

# CTS Catalyst

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Accelerating the pace of transportation innovation

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*The consortium will support a variety of transportation research at member universities, including new projects at the University of Minnesota's HumanFIRST Program (above) and Minnesota Traffic Observatory.*

## CTS to lead \$10.4 million regional consortium on transportation safety

In a national competition held by the U.S. Department of Transportation, CTS has been selected to lead a new \$10.4 million regional University Transportation Center (UTC) consortium focused on improving transportation safety.

The new Region 5 Center for Roadway Safety Solutions will be a regional focal point for transportation safety research, education, and technology transfer initiatives. The region includes Minnesota, Illinois, Indiana, Michigan, Ohio, and Wisconsin.

*CTS continued on page 7*

## Increasing efficiency, reducing emissions with hydrous ethanol in diesel engines

Nearly all corn-based ethanol produced in the United States is anhydrous, meaning that it contains less than a half percent water by volume. However, the distillation and drying processes required to remove the water from ethanol consume a great deal of energy.

Researchers from the Department of Mechanical Engineering are investigating a more efficient alternative: the use of hydrous, or wet, ethanol, which contains more water. Not only does hydrous ethanol require less energy to produce, but it can also result in reduced emissions of nitrogen oxides (NOx) and soot when used in diesel engines.

*Ethanol continued on page 6*



# The future of transportation

What does the future hold for transportation? University of Minnesota civil engineering professor David Levinson shared his thoughts as part of a panel of transportation experts in a series of videos from *The Week* magazine. Some highlights from Levinson's predictions are below.

## Urban mobility in 10 years

Over the next 10 years, Levinson predicts the emergence of driverless cars on the road, more car sharing and bike sharing programs, and more real-time information about buses and traffic congestion. "The future is already out there in pieces, but it will be much more systematically deployed in 10 years," he says.

He also predicts that cities will be cleaner, with more electric cars and lower levels of tailpipe emissions, even for transit vehicles and trucks. "Cities will be more pleasant places to live," he says.

## Mobility versus accessibility

"We'll need to think about transportation not as providing mobility but providing accessibility," Levinson says. "It's not just how fast we move on the network, but about how many things we can reach." According to Levinson, connecting people to the places they want to go is not only a transportation issue, but also a land-use issue.

The challenge, Levinson says, is that these issues are often governed by different organizations. "Land use is generally locally managed, and transportation is funded at least in part by the federal and state government... They have different objectives," he says. Improvements in accessibility will require better coordination and alignment of these transportation and land-use objectives.



Levinson predicts improved accessibility, more real-time transportation data, and cleaner cities.

## The role of data

According to Levinson, accurate and reliable transportation data are and will continue to be important because they can provide real-time information to help travelers plan in real-time. And although data are already being used to provide information to drivers, transit users, and flyers, there are still areas where data are incomplete—such as for travel time on urban arterials.

"We're in process," Levinson said. "We're going to be doing a lot better in five years than we are today, and we're

**70%**  
**OF THE WORLD'S  
POPULATION**  
will live in cities by 2050.  
*(Source: World Health Organization)*

doing a lot better today than we were five years ago. But we're not there yet in terms of being able to fully exploit the information that's out there."

## CTS Fall Luncheon: Could crashes be a thing of the past?

The traditional cornerstones of vehicle safety—such as seat belts and air bags—have significantly reduced injuries and fatalities over the decades. In the next wave of technologies, researchers and manufacturers are looking at ways to prevent crashes from happening in the first place. These systems, such as “6D vision” sensing technology and smart maps for connected vehicles, could make crashes much less common—and pave the way for self-driving cars.

At the CTS Fall Luncheon, Luca Delgrossi, group manager of vehicle-centric communications with Mercedes-Benz Research and Development, North America, will discuss these technologies and when they might come to a dealership near you. It will be held December 3 in the McNamara Alumni Center in Minneapolis. Details and registration information are online at [cts.umn.edu/Events](http://cts.umn.edu/Events).



## Freight and Logistics Symposium

### *The Gravity of Logistics: Building an Economy Conducive to Growing Business*

The seamless and uninhibited flow of goods from manufacturers and markets toward demand—the “gravity” of logistics—depends on infrastructure that can support and sustain economic growth.

