CENTER FOR TRANSPORTATION STUDIES

Catalyst

University of Minnesota

Accelerating the pace of transportation innovation

JULY 2020

cts.umn.edu

Transitway investment leads to higher regional GDP, job growth, and accessibility

A new study from researchers in the Humphrey School of Public Affairs found that transitway investment adds considerable economic value to metropolitan regions, including the Twin Cities area, and it increases access to the places people need to reach to prepare for, get, and keep a good job.

Transitway *continued on page 6*

Cooperative agreements bring benefits and risks for local governments

Local government contributions for Minnesota's roadway system have increased in recent years. This includes local spending on trunk highways—the roads under MnDOT's jurisdiction—that are part of local transportation systems.

For these projects, local governments and MnDOT develop cooperative agreements that define components such as cost participation and funding sources. While these projects can be mutually beneficial, they also carry risks for local governments, according to a new study from the Institute

Cooperative agreements *continued on page 7*

Student project analyzes road-funding tools for small suburban cities

The City of Ramsey is wearing down its roads faster than it can fund their maintenance and construction. In light of this, the city is investigating ways to fund road projects sustainably, and it partnered with the University of Minnesota's Resilient Communities Project (RCP) to advance the investigation.

RCP, housed within the U's Center for Urban and Regional Affairs, connects local government agencies with students and faculty to advance community resilience and student learning. The city was one of RCP's community partners for the 2019–2020 school year.

Four students in a Humphrey School of Public Affairs course—PA 5041: Qualitative Methods for Policy Analysis—collaborated with Ramsey officials for the project. The course instructor was Greta Friedmann-Sánchez, a Humphrey School associate professor.

Ramsey city administrator Kurt Ulrich was the project lead. "Our city council was pleased to get the RCP study results detailing how Minnesota communities fund the repair and reconstruction of city streets. The information confirmed the importance of long-term stable funding for streets and played a critical role in the discussion of possible solutions," Ulrich says.

For their project, the four students—David Ambuel, Sean Crawford, Steven Kutz, and Molly Sir—interviewed and surveyed city managers and public works professionals in the Minneapolis–Saint Paul metro. Their goal was to document the range and nature of sustainable road-funding mechanisms in suburban cities in the region. They then assessed which road-funding options would make the most sense for Ramsey.

They found that while general funds, supported by property tax levies and special assessments, were the most common funding techniques in their sample, franchise fees seem to be increasing in importance and popularity. (Using franchise fees, cities tax local utilities for their use of public roads to conduct their services. The fees, passed on to consumers, distribute the cost of road improvements across the community and allow residents to plan for a consistent monthly bill.)

The students also learned that some of the cities had updated their road-funding policies in the past decade. Key criteria such as equity, defined in numerous ways, led city leaders to make these decisions.

Their final report recommends the following steps for Ramsey to meet its future road construction needs:

- **Increase community engagement:** Establishing a robust and purposeful community engagement plan can help grow public support for new road-funding programs and help residents understand the current state of the city's road-funding situation.
- **Establish a new road-funding structure:** Given the inadequacy of the current road-funding program in Ramsey, adding another funding tool to its toolbox—franchise fees—is recommended.
- **Work in a coalition:** Working together with comparable cities can help elevate the local road-funding issues to the state and present a strong rationale for the passage of additional tools for local governments.

The students faced the additional challenge of completing their work during a pandemic. "We scaled down the scope of our research because of the pandemic," Ambuel says. "We could no longer conduct our interviews in person, and due to the added workload city officials were experiencing, many of the interviewees that we reached out to declined to participate in a timeframe that aligned with our deadlines. To adjust, our research team developed a pared-down survey from our interview protocol and expanded our recruitment efforts. These changes in our study design helped to supply valuable data and context to our report."

A final report and presentation are available at **rcp.umn.edu/content/2019–2020-partner-communities**.

