

# Catalyst



Accelerating the pace of transportation innovation

May 2018

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## Social media can be effective part of public engagement plans

Social media can be effective as a strategic and select part of public engagement plans, according to findings of a U of M study. Co-principal investigators were Professor Ingrid Schneider of the Department of Forest Resources and Associate Professor Kathryn Quick of the Humphrey School of Public Affairs. "Public engagement for transportation planning and programs is not only required, it's a crucial component in policy and project success," Schneider says. "Since 2000, advances in

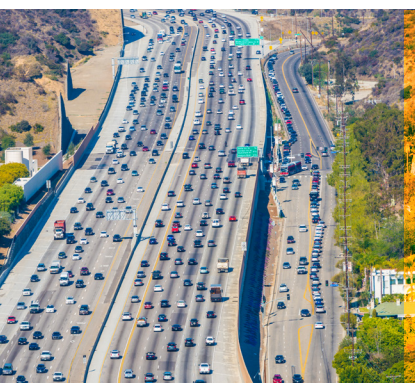
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## Study ranks accessibility to jobs by auto in U.S. cities

Annually updated research from the U's Accessibility Observatory ranks access to jobs by auto for the 50 largest (by population) metropolitan areas in the United States. According to the latest data, the Minneapolis–Saint Paul metropolitan area ranks 10th nationally. The study reports that the average worker traveling by auto in the Twin Cities metro can reach 976,018 jobs within 30 minutes. Total employment in the metro area is 1,745,960 (14th nationally).

The analysis also found that Minneapolis–Saint Paul ranks 26th in lost access to jobs because of traffic congestion. The average worker traveling by auto in the Twin Cities metro can reach 15

*Auto continued on page 7*



# System uses smartphone app to warn drivers of high-risk curves

Lane-departure crashes on curves make up a significant portion of fatal crashes on rural Minnesota roads. To improve safety, solutions are needed to help drivers identify upcoming curves and inform them of a safe speed for navigating the curve.

“Traditionally there are two ways to do this: with either static signage or with dynamic warning signs,” says Brian Davis, a research fellow in the Department of Mechanical Engineering. “However, while signing curves can help, static signage is often disregarded by drivers, and it is not required for roads with low average daily traffic. Dynamic speed signs are very costly, which can be difficult to justify, especially for rural roads with low traffic volumes.”

In a recent project led by Davis, researchers developed a method of achieving dynamic curve warnings while avoiding costly infrastructure-based solutions. To do so, they used in-vehicle technology to display dynamic curve-speed warnings to the driver based on the driver’s real-time behavior and position relative to the curve. The

system uses a smartphone app located in the vehicle to provide the driver with visual and auditory warnings when approaching a potentially hazardous curve at an unsafe speed.

“Highway curves [make up] 19 percent of the total mileage of the paved St. Louis County highway system, yet these curves account for 47 percent of all severe road departure crashes,” says Victor Lund, traffic engineer with St. Louis County. “In-vehicle warnings will be a critical strategy to reduce these crashes.”

To begin their study, researchers designed and tested prototype visual and auditory warning designs to ensure they were non-distracting and effective. This portion of the study included decisions about the best way to visually display the warnings and how and when audio messages should be used. “To create the optimal user experience, we looked at everything from how to order the audio information and when the message should play to the best length for the warning message,” says Nichole Morris, director of the U’s HumanFIRST

Lab and co-investigator of the study.

Next, a controlled field test was conducted to determine whether the system helped reduce curve speeds, pinpoint the best timing for the warnings in relation to the curves, and gather user feedback about the system’s usefulness and trustworthiness. The study was conducted with 24 drivers using the test track at the Minnesota Highway Safety and Research Center in St. Cloud, Minnesota. The selected course allowed drivers to get up to highway speeds and then travel through curves of different radii, enabling researchers to learn how sensitive drivers are to the position of the warnings.

Based on the study results, the system shows both feasibility and promise. “Our in-vehicle dynamic curve warning system was well-liked and trusted by the participants,” Davis says. “We saw an 8 to 10 percent decrease in curve speed when participants were using the system.”

The project was funded by the Minnesota Department of Transportation and the Minnesota Local Road Research Board.



*Participants’ driving perspective*

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# Transportation funding redistribution: data updated, new analyses

U of M researchers updated their datasets and completed a new analysis of transportation funding redistribution in Minnesota. “Unlike local funding, federal and state transportation funding may be collected in one area and redistributed to others,” explains principal investigator Jerry Zhao, associate professor in the Humphrey School of Public Affairs.

