

CTS Catalyst

cts.umn.edu

Accelerating the pace of transportation innovation

SNOW CONTROL TOOL

page 2

PREVENTING WATER POLLUTION

page 3

NEW FACULTY

page 4

VALUE CAPTURE

page 5

RESEARCH PARTNERSHIP AWARD

page 5



Teen Driver Support System helps reduce risky driving behavior

Although teen drivers make up a small percentage of the U.S. driving population, they are at an especially high risk of being involved in a crash. In fact, drivers between ages 16 and 19 have higher average annual crash rates than any other age group. Factors that contribute to teen drivers' risk include their lack of experience and their tendency to engage in unsafe behaviors such as speeding, driving aggressively, or using a cell phone while behind the wheel.

Teen drivers continued on page 6

Freight rail adds value to Minnesota's economy

When considering Minnesota's economic advantages, analysts and policymakers often mention factors such as a well-trained workforce, rich natural resources, or diverse manufacturing industries. But one important factor may be overlooked: a vibrant freight rail network.

Since 2012, researchers at the State and Local Policy Program (SLPP) at the Humphrey School of Public Affairs have been examining this factor in a study funded by the BNSF Railway Foundation. As part of the study, the research team investigated the role of freight rail in Minnesota's economy—particularly in rail-related industry clusters such as agriculture, mining, processed food, and manufacturing. (Industry clusters are groups of related businesses located near each other

Freight rail continued on page 7



Snow control cost/benefit tool goes online as program aims to expand



Corn rows left standing after fall harvest become a living snow fence.

Cornstalks may not be the first thing that comes to mind for keeping rural roads clear in the winter. But when stalks near roadsides are left standing after fall harvest, they become a living snow fence, reducing the amount of snow blowing onto roads.

To help determine reimbursement costs for farmers and choose which roads are good candidates, the Minnesota Department of Transportation (MnDOT) uses a snow control cost/benefit tool developed by University of Minnesota researchers. In a new MnDOT-funded project, CTS and U of M Extension are developing a website to host the tool and related snow-control resources.

The cost/benefit tool assesses agricultural and MnDOT costs to determine a fair and reasonable incentive payment for farmers. Farmers are compensated on a per acre basis that factors in crop yield, production costs, inconvenience factors for the farmer and traveling public, price of corn, and anticipated snow removal cost savings.

The new website is expected to be live by the end of the year. In future work, CTS and Extension will work with MnDOT and the U's Department of Applied Economics to update the annual cost and input data. CTS will also convene stakeholders to evaluate the tools' usage and functionality and discuss potential development needs.

The tool was developed by research assistant David Smith under a grant led by Gary Wyatt, an agroforestry extension educator with U of M Extension in Mankato. "With the new website, the tool will be available not just to MnDOT, but also to local transportation agencies in the state, and even to agencies in other states and countries," Wyatt says.

The standing corn rows are part of an innovative MnDOT program started about 15 years ago that pays farmers to leave up roadside corn stalks after harvest, says Dan Gullickson, MnDOT program coordinator. Last winter there were seven miles of standing corn rows (out of approximately 70 miles of living snow fence along MnDOT-maintained highways). "MnDOT has identified about 1,000 miles of drift-prone highways in our statewide network that require additional resources beyond routine snowplowing to keep open," he says.

For the coming winter, MnDOT is seeking farmers with fields to the north and west sides of state highways and interstates where there is a known snow-drifting problem. New this year, MnDOT will also pay farmers to position large hay bales and silage bags at the proper distance from the roadway to offer snow and blowing snow protection. And if farmers want to plant a perennial shrub row receiving conservation payments, MnDOT will complement these incentives as well, Gullickson says.

Wyatt is also continuing his work to connect farmers with youth or adult organizations to hand-pick ear corn from sites (4-H and the FFA have participated in the past). "If farmers want to participate by leaving standing corn rows, this allows the farmer to keep the corn and reduces unwanted corn emerging in next year's crop," he explains. "It's also a welcome source of revenue for nonprofit organizations."