Center for Transportation Studies
University Office Plaza, Suite 440
2221 University Avenue S.E.
Minneapolis, MN 55414

Phone: 612-626-1077
Fax: 612-625-6381
E-mail: cts@umn.edu
Web: cts.umn.edu

Publisher/Director: Laurie McGinnis
Catalyst Editors: Pamela Snopl, Christine Anderson
Contributing Editors: Amy Friebe, Michael McCarthy

Designer: Angela Kronebusch
Photography: Metro Transit, Shutterstock
Freelance Writer: Megan Tsai

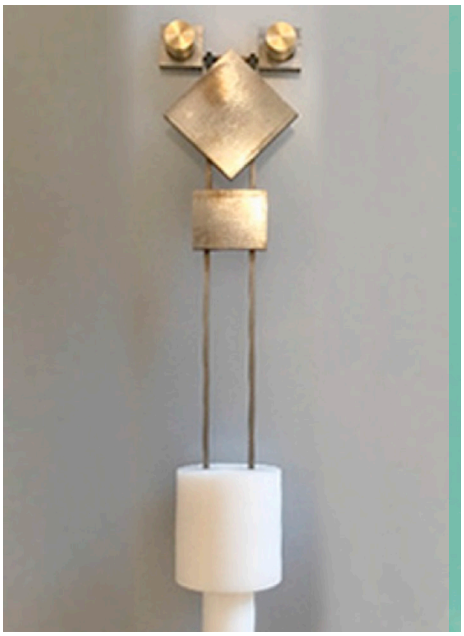
Simple changes to roadway signs can reduce wind-induced vibrations

Trailer trucks with rear extensions to reduce wind drag have become increasingly common on the highway. With the success of these truck-trailer tails, engineers wondered if the concept could help solve the problem of wind-induced vibrations of road signs as well.

Typically, roadside structures must feature breakaway mechanisms to reduce potential injuries to drivers and passengers, which means the support structures can't be stiffened. "This makes heavier signs very susceptible to wind-induced vibrations that potentially cause the support structure, and any attached electric signs, to fail prematurely," says Lauren Linderman, an assistant professor in the Department of Civil, Environmental, and Geo- Engineering (CEGE). In addition, the vibrations may make the signage less visible to drivers.

In a recent project, Linderman led a research team that studied the potential impacts of vibrations on large roadway sign panels, using a MnDOT rural intersection conflict warning sign (RICWS) for analysis. The goal was to understand wind-induced behavior and propose potential sign modifications. MnDOT and the Minnesota Local Road Research Board funded the project.

The researchers focused on two potential modifications. The first modification was the simple removal of the secondary panels behind the flashing yellow lights at the top of the original sign.



A scaled model

"The second idea was motivated by the ability of truck-trailer rear extensions to reduce drag, and involved adding short aerodynamic extensions to the main RICWS panel," says Dominik Schillinger, a CEGE adjunct associate professor on the research team (now a professor at Leibniz University).

To test the effectiveness of these modifications, the researchers used a computational fluid dynamics (CFD) approach that has been used successfully to calculate pressure on complex sign configurations due to wind loading or passing vehicles. In the first step of the project, researchers set up their CFD model of the rural intersection conflict warning sign, built a smaller, scaled model of the sign, and tested it in the wind tunnel at the U of M's Saint Anthony Falls Laboratory (SAFL).

In the next step, researchers used the validated CFD model at the field scale to determine the pressure data for the original sign configuration and added it to their mathematical model. Finally, they conducted an analysis to assess the ability of the new sign configurations to improve the sign's aerodynamic properties.

Based on their analysis, researchers concluded that the modifications to the sign structure were effective. The modifications led to significant reductions of wind drag, turbulent kinetic energy in the wake of the sign, and vibrations of the structure.

"We've taken an important first step toward establishing the use of aerodynamic devices for road sign structures," Linderman says.

"With the research findings and results, MnDOT has made the changes to the geometry of RICWS to reduce the wind-induced dragging force and improve the structure in dynamic resisting properties," says Jihshya J. Lin, MnDOT bridge evaluation and fabrication methods engineer. "This benefits MnDOT in RICWS service life and in safety to the public."

The warning sign in the field

The results of this study open up a number of avenues for future work, including optimizing the shape of the rear extensions for different classes of road sign structures and exploring the aerodynamic and vibration response under different wind conditions and directions.

Others on the research team included co-investigators Catherine French (professor) of CEGE and Michele Guala (assistant professor) with the SAFL Hydraulic Lab.

READ
Catalyst
ONLINE
for links to research reports and other resources.

CTS-funded projects to explore freight, transit, and travel behavior

CTS has awarded seed funding to three new projects that will explore topics across the transportation spectrum, from last-mile delivery to transit electrification to post-pandemic travel behavior.

