitiveness (TPEC) Program.

The five-year program, managed by the State and Local Policy Program at the Humphrey School of Public Affairs, seeks to further define and promote the relationship between transportation and economic development in Minnesota and the region. The program was established in response to a directive from the Minnesota Legislature in its 2013 session; the Minnesota Department of Transportation (MnDOT) is providing funding.

Research addresses three main areas: innovative transportation finance options (such as mileage-based user fees, public-private partnerships, and value capture); industry clusters; and transportation technologies (such as robotics, energy technologies, and intermodal applications). Results are intended to help MnDOT and its partners engage stakeholders, analyze investments, and approach programming.

## GREEN IS THE NEW BLACK

### ENVIRONMENTAL SUSTAINABILITY

There's more attention than ever on making transportation greener and our infrastructure more resilient.

At the U of M, we explore a spectrum of research areas—from hybrid buses to stormwater runoff to bike facilities—to create green solutions while helping agencies keep their budgets in the black.



## Advanced hybrid buses have better fuel economy, fewer emissions

Based on the results of U of M research, Metro Transit purchased two advanced “super hybrid” buses that use unique all-electric systems to power their heating and air conditioning, engine fans, and other accessory systems—dramatically reducing fuel consumption and emissions.

Built in Minnesota, the buses are billed as the cleanest, most efficient diesel-electric hybrid buses in the country. They currently operate on local routes with frequent stops in downtown Minneapolis and its surrounding communities.

The research, led by mechanical engineering professor David Kittelson, included an energy audit of major accessory systems on a standard hybrid bus. Findings indicated that up to half of the fuel consumed by hybrid buses is used to power accessory systems. The study was funded by Metro Transit, CTS, and the U of M’s Institute for Renewable Energy and the Environment (IREE).

In a follow-up study with Metro Transit, researchers are evaluating one of the advanced hybrids along with a standard hybrid bus and a conventional diesel transit bus. Funded by IREE, the team is collecting data from the three buses in all seasons on a variety of route types.





## Preventing water pollution with roadside swales

Increased environmental awareness and more stringent regulations mean that agencies must consider stormwater runoff and water quality in most stormwater management plans.

In a study sponsored by the Minnesota Department of Transportation, a multidisciplinary research team led by Professor John Gulliver of the Department of Civil, Environmental, and Geo- Engineering set out to develop methods and guidelines for assessing and improving the pollution prevention of one technique: roadside swales (low-lying tracts of land).

The team combined new findings from its studies with the best available knowledge on swale maintenance to develop recommendations for swale maintenance schedules and effort.

“Our recommendations will provide a valuable baseline for optimizing the effectiveness and cost-effectiveness of roadside swales in Minnesota,” Gulliver says.

Adds co-investigator John Nieber of the Department of Bioproducts and Biosystems: “These technologies and models can be used throughout the state and the country to enable the use of drainage ditches to their full pollution-prevention potential before building other, more expensive stormwater treatment practices.”



## big thinkers



### Transition to low-carbon fuels.

We aren't going to solve our transportation issues with any new wonder fuel, but we can't run on fossil fuels forever—not because we will run out, but because of their impact on climate. Initially the biggest impacts will come from more-efficient vehicles. Biofuels and other fuels synthesized using renewable energy, along with electrification, will play increasing roles—but we will need low-carbon electricity.

—David Kittelson, Professor,  
Department of Mechanical  
Engineering

## Tools for counting bicyclists and pedestrians help guide investment

U of M researchers have partnered with the Minnesota Department of Transportation, the Minnesota Department of Health, and several other state and local agencies to develop general guidance and consistent methods for counting bicyclists and pedestrians in Minnesota. Their work was honored with the 2014 CTS Research Partnership Award. (A video about the project is online.)

“The goal is to completely characterize the traffic network,” explains Professor Greg Lindsey of the Humphrey School of Public Affairs. “We have it for vehicles. We don't have it for bikes and pedestrians.”

Results from the counting initiative are allowing policymakers and planners to make data-driven decisions about transportation investments.

In continuing work, researchers are measuring bicycle and pedestrian traffic on a variety of facilities in both urban and rural locations, and testing and evaluating five different counting technologies.