New guidelines help agencies prevent water pollution near roadsides

Stormwater management isn't what it used to be. Historically, stormwater management focused on preventing flooding by routing stormwater runoff to a detention pond or another water-detention system; increased runoff volume and degradation of water quality were not typically addressed. Today, increased environmental awareness and more stringent regulations mean these issues are being considered in most stormwater management plans.

"Stormwater management has shifted to include techniques that reduce runoff volumes and improve runoff water quality in addition to reducing the peak flow rate," says University of Minnesota civil, environmental, and geo-engineering professor John Gulliver. "One way to do this is with vegetated roadside swales, which remove water during rainfall events, infiltrate water into the soil, and filter the solids and associated pollutants from the water."

In a study sponsored by the Minnesota Department of Transportation, a multidisciplinary research team led by Gulliver and bioproducts and biosystems engineering professor John Nieber set out to develop methods and guidelines for assessing and improving the pollution prevention of roadside swales (low-lying tracts of land or ditches).

The team began by conducting an infiltration study to measure the infiltration rates of roadside swales, then developing and testing a runoff-flow routing model that estimates the volume of runoff for a given rainfall event.

Next, researchers developed and tested a filtration system that can be installed in swales to provide significant treatment of dissolved heavy metals and dissolved phosphorus in stormwater runoff, along with a model that can predict the reduction of these pollutants that can be achieved using the filter.



A roadside drainage ditch along a Minnesota roadway

Finally, the best available knowledge on swale maintenance was combined with information collected from new surveys to develop recommendations for swale maintenance schedules and effort. "Our recommendations on maintenance actions and frequencies in roadside swales will provide a valuable baseline for optimizing the effectiveness and cost-effectiveness of roadside swales in Minnesota," Gulliver says.

Ultimately, this research will directly benefit those responsible for limiting the runoff of suspended and dissolved contaminants from watersheds using roadside swales, and provide information that can be used to gain pollution-prevention credits for these systems.

"Not only will this enable practitioners to develop design standards for new swales, it will also provide valuable information for practitioners wishing to re-classify their roadside drainage ditches as swales in order to receive credit for the pollution prevention they are already achieving and further enhance their pollution prevention efforts," Nieber says. "In addition, 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."

A second phase of the research is under way, adds Barb Loida, the coordinator engineer for MnDOT Metro District's stormwater program.



Researchers measured the water infiltration rate at five swales.

New researcher looks to improve mobility, reduce emissions



Adam Boies

The Department of Civil, Environmental, and Geo-Engineering (CEGE) has added a new faculty member with interests related to transportation: Adam Boies.

Boies returns to Minnesota after serving as a lecturer in the Division of Energy, Fluids and Turbomachinery at Cambridge University. He received his doctorate in 2010 from the U of M's Department of Mechanical Engineering and was the lead

author of *Reducing Greenhouse Gas Emissions from Minnesota Transportation Sources in Minnesota*, a report published in 2008 by CTS and funded through the Minnesota legislature. At Cambridge, Boies led the Transport Analysis in Energy Efficient Cities Initiative and was the co-investigator for the Centre for Sustainable Freight.

Learn more about Boies below.

Tell us about your plans for research at the U of M.

My research seeks to assess the impacts of transportation and develop more efficient means for providing mobility for humans and goods. Using experimental and analytical approaches, I investigate the impact of advanced technologies and new mobility constructs to improve mobility while reducing energy use and emissions.

What excites you most about your work?

This is a unique time for researchers, with an unprecedented ability to access "big data" that just a few years ago would not have existed. Data from smartphones, GPS devices, emissions monitors, etc., can provide true insights into both the operation of transportation technologies as well as the potential for those technologies to bring about meaningful reductions in energy use and emissions.

The availability of new transportation fuels, drivetrains, and automation will also transform the mobility of humans and goods. We are moving toward a future where the transportation fleet is diversifying with technologies that fill specific niches in the market. We have a unique time window in which to demonstrate the efficacy of technologies and deploy them in the most appropriate applications.

