Public universities play a well-known role in creating new knowledge, but they must also bring that knowledge beyond the ivory tower and into the community. A new pilot program at the University of Minnesota focuses on working with partners outside the U to create new knowledge and put it into play to benefit the community.

One of the pilot projects builds on a study of bus operator optimization completed earlier this year by Professor Diwakar Gupta of the Department of Industrial and Systems Engineering. In that project, Gupta’s team created and tested a new, improved algorithm to help Metro Transit schedule
Robotic roadway painter will improve safety and productivity

A crew of maintenance workers using stencils, rollers, and paint to apply pavement markings is a common sight—but a new robot has the potential to revolutionize this process. Researchers at the University of Minnesota Duluth (UMD) have created a fully functioning robotic roadway painter that they say will “completely change” the way messages and symbols are painted on the roadway.

The project’s goal was to create a large-scale, vehicle-mounted robotic roadway message painter that could be run by a single operator and to develop software that enables the robot to automatically paint messages and symbols on roadways. The project, sponsored by the Minnesota Department of Transportation, was led by Ryan Rosandich, an associate professor of mechanical and industrial engineering at UMD; it builds on his research team’s earlier development of a successful trailer-based prototype that was used to demonstrate the feasibility of robotically painting messages and symbols on a roadway.

“Pavement marking messages are expensive and labor intensive to maintain,” says Victor Lund, traffic engineer for St. Louis County. “The concept of a robotic painter has the potential to reduce these costs and the impact to traffic.”

Researchers moved through several design challenges over the course of the project. “Our initial design included a frame-mounted robot attached to the front of a truck, but when this design presented drawbacks, we changed the concept to a completely new, articulated robot arm that folds flat against the front of the truck,” Rosandich says. “In addition, we developed a control system, operator interface, paint-delivery system, truck mount, and mobile power supply.”

The finished system was thoroughly tested, and programs were written to allow the robot to paint several symbols and messages on the roadway. These programs were then tested and fine-tuned indoors and finally outdoors once the robot was mounted on the truck. This portion of the project produced several interesting findings.

“We found that the traditional pavement markings used by MnDOT are not ideal for robot application,” Rosandich says. “Robotic painting can be better accommodated by altering the outlines of the markings somewhat, and by using hash lines to fill in the symbols rather than solid paint. Helpfully, these machine-made markings are actually faster to apply and use less paint, and in the end may be more effective for motorists than the traditional markings.”

The new robot has the potential to provide several important benefits. Fewer workers will be exposed to the work zone, for a shorter period of time, because the system can be controlled by a single operator from the safety of the vehicle’s cab. Productivity will improve because painting operations can be conducted more quickly with less labor. And greater flexibility is possible because the system is not limited to stencils and is able to paint virtually any character or symbol on the roadway.

The technology has been licensed to Epic Solutions of Fargo, ND, for commercialization. “We expect to see the benefits of this technology grow in the future as these techniques are expanded to other areas such as automated crack-filling and automated pothole repair,” Rosandich says.
Are the health benefits of transit use overstated?

When people drive more, they use active travel modes—such as walking and biking—less. Many research studies have suggested that providing access to public transit reduces vehicle use and encourages active transportation. However, a paper authored by recent Ph.D. graduate Alireza Ermagun and David Levinson raises the question of whether the health impacts of transit use are overstated.

“Although there appears to be evidence that transit can increase physical activity, the question becomes whether this increased physical activity actually leads to improved health measures,” says Levinson, adjunct faculty in the Department of Civil, Environmental, and Geo-Engineering (CEGE). “While some research seems to show that transit use has beneficial health impacts because it requires more walking, other studies conclude that transit might actually substitute for cycling and walking trips, leading to reduced health benefits. Additionally, transit may be self-selected by people who are already healthier or already have a more physically active lifestyle.”

To help shed light on the questions of whether and to what extent public transit use and transit accessibility affect health, Ermagun, now a post-doctoral researcher at Northwestern University, and Levinson examined the effect of transit mode share and accessibility on general health, body mass index, and height while controlling for socioeconomic, demographic, and physical activity factors. The study was built on three major data sources: share of public transit use, accessibility to jobs by transit, and obesity and health condition characteristics in 46 of the 50 largest U.S. metropolitan areas.