## Funding projects with value capture could speed project completion

There's broad agreement that the U.S. transportation system cannot continue to be funded with existing methods. What's unclear, however, is how to supplement them. An alternative strategy is value capture, which aims to recover the value of benefits received by property owners and developers as a result of infrastructure improvements.

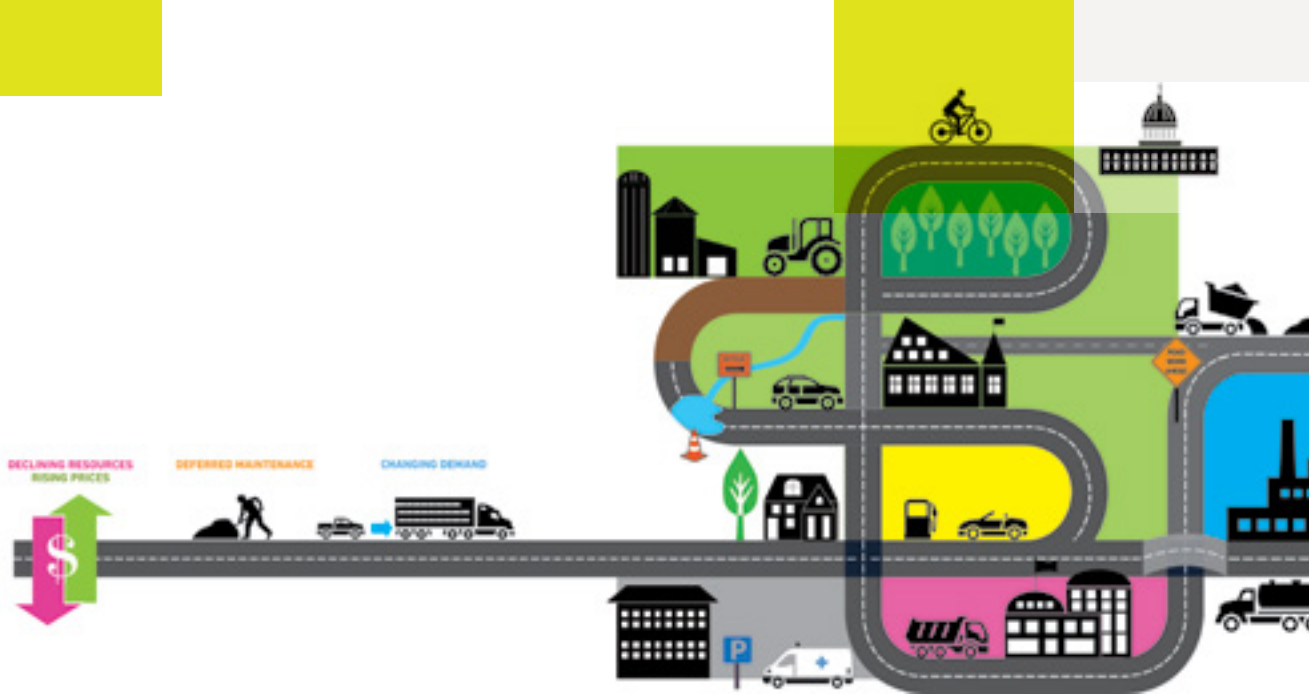
In a recent study, a research team applied previous work to a real-world scenario, with impressive results. Sponsored by the Minnesota Department of Transportation (MnDOT), the new research focused on the planned development of a trunk highway in Maple Grove, Minnesota—a stretch delayed for years by state transportation funding shortages. Researchers set out to discover how the value of the enhanced accessibility provided by the planned improvements could be predicted and captured to help fund the project's completion.

The researchers found significant evidence of a “highway premium.” Zhirong (Jerry) Zhao, associate professor in the Humphrey School, explains: “We discovered that the completion of this highway could lead to a more than \$17 million increase in property value for the study area [about 10 square miles]. The revenue potential of this increase using various value capture strategies ranges from about \$12 million to about \$37 million.”

Researchers expect these findings could have significant benefits for future infrastructure projects. “This method could greatly assist transportation agencies and stakeholders as we work to solve our nation’s transportation funding shortage,” Zhao says.