I look forward to working with private industry, government, and fellow academics to determine the best use of transportation technologies for efficient and cost-effective implementation.

What are the implications of your work for Minnesota, and beyond?

The impacts of my group's research will lead to greater deployment of technologies that can bring about meaningful reductions in energy use and emissions. Ongoing efforts into the development of catalysts that facilitate the oxidation of methane exhausted from compressed natural gas and liquefied natural gas vehicles will be an important enabler of the widespread deployment of these vehicles. The improvement of methane catalysts would have wide-reaching implications for the transportation sector in the U.S. and internationally.

Ongoing work in biofuel process modeling promises to give insights not only into current refining best practices, but also allow for an ability to predict the ultimate potential for lower energy use and emissions of new transportation fuels.

To read an expanded version of this Q&A, visit the CTS *Conversations* blog at blog.cts.umn.edu.



Boies plans to conduct research on advanced technologies that can be used to reduce emissions.

READ CATALYST ONLINE

for links to research reports and other resources.

Value capture expertise exported **beyond state's borders**

The University of Minnesota has developed a reputation for leadership in the study of value capture, an infrastructure financing tool. Two requests for assistance from outside Minnesota's borders demonstrate this leadership.

Zhirong (Jerry) Zhao, associate professor in the Humphrey School of Public Affairs, was contacted in May by the World Bank to provide recommendations for applying value capture strategies in Colombia. The task turned into a small research grant channeled through the University of Minnesota.

"The Colombian national government has started an ambitious expansion of the highway network system," Zhao says. Anticipating the huge potential of land value increases along the corridor, officials in Antioquia, one of 32 Colombian departments (or states), wanted to provide technical assistance and tools to municipalities that will be crossed by the future system. The tools would help municipalities capture some of the financial benefits that land owners and developers will gain from proximity to the new highways.

To assist in this effort, Zhao provided a report that reviews international experiences with the use of value capture instruments along interstate highway corridors. The report also proposes an action plan for Antioquia to help promote and assist in the application of value capture instruments.

Zhao finished the project in June. "The World Bank seems to be very satisfied with the report, and has

circulated it to the government of Colombia," he says.

In another project, Zhao was contacted by Ernst & Young, one of the world's leading professional services organizations, for a project it is conducting for the City of Charlotte, NC. The project will assess the potential of value capture in expanding the city's light-rail system.

"In terms of methodology," Zhao says, "the project sounds quite similar to the MnDOT project that I finished about

Trunk Highway 610 in Maple Grove" (see article in the March 2014 *Catalyst*). As an advisor for the Charlotte project, Zhao will suggest collection variables, statistical models, and value-capture design, and review the analysis and conclusion.

"These projects indicate that our value capture research continues to have real-world impacts, both domestically and abroad," Zhao says.



Research Partnership Award: **nominees sought**

CTS is accepting nominations for the 2015 Research Partnership Award. The award honors research projects within the CTS program that have resulted in significant impacts on transportation. The award will be presented at the CTS annual awards ceremony in April 2015.

Please submit your nomination by January 23. Criteria and submission instructions are available at cts.umn.edu/about/awards/rpa.



Demonstration of a TDSS speeding alert. When the driver is following the posted limit, the display background is white.

To help teen drivers stay safe on the road, researchers at the U of M's HumanFIRST Laboratory have been working for nearly 10 years on the development of the Teen Driver Support System (TDSS). The smartphone-based system is a comprehensive application that provides real-time, in-vehicle feedback to teens about their risky behaviors—and reports those behaviors to parents via text message if teens don't heed the system's warnings.

TDSS provides visual and auditory alerts about speed limits, upcoming curves, stop sign violations, excessive maneuvers (such as hard braking or cornering), and seat belt use. It also prevents teens from using their phones to text or call (except 911) while driving. Parent notifications include information about the teen's risky behavior as well as where and when it occurred.