The seed funding, awarded biennially, aims to help CTS Scholars develop expertise in emerging areas and foster strategic relationships that position them for future funding opportunities.

A project led by Saif Benjaafar, Distinguished McKnight University Professor in the Department of Industrial and Systems Engineering, will focus on developing a data-driven framework for a crowdsourced last-mile delivery system. Many retailers are increasingly relying on this method of delivery to meet the growing challenges of shorter delivery times and higher volumes, but there is limited research on how to effectively design, plan, and operate such a system.

Benjaafar's project will lay out a foundation for the system's design and management, develop data-driven algorithms to support its implementation, and test and validate these algorithms using real-world data from two major online retailers: Target and its affiliate Shipt in the US and JD.com in China. The project's algorithms and models will account for the interaction between customer demand, retailer decisions, and the decisions of independent drivers. Ultimately, they could also be adapted to account for other criteria, such as environmental impacts or labor welfare.

Alireza Khani, assistant professor of civil, environmental, and geo-engineering, will lead a project focused on the transition to electric transit systems. Work will include developing a practical, realistic plan to facilitate an incremental transition to electric vehicles using existing charging infrastructure and the current transit network layout.

As part of the effort, Khani and his team will create long-term infrastructure and fleet replacement plans as well as strategies for short-term decisions, such as bus scheduling or dispatching, that are compatible with the long-term plans. Successful implementation of the project will help transit agencies navigate the transition to an electric system with lower costs and risk, achieve social-environmental benefits such as reducing greenhouse gas emissions, promote transit and clean transportation, and improve public health and social equity.

In another project, Humphrey School professor Yingling Fan will lead a team of researchers exploring the implications of COVID-19 on public transportation and the travel behavior of downtown Minneapolis commuters. The COVID-19 pandemic and widespread social distancing measures have dramatically reduced public transit ridership, and it is unclear how long it will take for transit to recover. This research will aim to collect firsthand data about how downtown Minneapolis commuters make decisions related to travel behavior after the pandemic is largely contained.

Study participants will use a smartphone app that semi-automatically collects daily travel behavior activity and prompts users to answer context-specific questions about how they make various trip decisions—including how their COVID-19 experiences play a role in shaping them. Results will help transportation planners and engineers identify innovative and sensible ways to effectively promote the use of public transportation in the post-pandemic era.

CTS Research Conference is moving online

Due to uncertainty around the COVID-19 pandemic, this year's CTS Transportation Research Conference is moving online. Instead of convening on campus in Minneapolis, we will be hosting the event virtually on November 5, 2020. We'll miss the chance to see our stakeholders in person, but the health and safety of our attendees, speakers, and staff is our top priority.

Please mark your calendars to join us online for a day of learning and engagement on the latest transportation topics. More information, including program details and registration, will be available in August at **cts.umn.edu /events/conference**.

New system improves traffic volume estimates for freeway planning

MnDOT's Regional Transportation Management Center (RTMC) collects traffic data from more than 7,800 vehicle detectors to manage the freeway network in the Twin Cities area. A new system developed by University of Minnesota Duluth (UMD) researchers allows MnDOT to monitor the detectors' health and select those most appropriate for important traffic counts.

The RTMC's traffic data, collected every 30 seconds from in-pavement loop detectors and mounted radar, provides information about freeway volume, occupancy, and vehicle speed. The data has essential uses beyond daily traffic operations. MnDOT's Office of Transportation System Management, especially Traffic Forecasting and Analysis (TFA), uses this information to determine annual average daily traffic (AADT). AADT, along with other statistics, is used for federal reporting, traffic forecasting, and maintenance and safety planning.

Because the information informs so many decisions and plans, it is crucial that the data be accurate. "One of TFA's challenges has been a lack of information about the quality of the loop detector data," says Gene Hicks, TFA director. "Knowing which detectors are producing high-quality data and which may be in need of repair is key to our planning."

In a MnDOT-funded project, Professor Taek Kwon of UMD's Department of Electrical Engineering developed a system that screens loop detector data to allow TFA to generate more accurate estimates of AADT.

Building on previous research that identified faulty detectors, Kwon's team enhanced previously established diagnostic algorithms for this project. The researchers created and implemented a software tool that classifies loop detectors' level of functionality by continuously evaluating detector data from the RTMC.