MnDOT projects a \$12 billion gap between how much the state needs to spend on roads and bridges over the next 20 years and its projected revenue.



## New tool engages the public in decision making for local road funding

The public is typically unaware of local road funding challenges and not engaged in decision-making processes. To help overcome this barrier, U of M researchers studied the knowledge gaps surrounding local transportation funding and created a public engagement tool for use by local agency officials. Their work was funded by the Minnesota Local Road Research Board (LRRB).

To explain the complex nature of the road funding problem to a general audience, Kathryn Quick, an assistant professor in the Humphrey School of Public Affairs, and her team developed an engaging presentation (available free online) that presents Minnesota's road funding challenges in an accessible yet comprehensive way. The team then conducted a series of community meetings in three Minnesota counties. According to Quick, the process generated interesting results: for example, one group's attitude toward a new tax changed from strong opposition to strong support. The researchers anticipate that the process will serve as a model for many other counties throughout the state and country.

In a follow-up project also funded by the LRRB, the researchers are working with additional local jurisdictions, including cities and counties, to deepen knowledge about effective communication and engagement strategies and provide additional case studies for analysis.

## big thinkers



### Get the public involved.

Costs have risen, but resources have not. Cities, counties, and townships are feeling especially pressed for resources. Roads are an ongoing project, not something you can build and then consider done. We all know that if you don't put oil in your car, you're going to have big trouble down the road—and our road system is no different.

—Kathryn Quick, Assistant Professor, Humphrey School of Public Affairs

## Could public trust funds pay for infrastructure?

Economists widely agree that switching to a tax system that charges per mile used—similar to how heat and electricity are paid for—is the best solution to the nation's transportation funding shortage. The problem, says Rick Geddes, is that a mileage-based user fee system “currently is a political non-starter.” At the CTS Winter Luncheon, Geddes described a new approach for road pricing that he believes will make it more appealing: an investment public-private partnership (IP3) feeding a public trust fund.

The IP3 generates large, upfront concession payments that monetize asset value through public-private leases. All or part of the concession fee would be paid into a permanent fund—a type of public trust fund—to capitalize it. “If invested wisely, the fund generates a dividend forever to all citizen-owners of the transportation facility,” says Geddes, professor with the Cornell Program of Infrastructure Policy.



## Roadway Safety Institute develops human-centered solutions

The Roadway Safety Institute was established in late 2013 to conduct research focused on human-centered transportation safety systems.

Led by CTS, the Institute is the University Transportation Center for USDOT Region 5, which includes Minnesota, Illinois, Indiana, Michigan, Ohio, and Wisconsin. Other consortium members are the University of Akron, University of Illinois at Urbana-Champaign, Southern Illinois University Edwardsville, and Western Michigan University.

Projects address issues related to vehicle automation technologies, lane departures, and much more. “We hope to bring attention to areas that have either not received much attention in the past or have significant unsolved issues,” says Max Donath, the Institute’s director.

Initial work is examining safety issues related to vulnerable road users—those who have less protection and mass than passenger vehicles and are therefore more likely to be killed or sustain serious injuries in a crash. Pedestrians and bicyclists are a particular focus.

Issues related to two other high-risk road user groups—commercial truck drivers and impaired drivers—will also be examined. In addition, safety on tribal lands, where there is an unusually high number of motor vehicle crash fatalities, is also being investigated.

## big thinkers



Gather data—vast amounts—for safer autonomous ‘vehicle’ decisions.

As we move toward more autonomous functionality in our cars, we will need vast amounts of data about our roads: a digitized database of lanes, boundaries, and signals that is continuously updated—everything the “vehicle” needs to make what we perceive to be intelligent decisions. These systems will need to think like humans do and make value judgments in an instant.

—Max Donath, Director,  
Roadway Safety Institute



## Tools improve diagnosis of pavement problems

When diagnosing a patient, doctors often rely on advanced imaging technologies such as X-rays and MRIs. In recent years, civil engineers have also used technologies such as the falling weight deflectometer (FWD) and ground penetrating radar (GPR) to pinpoint what's going on beneath a pavement's surface and diagnose pavement problems. GPR generates a cross-sectional image of the pavement's subsurface, while FWD measures stiffness of the pavement layer.