“We found that the transit mode share and transit accessibility did not have any significant effect on public health,” Levinson says. “We found a correlation between transit and height. Of course, we do not believe this relationship is causal—we have simply used this as an example to show the need for caution when selecting data and variables, particularly in studies with large sample sizes where ‘statistical significance’ is easily achieved.”

“What becomes clear from our study,” Ermagun adds, “is that basing the results only on ‘statistical significance’ is worthless, unless the effect of the large sample is carefully quantified as a post-analysis.”

Levinson’s ultimate hope? That the study “will help transportation policymakers and practitioners gain a clearer view of the limited health benefits of transit use and allow them to direct scarce resources in more effective directions.”


Reminder: Submit a Research Partnership Award nomination

There’s still time to submit a nomination for the 2017 Research Partnership Award, which recognizes research projects within the CTS program that have resulted in significant impacts on transportation.

The submission deadline is November 23. Criteria and submission instructions are available at cts.umn.edu/about/awards/rpa.
Professor David Levinson, a prolific transportation researcher and thought leader, is joining the School of Engineering at the University of Sydney. He is currently an adjunct faculty in the Department of Civil, Environmental, and Geo-Engineering, where he served on the faculty from 1999 to 2016. He held the Richard P. Braun/CTS Chair in Transportation from 2006–2016 and also served as managing director of the Accessibility Observatory. Levinson shares reflections below.

**What are some highlights of your U of M research?**

I engaged in dozens of projects at the University. Three of the most interesting areas to me were:

**Network evolution.** How do networks grow and shrink over time? Looking at historical cases (especially London and the Twin Cities) as well as building interesting simulation models gives new insights into the problem. We can probably apply lessons from the past toward designs for new networks, from bike lanes in the cities to networks for autonomous vehicles in the future.

**I-35W bridge collapse.** The collapse of the I-35W Mississippi River Bridge was a tragedy, but we were also able to use it to learn a lot about traveler behavior both on a daily basis and in response to system shocks. With support from several funding agencies (NSF, OTREC, MnDOT, U of M), colleagues and I were able to instrument a large number of cars with GPS devices and track their daily movements before and after the replacement bridge opened. This data set was extremely rich and was used by five students in their dissertations on various topics, including route choice, destination choice, travel time perception, bounded rationality, and reliability.

**Accessibility.** From the Access to Destinations project of the mid-2000s to the Accessibility Observatory’s National Accessibility Evaluation, we have measured accessibility, first for the Twin Cities at the traffic zone level and then for the entire United States at the census block level. These projects illustrate the increasing computational power and new ‘big data’ opportunities that have emerged in the past decade.

**Will you maintain a connection with the U of M?**

I will stay involved with accessibility research and continue to supervise several graduate students here. I will also stay on as editor of the *Journal of Transport and Land Use* and help with the World Symposium on Transport and Land Use.

**What’s your research focus at the University of Sydney?**

I will try to work more on network and land-use designs given the changes being brought about by new transport technologies (especially automation, electrification, and mobility-as-a-service) and changes in underlying travel patterns with new kinds of work, shopping, and socializing. This work will inevitably be more speculative than empirically-based work that examined how people actually behaved in some time past as recorded in data, or how networks did evolve, as it is future-looking. But trying to design for the future is the core task for infrastructure building in a rapidly changing world.

**What are some of the unique challenges in Australia? Any similarities?**

Beyond technology changes, Australia is growing much faster than the U.S. and investing far more in new infrastructure. Sydney is in various stages of building a new Metro system, several light-rail lines, a new airport, and a major underground freeway network. Unlike Minneapolis, Sydney is constrained by an ocean on
Roadway Safety Institute museum exhibit grand opening

Join us Friday, December 9, 2016, as we celebrate the grand opening of the Roadway Safety Institute’s safety-themed museum exhibit at The Works Museum in Bloomington, MN.

The exhibit, a permanent installation at the museum, uses a variety of hands-on activities to teach preteens about reflectivity and safety. It features videos, interpretive signage, engineer and researcher profiles, a microscope area for examining reflective materials up close, and a dark room where kids can try out reflective clothing and see how visible they are in simulated headlights.

The grand opening, scheduled from 11:00 a.m. to 12:30 p.m., will include a light lunch, a short program, and tours of the exhibit.

More information is available at roadwaysafety.umn.edu.

Dangers of distracted driving highlighted at Open Streets

CTS partnered with Minnesota TZD to highlight the dangers of distracted and impaired driving at Open Streets Minneapolis on Saturday, October 1.