Diagnostic results are conveyed from the central client-server system running the diagnostic program and database to the computers of individual users. A software tool for users, detHealth_app, translates the data into four easily understood health levels for loop detectors: healthy, tolerable, impaired, or nonfunctional.

"The project's results will enable MnDOT to quickly determine which detectors are providing inaccurate data," Kwon says. "Better detector data will allow more accurate AADT totals and other volume statistics."

Detectors that are categorized as healthy can be specified for vehicle counting program use, providing accurate counts. Detectors classified as tolerable can be used only if no healthy detectors are available in the same location. Impaired or nonfunctional detectors are not used for counting but are instead targeted for maintenance operations.

"This project saves us time in checking traffic sensor health to determine if detectors are working or are in need of repair," Hicks says. "Repairs are now done quickly. The project improves the accuracy of data we use for official traffic volumes."

The system, now operating for the Twin Cities freeway system, also provides many additional categories of information about the detectors.

The project's success led to the expansion of the effort with an additional research project, which is now in progress. The new project will work toward using loop detector data to categorize the types of vehicles passing over the detectors. It will make another area of information easily available to TFA professionals, enhancing their ability to make accurate traffic forecasts and better decisions.

***Transitway** from page 1*

Most previous research focused on the economic impacts to residential, industrial, and commercial properties in station areas, using property value data. "Those studies, however, rarely examined economic gains from transitways at the regional aggregate level," says Professor Yingling Fan, the principal investigator.

The new study had two components:

- A national analysis that assessed the relationship between the amount of transitway service and the overall economic strength of the 100 largest metropolitan areas in the US, as well as impacts on income inequality.
- A comparative analysis of the Minneapolis–Saint Paul metro area, under current and hypothetical future transit conditions, and five other US metro regions. This analysis compared how well these regions provide transit accessibility to regional employment centers, higher educational institutions, and workforce development service providers.

The national analysis found that transitway investment increases regional GDP and job growth.

"The higher the proportion of fixed-guideway transit in a regional network, the higher the GDP and job growth," Fan says. (Fixed-guideway transit is defined as any transit that runs on a dedicated right-of-way, and includes any rail transit as well as bus rapid transit.)

Transitway investment does not, however, measurably change a region's median household income or income inequality. "While a whole region may see growth from transitway investment, we found no direct impact on how income is distributed," Fan says.

The comparative analysis looked at access—not economic effects—at a finer regional scale. The team found that more extensive fixed-guideway transit systems (such as those in the Twin Cities and Denver) not only increase access overall to employment, education, and workforce development opportunities, they also provide more equitable access for people of color and residents of areas with concentrated poverty.

As part of this analysis, the researchers compared the access provided by four potential Twin Cities transitway scenarios: a full build-out of the regional transitway system and three partial build-out scenarios. All four scenarios produced very similar results, they say, likely because all of them involve most of the proposed future system.

"We found that overall accessibility gains, including those for whites, are modest," says Andrew Guthrie, assistant professor with the University of Memphis and a project co-investigator. "The greatest gains go to people of color. Access rates increase between 10 and 15 percent for African Americans and Hispanics. Residents in areas of concentrated poverty see greater gains as well."

The researchers note that accessibility gains for low-income minorities do not necessarily translate to economic gains for these communities, and that low-income minority neighborhoods are often at risk for gentrification. Without proper planning, investment in these areas may not benefit disadvantaged population groups.

"As regions continue their investments, they should understand that transitway development could displace low-income residents," Fan says. "A rising tide may not necessarily lift all boats—or reduce the gap between rowboats and yachts."

"In transit, and especially transit-oriented development (TOD), we strive to increase economic growth and reduce economic disparity," says Lucy Galbraith, TOD director with Metro Transit. "This research shows success in regional growth and challenges us all to do better in helping disadvantaged communities."

Others on the research team were research assistants Noah Wexler, Leoma Van Dort, and Yuxuan Guo of the Humphrey School. The study was sponsored by the Transitway Impacts Research Program.

Cooperative agreements *from page 1*

for Urban & Regional Infrastructure Finance at the Humphrey School of Public Affairs.

"The agreements can add unexpected costs for local governments and limit their ability to address the needs of their own roads," says Jerry Zhirong Zhao, the study's principal investigator. "These agencies should be aware of the risks."

