University of Minnesota

CENTER FOR TRANSPORTATION STUDIES

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Accelerating the pace of transportation innovation

Exploring Nice Ride job accessibility and station choice

Although bike share systems are becoming more popular across the United States, little is known about how people make decisions when integrating these systems into their daily travel. For example, when more than one bike share station is located nearby, how do users choose where to begin their trip, and what factors affect their decision?

In a study funded by CTS, researchers from the U of M's civil engineering department sought to answer this question by investigating how people use the Nice Ride bike share system in

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Do streetcars support commercial development?

New Orleans results say yes

New streetcar lines are in the planning stages in Minneapolis and St. Paul. Proponents cite not only the lines' ability to strengthen the transit system, but also their potential as catalysts for development. Estimating the impacts of streetcars is challenging, however, as most U.S. lines operate in downtown areas with many interrelated factors at play. A recent U of M research project examined the issue through the prism of one city's experience: post-Katrina New Orleans.

The team—research fellow Andrew Guthrie and Assistant Professor Yingling Fan of the Humphrey School of Public Affairs—analyzed building permits near streetcar stops in

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Driver-assist systems: Could they make crashes a thing of the past?

In the not-too-distant future, your car will warn you if you're getting drowsy, remember where potholes are on your route home, and apply the brakes at intersections. Advanced driver-assist systems combined with "big data" are moving us quickly to this day—offering the possibility to greatly reduce crashes or even make them a thing of the past.

At the CTS Fall Luncheon on December 3, Luca Delgrossi, the director of driver assistance and chassis systems at Mercedes-Benz Research & Development North America, gave his perspective of where we stand today, what's in development, and when to expect it on the road.

Traditional safety systems, such as seat belts and air bags, work to minimize the effects of crashes. The next generation, Delgrossi said, focuses on preventing crashes altogether. Systems fall into two categories: those that inform the driver, and those that also act when danger is present.

This next generation is possible because of a richer set of sensors covering a broader space around the car, he explained, as well as new actuators that can control the vehicle. Sophisticated in-car networks exchange data from one component to another, creating more powerful systems as well as system redundancy for reliability.

New Mercedes vehicles already come equipped with such technologies: steering-assist for lane keeping, for example, and brake-assist to avoid rear-enders. "A little bit of the future is already here today," Delgrossi said.

There are many other opportunities to help drivers who are distracted or facing a complex situation. One system, for example, would help drivers stay awake during long trips. It builds a profile from data collected in the first 20 minutes; during the rest of the trip, it checks to see if the driver is deviating from this pattern—and if so, gives an alert to take a break. "We want to introduce automation every time it protects the driver," he said.

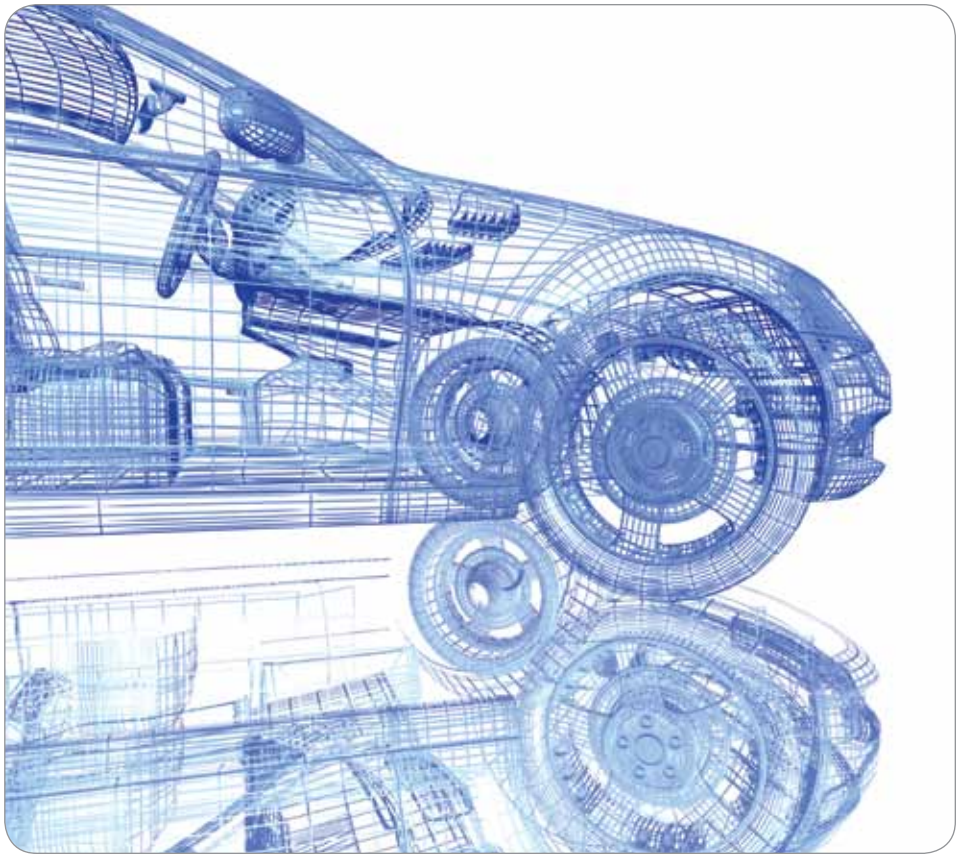
Ultimately, the goal is to avoid crashes by allowing cars to take more and more control. "Hands-off driving is coming. Eyes-off is the next step—a big, big step," Delgrossi said. "We need to bring technology to perfection to do this. That's what the industry is working on. We will see progress in the next five to seven years."