At this year’s Freight and Logistics Symposium, public, private, and academic professionals will discuss strategies to maintain the existing transportation infrastructure in Minnesota and the region. They also will discuss private- and public-sector perspectives on successes and challenges to the current supply chain.

The symposium will take place December 6 in Minneapolis. More information and registration information are at [cts.umn.edu/Events](http://cts.umn.edu/Events).

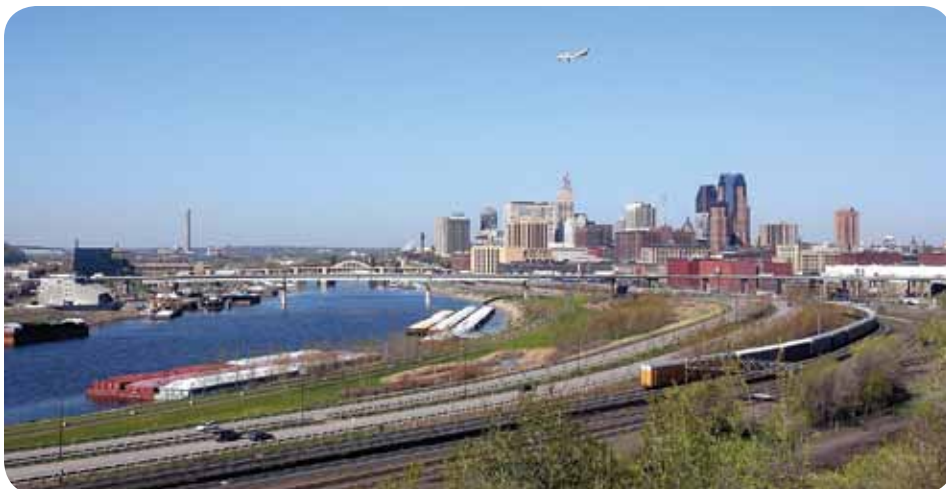


Photo: Dave Gonzalez, MnDOT

## Leaders join Executive Committee

CTS convenes diverse stakeholders to share, learn, and act. A prime example of this is the CTS Executive Committee, which has primary responsibility for providing strategic direction to the center and for overseeing the implementation of CTS programs. In recent months, the committee welcomed 10 new members from various organizations:

- **Laura Bloomberg**, Associate Dean, Humphrey School of Public Affairs, U of M
- **Ardell Brede**, Mayor of Rochester, Minnesota
- **Chris Cramer**, Associate Dean for Academic Affairs, College of Science & Engineering, U of M
- **Joseph Favour**, Associate Professor of Practice, Department of Landscape Architecture, U of M
- **Peter Frosch**, Director of Strategic Partnerships, GREATER MSP
- **Brian Herman**, Vice President for Research, U of M
- **Jim McDonough**, County Commissioner, Ramsey County
- **Sue Mulvihill**, Deputy Commissioner and Chief Engineer, MnDOT
- **Michael Noble**, Executive Director, Fresh Energy
- **George Schember**, Vice President, Cargill Transportation & Logistics



## READ CATALYST ONLINE

for links to research reports and other resources.



# A conversation with the new head of civil engineering

Earlier this year Professor Joe Labuz accepted a five-year appointment as head of the Department of Civil Engineering. Labuz served as interim department head since July 2012 and as a member of the faculty since 1987. As an instructor, he has taught numerous soil and rock mechanics courses and developed new courses in experimental geomechanics and fracture of geomaterials. He has conducted more than 20 transportation-related research projects in the areas of pavements, soils, and structures and has also served students as the director of both undergraduate and graduate studies. Below he shares his vision and directions for the department.



## Vision

I am very much looking forward to my tenure for a number of reasons: the faculty are among the world leaders in their fields; our students more than ever are focused on developing skills that can be used to serve society; and the college is committed to supporting and rewarding cutting-edge research and quality instruction.

I should first acknowledge the previous head, Professor Roberto Ballarini. Through his leadership, the department experienced growth in research expenditures and student satisfaction. His vision was one of excellence in all that we do.

I will try to continue his legacy of excellence, while striving for my vision of building—building progressive educational programs in civil engineering, environmental engineering, and geoenvironmental engineering; building research thrusts that are aligned with regional and state priorities; and building a vibrant, cohesive department where faculty and students are recognized nationally and internationally for distinguished academic achievement.

