University of Minnesota
Center for Transportation Studies
Research E-News

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CTS Research E-News brings you the latest research project milestones, published reports, and seminar coverage.

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Announcement

University of Minnesota presenters at TRB Annual Meeting

The University of Minnesota will be well represented at the annual meeting of the Transportation Research Board in Washington, D.C. Engineering and public affairs researchers will present and discuss their recent research on a range of topics, including transportation planning, safety, congestion management, transportation finance and pricing, and pavement management.

For more information, download a complete list (128 KB PDF) of University of Minnesota presenters or visit the TRB Annual Meeting website.

Policy & Planning

Enhancing public engagement in transportation policymaking

Public engagement—gathering public input to inform decision making by government agencies, political leaders, or nonprofits involved in administering public policies and programs—has become a fundamental feature of the public-government relationship. However, public engagement is less common in transportation than in other areas of public policy.

Assistant professors **Zhirong "Jerry" Zhao** and **Kathryn Quick** of the Humphrey School of Public Affairs recently completed a study aimed at increasing and improving public engagement in transportation policymaking. The study, funded by CTS, included the development of a four-step framework for managing the public engagement process and a list of suggested transportation engagement opportunities.

The benefits of public engagement include the contribution of valuable resources and knowledge by participants, the researchers say. It generates better buy-in and limits delays, mistakes, and lawsuits, with stakeholders being more likely to accept a decision reached in a participatory manner—even if it was not their preferred decision. It can also help create relationships that facilitate communication and collaboration among different parties.

Zhao and Quick's four-step framework was designed to assist public works leaders who want to improve the engagement process in transportation-related projects. The four steps—1) decide the purpose of public engagement, 2) consider moving beyond participation, 3) select techniques for managing engagement, and 4) evaluate public engagement—serve as a guide for designing and managing the process.

The steps are designed to help public works professionals identify goals of the public engagement effort as well as methods for making the process as collaborative and inclusive as possible. They can also assist in outlining the most appropriate strategies to facilitate the engagement

and methods to assess the effectiveness of a specific effort.

The researchers also identified several initiatives that could benefit from the incorporation of this framework. These include assessing the feasibility of a mileage-based user fee system to replace the fuel tax, involving transit users in service planning to decide how to cope with budget cutbacks, and engaging historically marginalized communities in planning for proposed transitways.

Taking advantage of these opportunities for public engagement will help build meaningful collective decisions to address our transportation issues in the face of a severe funding shortage, Zhao and Quick suggest. Public engagement may provide new information, new motivations, or new ways for issue understanding and problem solving. It can also lead to more inclusive, democratic, and equitable decisions about how to utilize limited public resources.

A final report on the project, *Suggested Design and Management Techniques for Enhancing Public Engagement in Transportation Policymaking* (CTS 11-24), is available on the CTS website.

Intelligent Transportation Systems

Measuring truck traffic with batteryless sensors


Batteryless sensor installed at MnROAD

Many factors can contribute to the deterioration of roads, but traffic weight is the most harmful. Increased damage to roads and bridges caused by overloaded trucks is a rising concern for many transportation agencies. Monitoring and enforcing the limits on excessive loading is one strategy these agencies can use to reduce roadway damage and its associated repair costs.

Mechanical engineering professor **Rajesh Rajamani** and his research team—former graduate students **Krishna Vijayaraghavan** and **Sean Pruden**—have been working on a self-powered traffic flow sensor that can measure moving vehicle axle weights. With funding from the ITS Institute, they've developed recent enhancements that increase the accuracy and reduce the cost of these sensors, making it easier and less expensive for transportation agencies to monitor truck traffic, especially in rural areas.

Originally, the sensor was designed to collect data on traffic flow rate and transmit it to a nearby receiver by harvesting energy from vibrations caused by vehicles passing over it in the road. Called a batteryless wireless sensor, it requires no batteries or other power source and can wirelessly transmit its data.

Recently, Rajamani and his team have redesigned the sensor to harvest more energy, which enables it to communicate wirelessly over larger distances. Now, with a transmission distance of 500 feet, the sensor can communicate with a receiver placed in a regular roadside cabinet on the highway.

The increased energy also enables the system to measure and transmit weigh-in-motion (WIM) measurements in addition to traffic flow rate. The design goal was to allow enough energy to be harvested from lighter vehicles without sustaining structural damage from heavier vehicles.