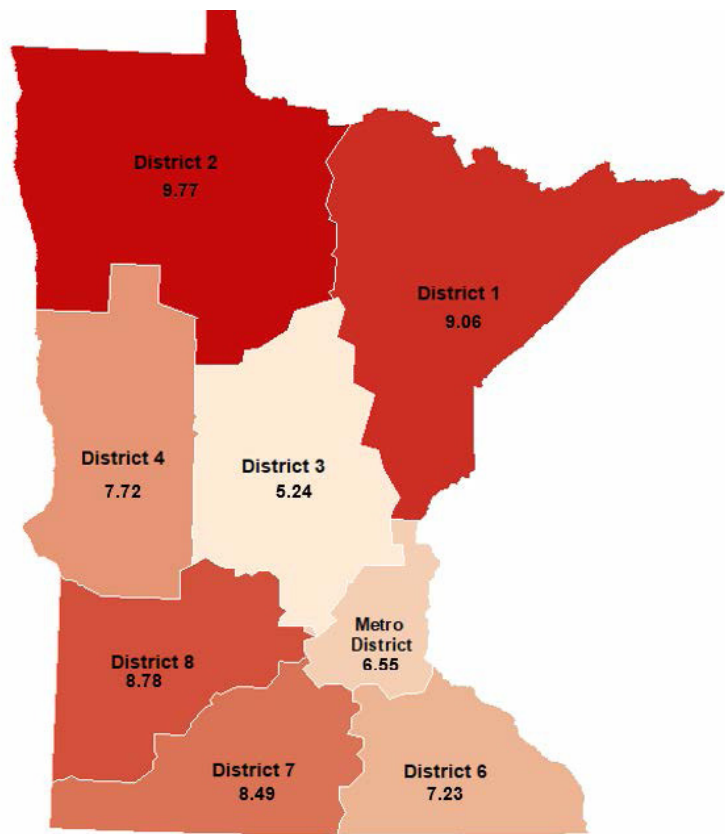
For the six-year period between 2010 and 2015, Zhao’s team found that the Twin Cities Metro district contributed slightly more than it received. “It contributed about 49 percent of federal and state transportation revenues and received about 47 percent back in expenditures,” he says.

A previous study using data from 2009–2014 found that the Metro district contributed about 48 percent of federal and state transportation revenues and received about 51 percent of expenditures (see May 2017 *Catalyst*).

In both six-year periods studied, most districts in Greater Minnesota received more federal and state funding than they contributed. “For example, District 1 and District 2 received more than they contributed, probably due to a much lower population density in these areas,” Zhao says. “District 3, however, contributed more than it received.”

The analysis included three steps. First, the researchers calculated the share of transportation revenues contributed from different localities. Next, they examined the share of federal and state transportation expenditures (i.e., costs such as construction and maintenance) across different localities. Then, they compared the expenditure share and the revenue share for each district to see what areas contribute more than they receive, or vice versa. Findings are presented for both roadway development and public transit.

Others on the research team included Adeel Lari, director of innovative financing in the Humphrey School’s State and Local Policy Program, and Camilla Fonseca Sarmiento, research associate in the U’s Institute of Urban & Regional Infrastructure Finance.



*Cost per vehicle-mile of travel (in cents), 2010–2015*

In an additional analysis, the researchers examined the funding structures for roadways and transit in Minnesota. They found that during 2010–2015, local efforts accounted for about 45.5 percent of total roadway funding in Minnesota. Metro counties had a higher reliance on local efforts—about 56 percent.

For another perspective, the team also assessed the roadway funding structure per vehicle-mile traveled (VMT). “Overall, we calculated an average cost of roughly 7 cents per vehicle-mile traveled in the state,” Zhao says. “Districts in the north of the state had the highest expenditures per VMT.”

The transit structure analysis showed that about 65 percent of public transit expenditures in Minnesota comes from federal and state special revenues. Fare revenue accounted for about 14 percent, while other local efforts accounted for about 21 percent.

One final conclusion: “Overall, we found that local governments fund a significant proportion of

the transportation infrastructure in Minnesota, primarily through the property taxes they collect,” Zhao says.

“This work helps inform the larger discussion on transportation funding in Minnesota by unveiling the questions on who funds transportation and how those resources get distributed across the state,” says Ken Buckeye, pricing program manager with the Minnesota Department of Transportation.

The work was completed as part of the U’s Transportation Policy and Economic Competitiveness Program (TPEC). A paper summarizing the analysis is available on the TPEC website at [tpec.umn.edu](http://tpec.umn.edu).

READ  
**Catalyst**  
ONLINE

for links to research reports and other resources.



## Estimating drivers' behaviors from event recorder data

You could call it *CSI: Crash Scene Investigation*—a new project by U of M researchers sits at the intersection of crash investigation and forensic science.