In its second year on campus, Open Streets closed several roads to traffic on the East and West Bank and invited students and area residents to walk, bike, skate, and play. Exhibits featured a variety of U of M offices, transportation organizations such as Metro Transit and Nice Ride, local businesses, and arts and entertainment.

The CTS booth featured a pedal cart and “drunk goggles,” provided by TZD. Visitors learned how treacherous it is to drive while distracted or intoxicated by using the pedal cart while either texting or wearing the goggles.

READ CATALYST ONLINE for links to research reports and other resources.
schedules for the 7:00–9:00 a.m. period. The calculations include all components of a transit journey, including “last mile” access and egress walking segments and transfers, and account for minute-by-minute variations in service frequency. Rankings are determined by a weighted average of accessibility, with a higher weight given to closer, easier-to-access jobs. Jobs reachable within 10 minutes are weighted most heavily, and jobs are given decreasing weights as travel time increases up to 60 minutes. Based on this measure, the Observatory estimated the 10 metropolitan areas with the greatest accessibility to jobs by transit, and for which sufficient data are available (see sidebar).

The report also presents detailed accessibility values for each metropolitan area and block-level maps that illustrate the spatial patterns of accessibility within each area, as well as a U.S. census tract-level map that shows accessibility patterns at a national scale. The accessibility metrics presented in this report are designed to be comparable to those presented in the Accessibility Observatory’s earlier Access Across America: Auto 2015 report. “Taken together, these reports provide a comprehensive view of the relative accessibility impact of auto and transit systems across different cities,” Owen says.

For example, the Phoenix and Minneapolis–St. Paul metropolitan areas have effectively the same total number of jobs (1.7 million; ranked 13th and 14th respectively), and their auto accessibility rankings are also very close—13th and 12th. “However, they differ significantly in their transit accessibility rankings: Minneapolis–St. Paul ranks 12th in transit access to jobs, while Phoenix ranks 22nd,” he says.

The research was sponsored by the National Accessibility Evaluation Pooled-Fund Study, a multi-year effort led by the Minnesota Department of Transportation and supported by partners including the Federal Highway Administration and 10 state DOTs. Future comparison reports will track the way that accessibility in these metropolitan areas evolves in response to transportation investments and land-use decisions, Owen says.

The Twin Cities area ranks 12th in transit access to jobs (page 1); Phoenix ranks 22nd (above).
operators as efficiently as possible. “Choosing between reserve operators or regular operators receiving overtime pay is a challenging decision for transit agencies,” he says.

In new work, two Metro Transit staffers—Scott Cady, business analyst, and Christine Kuennen, assistant director, Bus Administration—will spend a portion of their time during the next two years on campus with Gupta’s research team. U of M students will spend time at five Metro Transit garages to gain an understanding of current processes and issues.

“Jointly, we will develop methods that Metro Transit’s operations personnel can use to optimally size their workforce, assign contingent work to reserve drivers, and determine when to use planned and unplanned overtime,” Gupta says.

“This project is grounded in math and optimizing our work, but its importance lies in helping our dispatchers and operators better understand the work and the effects its stresses have on them,” Cady says. “As we examine that stress and develop opportunities for improvement, we can truly help take care of the people behind Metro Transit.”

Improvements in Metro Transit’s operations can benefit the transportation needs of residents and visitors in the metropolitan area. Researchers will also make the project’s key takeaways available to other transit providers to expand the number of people who benefit from this research.

The project is one of three under way as part of the External Stakeholder Engagement program, launched earlier this year by the Office of the Vice President for Research. The program combines University research talent with one or more partners from community organizations, government agencies, industry, and nonprofits to promote innovation across a range of disciplines.

Claudia Neuhauser, associate vice president for research and program leader, says the partnerships are designed to catalyze and sustain research between the University and external partners to accelerate the transfer of new knowledge for the public good—a cornerstone of the U’s research strategic plan, Five Years Forward.

Neuhauser says the pilot program will expand to include projects based at all U of M system campuses.

CTS facilitated the collaboration between Gupta and Metro Transit and spearheaded the application process to the program. Metro Transit is cosponsoring the project.
New program aims to **INCREASE ENGAGEMENT** with external organizations. page 1

Robotic **ROADWAY PAINTER** will improve safety **AND PRODUCTIVITY.** page 2

Are the **HEALTH BENEFITS** of transit use **OVERSTATED?** page 3

**Study estimates accessibility to jobs by transit.** page 1