Though FWD and GPR are widely used, both have room for improvement, says Joe Labuz, professor and head of the Department of Civil, Environmental, and Geo- Engineering. The data interpretation needed for these tests can be overly simplistic, and inherent assumptions can reduce each test's accuracy when they are used in standalone fashion.

To improve the effectiveness and accuracy of these tests, a team of researchers led by Labuz created a new software tool for field engineers called GopherCalc. This new software package combines the analysis of both FWD and GPR data into a single tool. By integrating the two tests, calculations and results from one test can be used to inform the other. This reduces the number of assumptions needed to analyze the data, thereby increasing their accuracy. The team's work was funded by the Minnesota Department of Transportation.

"These tests offer significant benefits over the traditional, labor-intensive method of taking core samples," Labuz says. "They are non-invasive and can be performed quickly with minimal traffic disruption, which improves highway safety."



35 percent of Minnesota's bridges are more than 50 years old.

—MnDOT, 2014





## Internship program continues its success in third year

Participants in the 2014 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).

Eight undergrads from the U of M Twin Cities and U of M Duluth spent 10 weeks getting hands-on transportation-related experience in MnDOT's Engineering Services Division as part of the program. The program provides 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.



## Leadership training prepares maintenance workers to succeed retiring boomers

The Minnesota Local Technical Assistance Program, a part of CTS, partnered with Hennepin Technical College to help local transportation agencies meet a critical workforce development need—filling the leadership vacuum left behind by retiring baby boomers. A one-day workshop—“From Line to Leadership: Transitioning from Operations to Supervision”—was held in October in St. Cloud and Rochester and reached almost 100 participants. The workshop is tailored for new supervisors and those thinking of taking their career to the next level, as well as for current supervisors wishing to enhance their leadership skills, communication, and effectiveness.

## Education awards

Each year, CTS honors academic excellence in transportation research and education through two awards:

[Matthew J. Huber Award \(honoring students in engineering, science, and technology fields\)](#)

- Andrew Kotz, doctoral candidate, mechanical engineering; advisor: William Northrup
- Jianfeng Zheng, master's candidate, civil engineering; advisor: Henry Liu

[John S. Adams Award \(honoring students in policy and planning fields\)](#)

- Chen Zhang, master's candidate, science, technology, and environment policy, Humphrey School of Public Affairs; advisor: Jason Cao



## 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) **Yingling Fan**, McKnight Land-Grant Assistant Professor, Humphrey School of Public Affairs; principal investigator for several Transitway Impacts Research Program projects

**Ray L. Lappegaard Distinguished Service Award** (outstanding leadership, mentorship, and support for the profession) **Howard Preston**, senior transportation engineer, CH2M Hill Inc.; project manager for the preparation of highway safety plans for all 87 counties in Minnesota

**William K. Smith Distinguished Service Award** (leadership, mentorship, and education of future leaders in private-sector freight transportation) **Chip Smith**, chief operating officer, Bay and Bay Transportation; long-time member of the Minnesota Freight Advisory Committee

**Distinguished Public Leadership Award** (public leaders who have influenced innovative transportation policy directions) **Susan Haigh**, chair, Metropolitan Council; former Ramsey County commissioner and early advocate of the Green Line



Yingling Fan



Chip Smith



Howard Preston



Susan Haigh

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Adeel Lari, Research Fellow, State and Local Policy Program  
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## St. Anthony Falls Laboratory