States use a combination of state funding and federal dollars to invest in highways and to provide aid to local governments. As federal and state governments have struggled to keep pace with transportation needs, the share of funding directed to local governments has fallen, Zhao says, but there has been little research on the impacts. His study, funded by MnDOT and the Minnesota Local Road Research Board, helps fill that gap.

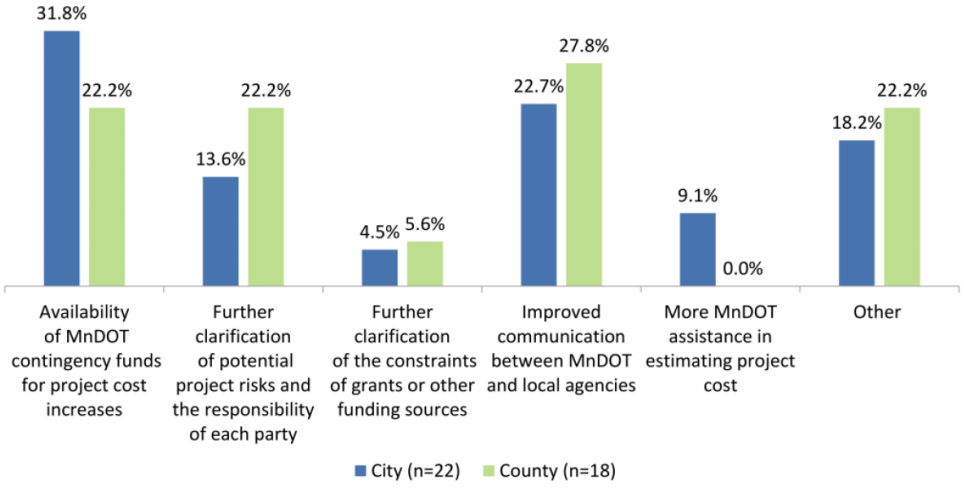
"The results of the research project should be required reading for all local agency project managers who participate in regional highway improvements with a local funding contribution," says Russ Matthys, director of public works for the City of Eagan. "Following the recommendations will limit, if not avoid, the impacts of unintended and costly surprises."

Zhao's research team completed six case studies of cities and counties that engaged in cooperative agreements with MnDOT since 2013 to understand the cost burden on local units of government from cooperative trunk highway projects. The local governments' contributions were mainly for the local match requirements of federal and state funding, intersection expenses, or unexpected increases in project costs.

Of the six cases, four local governments experienced additional financial burdens. Three of them had received state funding through the Corridor Investment Management Strategy (CIMS) program in 2013. "The fixed nature of CIMS grants placed the risk of unexpected costs on the municipalities that received them," Zhao says.

Competitive grants incentivize local governments to make low cost estimates to better compete with other projects. "The outcomes of these cases show the importance of producing conservative project estimates when applying for capped funding," he says.

Based on the case studies, the research team then developed and administered a survey to city and county engineers to better understand the experiences of local government agencies with MnDOT cooperative trunk highway projects. Respondents from a total of 37 counties and 41 cities completed the survey.



Factors that can improve trunk highway cost-sharing agreements

"A few of the respondents experienced additional project costs, mostly due to unexpected project work or much higher-than-expected bids," he says. "Overall, respondents believed that the availability of MnDOT contingency funds for project cost increases and improved communication between MnDOT and local agencies could improve trunk highway cost-sharing agreements."

Based on the findings, Zhao also recommends disclosing project requirements during the planning phase, discussing funding conditions of state funds or grants, and including in contracts the distribution of unexpected costs during the lifetime of the project.

EVENTS CALENDAR

cts.umn.edu/Events

SUBSCRIBE

to email announcements of upcoming events:
cts.umn.edu/Publications/Subscribe

Catalyst

Center for Transportation Studies
University of Minnesota
University Office Plaza, Suite 440
2221 University Avenue S.E.
Minneapolis, MN 55414

Nonprofit Org.
U.S. Postage
PAID
Twin Cities, MN
Permit No. 90155

Catalyst

A publication of the Center for Transportation Studies
University of Minnesota

JULY 2020

Transitway investment leads to higher regional GDP, job growth, and accessibility.

page 1