Delgrossi also touched on the potential for vehicles to share data with each other, such as warnings of icy roads ahead. If these systems include data from roadway infrastructure as well, even more benefits are possible: cars could automatically brake for red lights, for example.

An offshoot of this is vehicle platooning: linked groups of vehicles acting like train cars without the tracks. The concept is being tested in Europe, and start-up companies in California have shown it's feasible on a small scale. "They believe platooning can lead to new business models," he said. Users could pay for miles in a platoon, similar to buying a ticket for a transit ride.

In closing, Delgrossi described Mercedes' successful test of an autonomous vehicle last summer. The car, a production vehicle with additional sensors, drove 103 km through densely populated areas—including 53 km in towns, and through hundreds of crossings. "This was the first vehicle to complete the route autonomously," he said. "It proved autonomous driving is possible today, not just in test tracks but in everyday driving. It marks a breakthrough in a new era of individual mobility."

A video of his presentation is archived on the CTS website.



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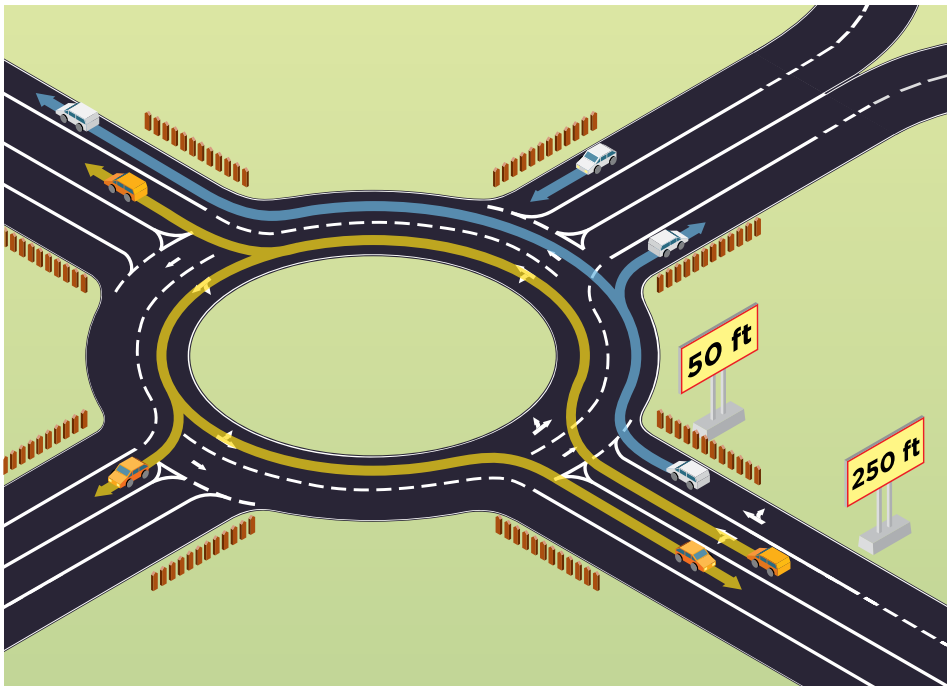
Roundabout study provides guidance for improving safety

Roundabouts are a fairly recent addition to the road system in the United States, and their relative newness has made them a topic of discussion and debate. While roundabouts dramatically reduce the incidence of fatal and severe-injury crashes compared to traditional signalized intersections, drivers continue to misunderstand the rules of the roundabout, resulting in improper use and avoidable collisions.