One challenge for the researchers was an inability to maintain the sensor flush with the road surface, which resulted in suspension vibrations from passing vehicles. These vibrations changed the load experienced by the roadway by as much as a factor of two. To compensate for this, the team used a series of four consecutive WIM sensors in the road, evaluating the static weight of the vehicle using a combination of three different algorithms.

Overall, the research found that the sensor is effective at measuring the weights of heavy vehicles and less effective with light vehicles. Rajamani and his team suggest that improvements could be made through manufacturing changes, better installation practices, and system characterization. In addition, they recommend making the design more robust to better handle high speeds, to withstand the elements year-round, and to not cause a disturbance in the road for passing vehicles.

A final report on the project, *Enhancement and Field Test Evaluation of New Batteryless Wireless Traffic Sensors* (CTS 11-22), is available on the ITS website.

Suggestions for peaceful coexistence: ITS and privacy

In a recently published report, researchers from the Humphrey School of Public Affairs outlined several strategies to help developers of intelligent transportation systems (ITS) technology address privacy concerns. The report is the result of an ITS Institute-sponsored study focused on privacy issues related to electronic communications and data collection—a primary concern for transportation organizations implementing ITS technologies.

As part of the study, **Frank Douma**, associate director of the State and Local Policy Program at the Humphrey School, and graduate student **Sarah Aue** developed a privacy toolbox and taxonomy that explores potential legal and political privacy issues for ITS projects. They also created a list of recommendations to help developers successfully address these issues or, where possible, avoid them completely.

The privacy toolbox explains the spectrum of information that ITS technologies can collect and use as well as the corresponding legal questions related to consent, second use, public versus private data collectors, and the use of ITS-collected data by law enforcement agencies. The taxonomy considers the type of data being collected, method of data collection, purpose of the technology, and resulting privacy expectations.

According to the researchers, the basic rule is that the more personal the nature of the collected information, the greater the number of associated privacy considerations. A technology's proposed purpose also triggers different levels of privacy expectations. For instance, information collected to help manage traffic flow will raise a lower legal expectation of privacy than ITS information collected for law enforcement purposes.

To help ITS planners and developers take steps to prevent or resolve legal and political privacy issues, Douma and Aue created a list of recommendations for designing and implementing new ITS technologies.

The best option is to work with the most anonymous data sets possible, the researchers say. By choosing not to collect personally identifiable information, ITS developers will avoid many legal restrictions and obstacles. When personally identifiable information is required, ITS developers should establish clear privacy guidelines that outline how they will manage and protect individual users' information.

For technologies that appear intrusive, public acceptance can be even more important than passing legal scrutiny, according to Douma and Aue. One way to increase the likelihood of public acceptance is to provide an opportunity for individuals to use the technology by choice. People who opt to use the technology are giving up their information willingly, which reduces the potential for legal complaints and often results in a more positive political response.

Additional recommendations include educating the public about the effectiveness and reliability of a new technology, introducing the technology at the right place and time, and using states as testing grounds to find out what survives legal challenges and meets public acceptance.

The project's final report, *ITS and Locational Privacy: Suggestions for Peaceful Coexistence* (CTS 11-21), is available on the ITS Institute website.

Transportation & the Environment

Sustainability Forum: translating research to benefit urban communities

Leading thinkers and practitioners from Minnesota and throughout the world came to the St. Paul campus on November 2 and 3 for the Twin Cities Urban Sustainability Forum.

The goal of the forum was to strengthen and expand linkages among the practitioners and academics involved in urban sustainability and urban ecosystems in the Twin Cities and develop a framework for "translational research"—research that would connect the sustainability goals of Minnesota's urban communities with research and outreach at the University of Minnesota.

Forum co-organizers were **Lawrence A. Baker**, research professor in the Department of Bioproducts & Biosystems Engineering, and **Carissa Schively Slotterback**, associate professor in the Humphrey School of Public Affairs. The event was funded by the McKnight Foundation, the National Science Foundation, CTS, and the University's Center for Urban and Regional Affairs (CURA).

One panel session focused on the research and outreach activities of four U of M centers. Speakers were **Laurie McGinnis**, director of CTS; **Ed Goetz**, director of CURA; **John Carmody**, director of the Center for Sustainable Building Research; and **Tim Smith**, director of the Institute on the Environment's Northstar Initiative for Sustainable Enterprise.