## Priorities

One of my first priorities is to build a state-of-the-art measurements laboratory for hands-on learning and instruction. Just as numerical modeling has become a common thread of engineering analysis and design, so too should sensing be a component of our core programs.

## New degree program

Furthermore, the department is proposing a new degree program, the first in Minnesota: bachelor of environmental engineering (BEnvE). This reflects the extensive interests of our faculty and students in forwarding environmental issues within a civil and geoenvironmental paradigm. Our interests span from clean energy to water treatment, from hazardous waste to groundwater remediation, to name a few. The introduction of this program aligns us with many other leading civil engineering departments nationwide.

## Name change

Perhaps the most exciting news is the name change to Department of Civil, Environmental, and Geo-Engineering. The proposed name will better reflect the character of the department and readily identify our degree programs. Note that the name will be unique in the U.S. The name change, when approved by the Regents, will be official on July 1, 2014.

## Research

On the research side, several initiatives are focused on issues important to the region and nation. Measurement and analysis of transportation infrastructure, environmental restoration of lakes and streams, and renewable energy such as wind and biofuels have substantial funding in the department, and resources such as faculty hires and laboratory space are being dedicated to these thrust areas.

## CE building and labs

Finally, the building itself is being renovated and some laboratories are being remodeled, as is the second floor student lounge, through the generous support of WSB & Associates and the College of Science & Engineering. The unique underground structure received the 1983 outstanding civil engineering achievement award from ASCE. I look forward to inviting the community to visit sometime in December 2013 to celebrate the 30-year anniversary.



Lab space and faculty hires are being directed to key research areas.

## 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—drivers may not notice them until it is too late to stop safely.

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 project was led by John Hourdos, director of the U of M's Minnesota Traffic Observatory, and sponsored by the Minnesota Department of Transportation (MnDOT).

The IDL system consists of two instrumented work-zone drums that detect vehicles traveling at unsafe speeds as they approach the work zone. 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, including the MnROAD research facility near Albertville. Tests included 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. However, because drivers were aware of the system beforehand, further testing under real conditions is needed to verify the system's success.

Other future needs include streamlining the system and its construction so it will pass a Federal Highway Administration crashworthiness test, which would allow the system to be tested in actual roadway work zones. The researchers also recommended a follow-up human factors study that could evaluate the positive and possibly negative effects of the system when used in practice. The loud auditory warning, in particular, could surprise drivers unaware of the system.

To help meet the latter need,



In the past five years, there have been

**26,502**

**WORK-ZONE CRASHES**

in Minnesota, resulting in 41 deaths and 4,017 injuries.

*(Source: Minnesota Department of Public Safety)*

Kathleen Harder, a senior research associate at the College of Design, plans to include the IDL system in a new study on capturing and sustaining driver attention in work zones. Harder will test the IDL system, as well as other potential warning methods, in a driving simulation study sponsored by MnDOT. The most effective methods will then be tested in the field.

## Humphrey School offers Ph.D. in public affairs

The Humphrey School of Public Affairs is now offering a Ph.D. program in public affairs. The Board of Regents approved the Ph.D. program this past summer.

The program offers students opportunities for advanced study in the areas of public affairs, policy analysis, and planning. It is designed to prepare students for successful careers in academia, public agencies, and nonprofit institutions.

"Our motivations were to increase intellectual vibrancy of the school, to position the school to better serve the discipline and profession, and to position the school for competition in the global market for public affairs education," says Professor Greg Lindsey, the program's director.

The application deadline for the program is December 1. Details are online at [hhh.umn.edu/degrees/phd.html](http://hhh.umn.edu/degrees/phd.html).



## Ethanol from page 1

Assistant Professor Will Northrop and Professor David Kittelson are conducting two projects examining the use of hydrous ethanol in diesel engines. The first uses an engine system that would need to be implemented by original equipment manufacturers, and the second is exploring the potential for aftermarket systems.

The research has received funding from the Agricultural Utilization Research Institute (AURI), Minnesota Corn Growers Association, and the Initiative for Renewable Energy and the Environment, a former program of the U of M's Institute on the Environment.

In the first project, the researchers are using hydrous ethanol in a dual-fuel diesel engine that uses a combustion method called reactivity-controlled compression ignition (RCCI). In an engine using RCCI, the ethanol and diesel fuel are mixed directly in the combustion chamber. Unlike other approaches for using ethanol in diesel engines, RCCI allows ethanol to be the primary fuel source for the engine, thereby reducing harmful exhaust emissions.