In the latest phase of TDSS development, the research team has completed a 12-month field operational test of the system with funding from the Minnesota Department of Transportation (MnDOT). The test involved 300 newly licensed teens from 18 communities in Minnesota. Teens were divided into three groups: a control group in which driving behavior was monitored but no feedback was given, a group in which the TDSS provided only in-vehicle feedback to teens, and a group with both in-vehicle and parent feedback from the TDSS.

According to Janet Creaser, HumanFIRST research fellow and a lead researcher on the project, test goals included measuring the effectiveness of the TDSS on teens' driving behavior and investigating the specific benefits of

providing feedback to parents.

Preliminary results show that teens in the TDSS groups engaged in less risky behavior, especially the group that included parent feedback. These teens were less likely to speed or to engage in aggressive driving. Cell phone use was also blocked for both TDSS groups, while teens in the control group frequently used their phones to call and especially to text while driving. In addition, parent opinions of the system were highly favorable—more than 90 percent liked the system and would recommend it to other parents.

"This field test was the culmination of years of research developing the application," says Sue Groth, director of the MnDOT Office of Traffic, Safety and Technology. "The results were exactly what we had hoped for, especially for novice drivers using the application with their parents' supervision."

Although these test results demonstrate that the TDSS can be effective in reducing risky driving behavior in teens, Creaser stresses that technology alone is not enough.

"We don't want parents to believe that having something like this in the vehicle means their teen is OK. The technology is not a substitute for parent interaction," Creaser says. "The whole goal of our system is to get parents talking to their teens about safe driving. And maybe, if you're a parent getting 10 text messages a week, you'll take your teen out and help them learn how to drive a little more safely."

Currently, the HumanFIRST research team is working with the Liberty Mutual Research Institute for Safety on a focus-group study with participants from

the field test. Their goals are to better understand how parents and teens used the TDSS and to gain more information about their opinions on the technology.

Commercial app builds on design of TDSS

In 2012, the U of M licensed the software behind TDSS to a startup company, Drive Power LLC.

The company used the software to create DriveScribe, a smartphone-based application that offers in-vehicle driver coaching and real-time parent notifications similar to that provided by the TDSS. In addition, the application offers a points-based rewards engagement program. Teens earn points based on their safe driving performance and can redeem them for gift cards and discounts at major retailers.

The basic version of DriveScribe is available for free. For higher point-earning capabilities, the app is also offered at monthly subscription rates ranging from \$3 to \$10. To learn more, visit DriveScribe.com.

More than
12%

of drivers involved in
**U.S. TRAFFIC CRASHES
ARE UNDER AGE 20,**
even though teens make up only 5%
of the driving population.

Freight rail from page 1

that tend to have a large economic impact on a region.)

The project team included SLPP director Lee Munnich, SLPP associate director Frank Douma, and visiting research scholar Tom Horan, also a professor at Claremont Graduate University.

According to the researchers, the study's findings encompass two big ideas. First, freight rail is a significant but not always understood factor in Minnesota's economy, providing a crucial link between other transportation methods. Second, maintaining the high performance of the freight rail system through public and private investments is essential to continued economic growth in Minnesota and throughout the United States.

As part of the study, the team produced a summary report that reviews these big ideas and specifically outlines the following key findings:

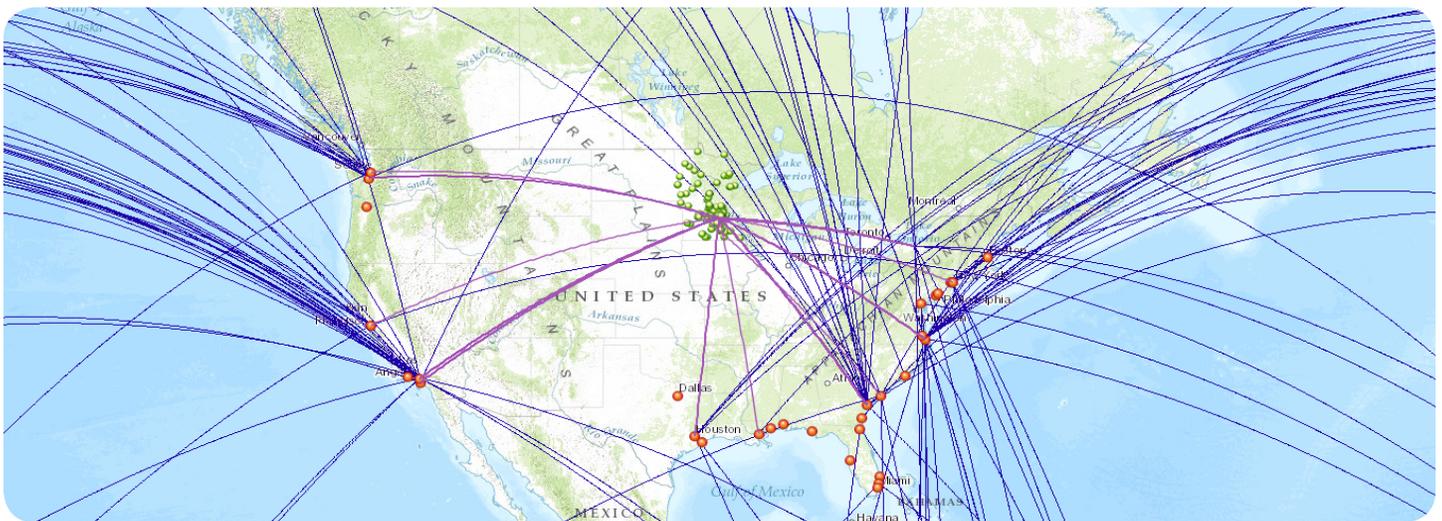
- An efficient freight rail system is vital to economic competitiveness.
- Partnership between Class 1 and short-line railroads is important for economic growth in Greater Minnesota.
- Because rail infrastructure is generally the business of the private sector, the nature of the public-private partnership is unique.
- Intermodal transportation policy represents an important new arena for ensuring the continued performance of freight transportation.
- The freight transportation community needs to maintain an ongoing dialogue with the public on freight rail.

"The importance of the supply chain to the American economy—including freight rail's role in it—is sometimes hard to convey," says BNSF executive chairman Matt Rose in an introduction to the report. "This report provides a vivid description of the synergy between the local economies and the freight infrastructure that connects those economies to national and, increasingly, international markets."

The SLPP team also developed a website showcasing the value of freight: **freighteconomy.org**. The website features maps of Minnesota's industry clusters and illustrates how products flow from Minnesota to domestic and international markets. It also includes stories of Minnesota companies and the ways they use rail and other transportation systems. The summary report and a project video are also available.

"[This] study may focus on Minnesota, but the lessons apply across the U.S.," Rose says. "It's a valuable presentation of information for understanding the importance of the region's transportation economy and it tells the story that we see every day, as we move freight to market from local communities."

THE GROSS DOMESTIC PRODUCT
in Minnesota attributed to rail transportation is
40% HIGHER
than the national average.



The website illustrates how products make their way from Minnesota to U.S. ports and then to international markets.

EVENTS CALENDAR

cts.umn.edu/Events

♻️ Recycled paper with 30% postconsumer waste • The University of Minnesota is an equal opportunity educator and employer. This publication is available in alternative formats upon request.

SUBSCRIBE

to e-mail announcements of upcoming events:
cts.umn.edu/Publications/Subscribe



Researchers investigate how
FREIGHT RAIL
affects
MINNESOTA'S ECONOMY.
page 1

SNOW CONTROL TOOL
goes online
as program aims to expand.
page 2

Study offers insights on using
ROADSIDE SWALES
FOR WATER POLLUTION
PREVENTION.
page 3



Teen Driver Support System
helps reduce risky driving behavior.

page 1