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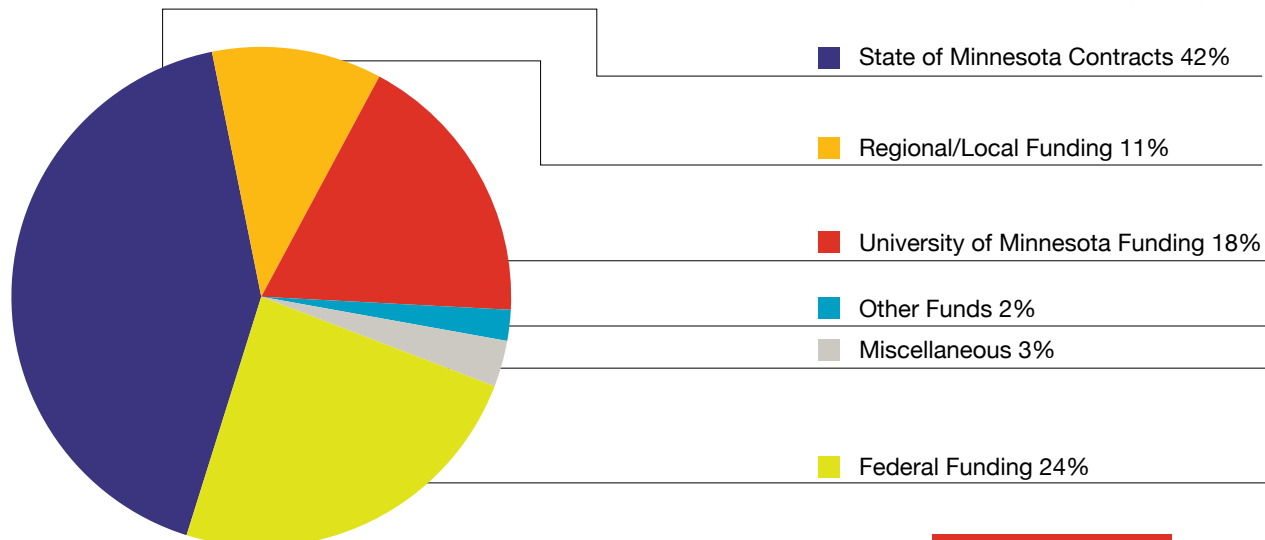
## Civil Engineering (Duluth)

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

## Electrical and Computer Engineering (Duluth)

Taek Kwon, Professor

## FY14 Revenues: \$13,781,925



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*Front: Mindy Carlson, Stephanie Malinoff, Colleen O'Connor Toberman, Hannah Grune. Back: Kaydee Kirk, Jim Grothaus, Brenda Thomas, Elizabeth Andrews, Kylie Bivins*



## CTS events bring latest thinking to Minnesota

### Extreme weather increases need for resilient systems

Recent record-setting weather events have demonstrated the costs and vulnerabilities associated with our transportation infrastructure and services. In a plenary presentation at the 25th annual CTS research conference, Joe Casola outlined some of the climate trends that will continue to affect our nation's transportation systems. He also advised transportation planners to increase their focus on building resilient transportation systems that can anticipate, absorb, adapt to, or rapidly recover from disruptive events. "By leveraging existing risk management activities and building resilience, we can constructively address these issues," said Casola, staff scientist with the Center for Climate and Energy Solutions Center.

### Do socio-economics point to the end of car culture?

By 2030, 20 percent of the population will be older than 65 and will likely drive less; the Millennial generation is very different in terms of travel choices. Such socio-economic trends are making the outlook for travel complex, said John Njord in a plenary session of the 25th annual CTS research conference. Perhaps the most significant trend is the possibility that Americans are losing their appetite for driving. "Since the 1950s our country has had a love affair with the automobile, but in the past ten years we've seen something different than we've ever seen before," said Njord, of Tom Warne and Associates and former executive director of the Utah DOT. "Every other time the numbers of vehicle miles traveled per capita has dropped it has recovered, but it's been dropping since 2004, and now the future is uncertain."

### Could crashes become a thing of the past?

In the not-too-distant future, your car will apply the brakes at intersections and warn you if you're getting drowsy. Technologies offer the possibility to greatly reduce crashes—or even make them a thing of the past. At the CTS Fall Luncheon, Luca Delgrossi described Mercedes' development of autonomous vehicle technology. In 2013, a test car drove 103 km through densely populated areas in Germany. "This was the first vehicle to complete the route autonomously," said Delgrossi, of Mercedes-Benz Research & Development North America. "It proved autonomous driving is possible today, not just in test tracks but in everyday driving. It marks a breakthrough in a new era of individual mobility."



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