In fact, the researchers have been able to use 150-proof ethanol—75 percent ethanol and 25 percent water—to provide up to 85 percent of the fuel energy in a diesel engine using RCCI. Using the 150-proof hydrous ethanol saves about 20 percent of the life-cycle greenhouse gas emissions compared to traditional ethanol.

"It so happens that making the hydrous ethanol is less energy intensive, and it is really great for this type of engine combustion. We're able to show comparable overall engine thermal efficiency to diesel-only energy and reduce emissions

to a low level," Northrop says. Specifically, the researchers were able to keep emissions below the Tier 4 Environmental Protection Agency standards for off-road diesel engines.

"This is a big deal because most people need aftertreatments to get rid of particulate matter and NOx emissions, and we don't need to use them. This is a huge selling point because companies are interested in eliminating aftertreatments in off-highway applications like tractors and locomotives," Northrop says.

In the second project, the researchers are examining aftermarket systems that could be used to retrofit a range of older diesel engines to use hydrous ethanol. As part of the project, the researchers are partnering with CleanFlex Power Systems, a Nebraska-based company that has developed a dual-fuel aftermarket system allowing diesel engines to use hydrous ethanol.

Northrop and Kittelson plan to install a CleanFlex retrofit kit on an engine in their lab. "We will use our expertise in particulate emissions management to do a deep dive into the composition of these emissions from dual-fuel hydrous-diesel operation," Northrop says.

"We hope to learn what the makeup is of the emissions that are remaining after an engine is retrofitted with a CleanFlex system," says Ron Preston, CleanFlex president. "With the research being done at the University of Minnesota, we hope to be able to make some alterations that will get a reduction of particulate matter at 85 percent or greater. That will make this a very important solution for emissions reduction in diesel engines."



The two-year consortium will focus its research on regional issues related to high-risk road users and systematic safety improvements. Within these areas, the consortium will address multiple modes of transportation across a variety of topic areas, including roadway departures, urban and rural intersections, pedestrians and bicyclists, and commercial vehicle drivers. The consortium will also explore transportation safety engagement in the region's Native American communities.

"More single-vehicle fatal crashes occur on reservations than in the country as a whole," says U.S. Sen. Al Franken. "This statistic serves as a stark reminder that we need to support transportation research to improve road safety, particularly in our tribal communities. As a member of the Senate Indian Affairs Committee, I was proud to support CTS in their grant request and I applaud their efforts."

The CTS-led consortium was one of 33 federal grant recipients selected out of 142 applicants. Other consortium members in CTS's winning proposal are the University of Akron, University of Illinois at Urbana-Champaign, Southern Illinois University Edwardsville, and Western Michigan University.

"The new consortium will allow us to bring together the diverse strengths and expertise of our members to work toward the shared goal of improving safety," says Laurie McGinnis, director of CTS and chair of the new regional center's Advisory Board. "Together, we can do much more to save lives on our roads than we could do alone."

Max Donath, professor of mechanical engineering at the University of Minnesota and an internationally recognized leader in transportation safety research, will serve as the director



of the new Region 5 center.

"This award will allow us to bring together a multidisciplinary team of researchers from across the region to improve safety for broad groups of travelers," Donath says. "We've made great strides in transportation safety in the past 20 years, but that's not enough for the families and friends of the 4,500 people who died on our region's roads in 2011. We need to determine and deliver the next wave of transportation safety improvements."

"Improving our road safety system is critical to preventing crashes," says U.S. Sen. Amy Klobuchar. "This support will go a long way to help CTS advance safety improvements to help make our roads safer and save lives."

The center will receive \$5.2 million from the USDOT and \$5.2 million in

matching funds from member universities, state departments of transportation, and other regional, state, and local partners.

"This is great news for the University, our regional partners, and ultimately our national transportation infrastructure. The award demonstrates that through collaboration, great innovation can come," says Brian Herman, Vice President for Research at the U of M. "This consortium has the most comprehensive university-based transportation research facilities in the region, as well as a diverse group of faculty and research staff experienced in implementing safety solutions. I am pleased for the recognition of the University of Minnesota and the longtime leadership of CTS in the area of transportation safety."

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# Catalyst

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Researchers are investigating the use of

## HYDROUS ETHANOL IN DIESEL ENGINES.

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Professor David Levinson

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