For more than a decade, the transportation community has recognized that using pre-crash data from event data recorders (EDRs) installed in many passenger vehicles might help illuminate the actions of drivers prior to crashes. Now, that recognition is becoming reality.

"In forensic science, we need to quantify uncertainty," says Gary Davis, a professor in the Department of Civil, Environmental, and Geo- Engineering. "Often, the crime is known but the criminal is unknown. However, when investigating car crashes we have the opposite problem—we know who was driving the cars; the question is whether

there was a crime."

Using data from left-turning crashes where pre-crash data are available from both vehicles, researchers set out to determine whether they could estimate features such as the location and speed of the opposing vehicle at the time of turn initiation and the reaction time of the opposing driver. To do this, they needed to overcome a number of difficulties, including data measurement errors and the fact that EDR data from the two vehicles are not synchronized.

To help overcome the uncertainty, researchers used a probability formula known as Bayes Theorem to assess uncertainty after learning about a crash. Using event recorder data available through a National Highway Traffic Safety Association database, researchers were able to calculate the five characterizing

features of several crash events with a degree of certainty. These crash features included the apparent gap the turning vehicle accepted, the speed of the opposing vehicle, the braking rate of the opposing vehicle, and the opposing driver's reaction time.

In addition to analyzing real-world crashes, researchers tested their calculations with data from instrumented test crashes to confirm that their math was on the mark. "Using the test crash data, we were able to see that our estimates from EDR data seem to be within uncertainty levels," Davis says. "We plan to do more model checking using instrumented test crashes in the near future."

Based on their work so far, researchers believe that crash estimation using EDR data is possible, but say some uncertainties remain. "While the precise characterization of individual events continues to be difficult based on EDR data alone, the statistical analyses of large samples is feasible," Davis says. "As higher resolution data taken at half-second intervals becomes more widely available, that should also allow us to be more precise."

The research was funded by the U's Roadway Safety Institute. A seminar of Davis discussing the project is online at [roadwaysafety.umn.edu](http://roadwaysafety.umn.edu).



## CTS hosts next generation of women in transportation

In April, CTS introduced a group of high school girls to transportation-related research and education opportunities at the U of M.

The visit was organized by TransportationYOU, a mentoring program of the Minnesota Chapter of the Women's Transportation Seminar (WTS) that encourages girls ages 13–18 to pursue transportation careers.

During their visit, 11 students from

Blaine High School and 4 students from Wellstone International High School got a tour of the HumanFIRST Laboratory from lab director Nichole Morris and heard a presentation on automated vehicles from Humphrey School professor Yingling Fan. Other activities included a campus walking tour and an admissions information session. Students also had lunch with U of M student members of the Society of Women

Engineers and the student chapter of the American Society of Civil Engineers.

The day wrapped up with a transportation research activity on the Washington Avenue Transit/Bike/Pedestrian Mall. Working in groups, the students observed activity on the street, looking for problems or potential problems and identifying strategies for improving the flow or user experience of pedestrians and cyclists on the mall.

# New system determines road recovery time during snow events

Researchers at the University of Minnesota Duluth (UMD) are developing a system that uses highway loop detector traffic flow and weather data to determine when road conditions have recovered from a snow event. Currently, the Minnesota Department of Transportation (MnDOT) relies on snowplow drivers to estimate when roads are back to normal. The new system aims to relieve drivers of that burden and increase overall fleet efficiency.

In two previous MnDOT-funded projects, UMD researchers looked at using data from loop detectors along with weather station data to develop an automated system that determines normal condition regain time (NCRT) based on changes in traffic flow patterns. The goal is to improve the accuracy of road condition estimates and give dispatchers a big-picture view of traffic flow.

“This is a shift to different criteria,” says John Bieniek, Metro District maintenance operations engineer at MnDOT. “The bare lane regain time is now based on judgments from plow operators on the highways and phone calls to dispatchers. We could use the new system to quickly direct trucks to harder-hit areas within and between stations as they are needed.”

The latest project, led by UMD civil engineering professor Eil Kwon, transformed a previously developed



computer model into a user-friendly, integrated computer system. The system includes a data management module, a module for target detector station identification and speed recovery function, an NCRT estimation module, and a map-based user interface that allows dispatchers to generate the estimated NCRT for a specified area. Dispatchers and supervisors can also use the interface to assess traffic flow variations, assign plows, and generate reports for past snow events.

The team tested the new integrated system on data gathered from I-494 and I-694 during two snow events in 2015 and 2016. Results show the system was able to successfully generate NCRTs that met or exceeded the accuracy of estimates by maintenance personnel.