The directors gave highlights of their centers' research related to sustainability—ranging from pervious pavement to alternative fuels to building design guidelines—and described how external stakeholders help shape their research agendas. Centers are "portals" that allow outside agencies to approach the University more easily with their research needs. Centers also help to bridge the gap between short-term, smaller-scale stakeholder research needs and the longer-term academic perspective. McGinnis noted that CTS actively facilitates matches between research teams and agencies and nurtures engagement between researchers and practitioners.

Another session featured presentations by three U of M researchers: **Yingling Fan**, assistant professor in the Humphrey School; **Julian Marshall**, assistant professor in the Department of Civil Engineering; and Baker.

Fan discussed research under way through a new research partnership between the University and the Minneapolis Park and Recreation Board. Fan and co-principal investigator **Simone French** of the Department of Epidemiology and Community Health are investigating the outdoor leisure time activity needs of different family types and the impact of neighborhood park design on family health and well-being.

Marshall presented highlights from recent research exploring how urban form and transportation relate to air quality and physical activity. One study, for example, found that cities with transit systems and less-dispersed populations have lower (population weighted) concentrations of certain air pollutants. Other research indicates that policies to increase "active travel" are likely to generate large individual health benefits as well as smaller but population-wide benefits through reductions in air and noise pollution.

Baker described several of his projects, including a project for the City of Prior Lake, Minnesota, that is quantifying nutrients removed through street sweeping. He also described outreach methods that help "science meet the street," such as the sharing of tools and databases.

Two other panels focused on federal and state agency perspectives; speakers included **Derrell Turner**, division administrator with the Minnesota Office of the Federal Highway Administration and member of the CTS Executive Committee, and **Nick Thompson**, assistant commissioner of the Minnesota Department of Transportation.

A series of smaller workshops over the next year will synthesize ideas from the forum into a framework for translational research.

View forum PowerPoints and videos

Reprinted from the December issue of the CTS Report.

Safety & Security

Detecting dangerous conditions on winter roadways

To improve public safety on potentially hazardous winter roadways, researchers from the University of Minnesota Duluth have developed a system to detect snow and ice on road and bridge surfaces.

At an October 13 seminar, chemistry and biochemistry professor **John Evans** outlined the development of the system, which was designed to be inexpensive, versatile, and easily deployable in almost any location. Ultimately, Evans said, the real-time information collected by the system could be used to warn motorists about unsafe conditions or trigger deicing operations by maintenance crews.

Evans's system consists of an array of passive, puck-shaped sensors installed directly in the road or bridge surface. All sensors in a given area, such as on a single bridge deck, are connected to a common local data acquisition system that wirelessly transmits data back to a central processing system. The sensors and acquisition system can be powered by solar panels, making the system ideal for deployment in remote locations.

The detection system uses time domain reflectometry to acquire dielectric relaxation spectroscopy data, a technology that has traditionally been

used to determine moisture content in soil, optimize water delivery to agricultural fields, and identify faults in high-speed electronic circuits.

Each individual sensor sends out an electric pulse and collects data on how the material surrounding the sensor reflects that pulse. Evans explained that a material's response to the electric field changes depending on its temperature and state, so ice, water, and air all react differently. The processing system is able to determine whether the roadway surface contains ice, water, deicing chemicals, or nothing at all by comparing the collected data to baseline measurements for a variety of materials.

"We ultimately use this very complex information to determine a simple response: Is the roadway safe or unsafe?" Evans said.

When the system detects ice or other dangerous roadway conditions, it could be used to trigger electronic signs that alert drivers to potentially hazardous conditions. It could also send information to maintenance crews or individual plow operators pinpointing the location where deicing is needed.

The system was scheduled to be deployed at a test site in Cloquet, Minnesota, in the fall of 2011 in partnership with the Minnesota Department of Transportation (MnDOT). Sensors were slated to be installed in a former weigh station that MnDOT continues to plow and salt.

"It should be a good test station to evaluate the technology," Evans said.

Watch the video or download the podcast

Transit, Bicyling, and Walking

Cyclopath: collaborative routing for cyclists

At the November 10 Advanced Transportation Technologies seminar, **Loren Terveen** described the innovative aspects and new development directions of Cyclopath, an online routing and mapping system for bicyclists in the Twin Cities area. Terveen, an associate professor of computer science and engineering, led the team of University of Minnesota researchers that developed the system.