“The system developed in this research can provide consistent and objective estimates of the NCRT by utilizing the traffic flow data that are

currently available from the existing detection systems in the metro area,” Kwon says.

Another goal of the project was determining a data-derived definition of normal traffic flow for snow-cleared roadways. As part of this effort, researchers found that traffic resumed free-flow conditions after roads were cleared, but always at a slightly slower speed than on normal, dry roads. Researchers then developed a process to determine the “wet-normal” free-flow speed at each detector station based on the traffic flow pattern during a given snow event.

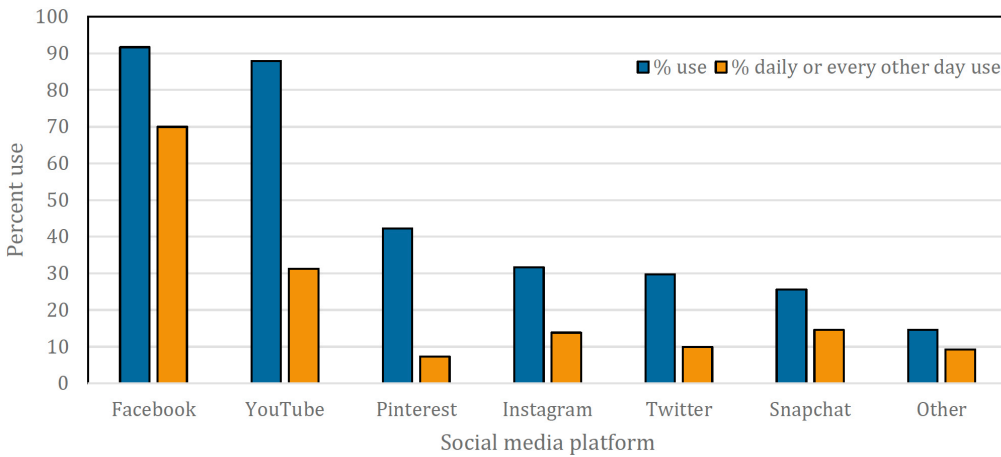
So far, the system has only been used with data from past snow events and has not generated results in real time. Going forward, MnDOT plans to fund additional work that will incorporate big data tools to allow the system to operate in real time—as storms happen—to improve roadway snow operations.



*Students visited the HumanFIRST Lab (left) and went on a walking tour of the U of M campus (right).*



**Social media from page 1**



*Percent of overall platform use and daily or every other day platform use among Minnesota State Survey 2016 social media users*

technology and communications provide opportunities to engage with more people in new ways.”

The multipronged, multiyear project investigated current knowledge about public engagement through social media nationwide and in Minnesota. It also developed guidance about how social media may be used to reach and engage diverse populations in the state about transportation planning and projects.

For the analysis, the team used multiple methods: a literature review, telephone interviews, and four case studies. “The literature review indicated social media needs to be part of a multipronged engagement plan,” Schneider says. “While 90 percent of U.S. adults are online and 69 percent use social media, a social-media-only plan may not reach people over the age of 65 or with a high school education only. Platform use also varies considerably: African Americans and Latinos, for example, use video-sharing more than other groups.”

Phone interviews of more than 800 Minnesotans found that 72 percent use social media, and 11 to 21 percent participated in some way in planning transportation programs, policies, and projects in the previous year. In addition, 36 percent expressed interest in using social media to get information, provide feedback, or make suggestions related to transportation programs, policy, and

planning.

The case studies compared pairs of transportation projects in Minnesota: two with significant social media use (Richfield, Red Wing), and two with low use (Saint Paul, Detroit Lakes). Findings revealed that the two projects with higher levels of social media had more connections with stakeholders. The quality and effectiveness of those connections, however, varied. “Government social media primarily informed audiences, while community-created pages fostered deeper engagement and dialogue,” Quick says. “In addition, the quality of social media, and their combination with other outreach technologies, influenced stakeholders’ perceptions of the engagement efforts.”

The project was funded by the Minnesota Department of Transportation (MnDOT) and the Minnesota Local

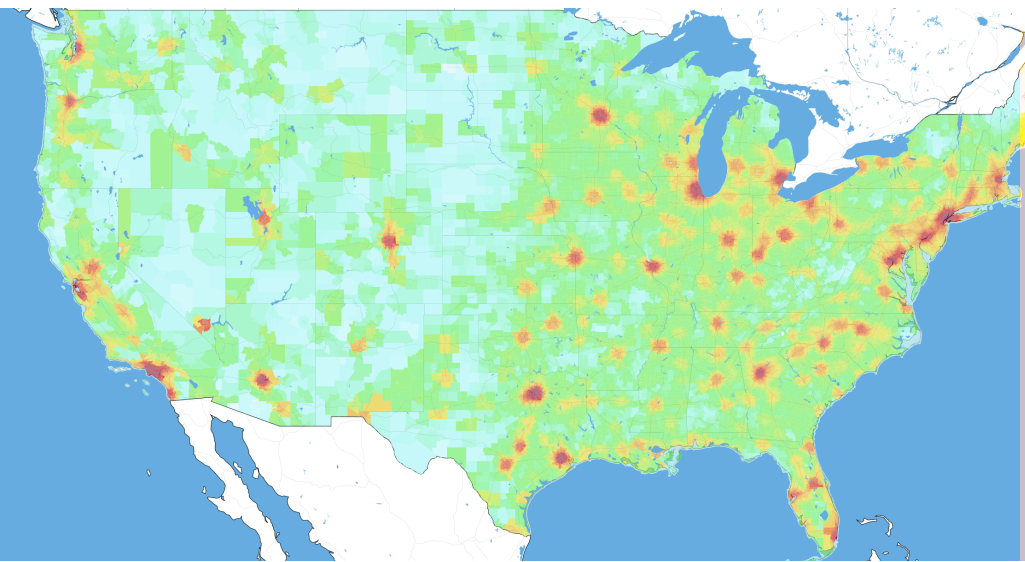
**NATIONWIDE,**  
**90%**  
**of adults are online and**  
**69%**  
**use social media.**

Road Research Board (LRRB). “MnDOT and LRRB are committed to listening to and learning from the public,” says Renee Raduenz, MnDOT market research manager. “Social media provides a unique, efficient, and potentially inclusive tool in those efforts. This research brings us one step closer to understanding how we can maximize the power of social media to its fullest.”

Taken as a whole, the findings suggest at least four main opportunities to strengthen meaningful social media engagement:

- Integrate social media into multipronged, dynamic engagement approaches. Pay attention and contribute to community-created social media pages, and provide a regular diet of new information and updates.
- Consider the demographic qualities of the key stakeholders to determine how social media can be most useful.
- Employ best practices for social media management, such as using hashtags to organize data, posting dynamic content (project videos, live streams), and clearly stating social media guidelines.
- Expand and/or develop research and evaluation plans to understand and assess future social media engagement efforts.

**72%**  
**OF MINNESOTANS**  
**surveyed use**  
**social media, with**  
**92%**  
**on Facebook and**  
**88%**  
**on YouTube.**



### Accessibility to jobs by auto

percent fewer jobs within 30 minutes during congested periods.

“This suggests that job accessibility is influenced less by congestion here than in other cities,” explains Andrew Owen, director of the Observatory. “Rather than focusing on how congestion affects individual travelers, our approach quantifies the overall impact that congestion has on the potential for interaction within urban areas.”

The new rankings are part of the Access Across America study, which began in 2013. The rankings focus on accessibility, a measure that examines both land use and transportation systems. Accessibility measures how many destinations, such as jobs, can be reached in a given time.

“The Auto 2016 report provides baseline data for annual comparisons of accessibility change, both by the zone/

block level and as an overall value for the region,” says Deanna Belden, director of performance, risk, and investment analysis with the MnDOT Office of Transportation System Management. “Certain areas with completion of large construction projects will be worth watching in the next couple of years, such as I-35W in Minneapolis, I-694 in Shoreview/Arden Hills, and Highway 610, among others.”

This year’s report—*Access Across America: Auto 2016*—presents detailed accessibility and congestion impact values for each of the 50 metropolitan areas, as well as detailed block-level maps that illustrate the spatial patterns of accessibility within each area.

The research is sponsored by the National Accessibility Evaluation Pooled-Fund Study, a multiyear effort led by MnDOT and supported by

partners including the Federal Highway Administration and 10 additional state DOTs.

The Auto 2016 report and other Access Across America research reports for transit, walking, and soon, biking, are available at [access.umn.edu](http://access.umn.edu).

### Top 10 metro areas for job accessibility by auto

1. New York
2. Los Angeles
3. Dallas
4. Chicago
5. San Jose
6. Houston
7. San Francisco
8. Washington, DC
9. Phoenix
10. Minneapolis–Saint Paul

### Top 10 metro areas for loss in job accessibility due to congestion

1. Los Angeles
  2. Riverside
  3. San Francisco
  4. New York
  5. Boston
  6. Chicago
  7. San Jose
  8. Washington, DC
  9. Atlanta
  10. Seattle
- 
26. Minneapolis–Saint Paul

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