Cyclopath allows users to generate personalized bicycle routes within the seven-county Twin Cities metro area. For instance, users can look for routes that maximize ridability, minimize distance, avoid hills, or contain roads with bike lanes whenever possible. Other options include exporting the route to a GPS device or creating a URL to share the route with others.

The system was developed in partnership with the Minnesota Department of Transportation, the Metropolitan Council, and other local partners.

Cylopath is also the world's first full-featured geographic wiki—all users can edit the system's maps of roads and trails. Editing tools allow users to add a block or segment of trail to the map and connect it to the existing network. Other online cycling tools also include this feature, but a rich infrastructure that allows users to annotate the system's maps sets Cyclopath apart, Terveen explained.

Cyclists can add notes about a route or trail feature that are visible to all users, enter tags or short keywords (e.g., hill, spiral, entering nice view, etc.) to identify trail characteristics, and create discussions that link to specific geographic objects. When users are browsing a map, they can see all of the discussions associated with a specific area, and the user-generated tags help the system create more accurate personalized routes.

Users can also input ratings based on ridability of a trail or segment, Terveen said. The system uses these ratings—which range from impassable to excellent—to generate new routes for other users.

Since the system's launch, more than 2,000 people have used Cyclopath to generate more than 60,000 routes, with an average of 175 route requests per day. Users have entered a total of more than 12,000 map revisions and 70,000 ratings.

"Ultimately, Cyclopath serves a dual role. We absolutely believe that it is designed to be a great system for bicyclists. On the other hand, we have done and will continue to do research based on the system," Terveen said. So far, the researchers have conducted studies that examined what motivates users to participate in the system and assessed the value of user-generated content.

Future work includes expanding the system to the entire state of Minnesota in a project funded by the Minnesota Department of Transportation. In addition, the research team is developing a multimodal routing system that combines transit and bicycle routes.

Also in the works is Cycloplan, a new version of the Cyclopath system with added functionalities for planners. Terveen hopes that this system will allow planners to better understand where there is a need for new facilities, get feedback from the cycling community, and analyze possible courses of action.

Watch the video or download the podcast

TCRP research publications available online

The federal Transit Cooperative Research Program (TCRP), administered by the Transportation Research Board, provides practical transit research to address technical and operational issues. TCRP emphasizes putting research results into the hands of organizations and individuals that can use them to solve problems.

Recent TCRP publications include:

- *Practical Resources for Recruiting Minorities for Chief Executive Officers at Public Transportation Agencies* (TCRP Report 148)
- *Reinventing the Urban Interstate: A New Paradigm for Multimodal Corridors* (TCRP Report 145)
- *Innovative Rural Transit Services* (TCRP Synthesis 94)
- *Practices to Protect Bus Operators from Passenger Assault* (TCRP Synthesis 93)
- *Use and Deployment of Mobile Device Technology for Real-Time Transit Information* (TCRP Synthesis 91)

- *Sustainable Public Transportation: Environmentally Friendly Mobility* (TCRP Research Results Digest 103)
- *Transit-Oriented and Joint Development: Case Studies and Legal Issues* (TCRP Legal Research Digest 36)

Upcoming Events

Winter luncheon: 'How New Transportation Systems Shape Cities: The Example of Greater Paris'

From the days of antiquity to modern times, cities have always adapted to and been shaped by new transportation technologies. At the CTS Winter Luncheon, Michel Parent will use the example of the greater Paris region to explore how new transportation technologies can help cities meet the challenges of mobility—for people as well as goods—while satisfying the constraints of ecology and quality of life.

In his presentation, Parent will describe how intelligent transportation systems technologies can transform the way private automobiles are used and how the vehicle industry might be affected. In particular, Parent will talk about the European CityMobil project, which explored how automation in transportation can help improve mobility in cities. For more information or to register, please visit the event web page.

More Upcoming Events

February 9
TERRA Pavement Conference, Continuing Education and Conference Center, St. Paul, MN

February 14
CTS Winter Luncheon: 'How New Transportation Systems Shape Cities: The Example of Greater Paris', University Hotel, Minneapolis, MN

April 24-26
National Transportation Workforce Summit, Washington, D.C.

April 29-May 1
IBTTA Symposium on Mileage-Based User Fees and Transportation Finance Summit, Jersey City, New Jersey

May 23-24
23rd Annual CTS Transportation Research Conference, Saint Paul RiverCentre, St. Paul, MN