In a study funded by the Minnesota Local Road Research Board, researchers in the Minnesota Traffic Observatory (MTO) at the U of M examined driving behavior and safety before and after signing and striping changes were applied at a two-lane roundabout in Richfield, Minnesota.

This roundabout, built in 2008, exhibited an abnormal number of crashes after its completion. In response, local engineers experimented with changes in the roundabout's signs and striping. Researchers led by MTO director John Hourdos analyzed crash records and examined hundreds of hours of video to compare the crash rates and number of violations committed by drivers before and after the changes.

The findings indicate that the changes in signing and striping have made the Richfield roundabout safer. In particular, extending the solid line leading up to the intersection approach from 50 feet to 250 feet seems to have reinforced the message to drivers that they must select the correct lane before approaching the roundabout entrance.



Extending solid-line striping from 50 to 250 feet before a roundabout helps drivers choose and remain in the correct lane.

Immediately after the striping changes,
INCORRECT LANE CHOICES FELL BY
53 PERCENT.

This reduces the occurrence of drivers turning improperly and the need for a driver to change lanes within the roundabout.

Another important finding was that the traditional fish-hook-style roundabout signs and complex striping patterns often cause confusion among drivers. "Getting rid of the fish-hook signs and simplifying the striping really made a difference," says Richfield city engineer Kristin Asher. "Our biggest problem before the restripe was left turns from the outside lane causing conflicts and crashes. Once the fish-hook signs were replaced with traditional lane designation signs and the skips were removed from the circulatory lanes, those crashes essentially disappeared."

Prior to the changes, left turns from the outer lane accounted for 45 percent of the recorded crashes. Immediately after the changes, the occurrence

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Research persuades residents of roundabout safety

Because roundabouts are relatively new to the United States, engineers and project designers are often faced with the challenge of persuading a skeptical public at the start of new roundabout projects. That's exactly what happened when a new roundabout was planned on a local thoroughfare in Woodbury, Minnesota. "There was a very engaged neighborhood group near the intersection, and they were concerned that children couldn't cross the roundabout on foot and that it would cut off their access to local parks," says Bill Klingbeil, an engineer with the project's design firm HR Green.

When project designers spoke with the opponents, they learned that very few of them had actually crossed a roundabout. To counter their concerns, Klingbeil shared the results of a bike and pedestrian roundabout study conducted by MTO researchers (read about the project in the November 2012 *Catalyst*). "In this study, more than 3,000 people safely crossed a roundabout even busier than the one we were planning with no close calls or accidents," says Klingbeil. "The project opponents had a strong opinion on something they had never experienced, and this research helped persuade them that roundabouts are safe for pedestrians."

Vehicle sharing in Minnesota: identifying barriers and solutions

For people without access to or the ability to use public transit or a personal vehicle, the transportation services provided by community and social service organizations are essential to their mobility. These organizations, also called human services providers (HSPs), often provide transportation to seniors, individuals with disabilities, those with low incomes, and others as part of their overall missions.

Vehicle sharing can be an important tool for HSPs that provide these transportation services. Vehicle-sharing arrangements, which involve independent organizations sharing the same private transportation resources, can allow HSPs to save money and expand their services. However, in spite of its benefits, vehicle sharing is an underused resource.

In an effort to understand why more vehicle sharing isn't taking place among Minnesota HSPs, researchers from the Humphrey School of Public Affairs investigated the most common barriers to vehicle sharing. Research fellow Frank Douma and research assistant Thomas Garry also identified solutions that could help address these barriers and promote more widespread use of vehicle sharing. The study was funded by the Minnesota Council on Transportation Access.

The study examined barriers related to two common forms of vehicle sharing: time sharing (when two or more HSPs operate the same vehicle at different times) and ride sharing (when one organization transports the clients of another organization).

The researchers identified the following five factors as the most common barriers to vehicle sharing in Minnesota:

- Acquiring information on the mechanics of vehicle sharing can be too costly for individual HSPs.
- There is no available forum for HSPs to share information about their resources and needs, which makes it difficult to identify potential sharing opportunities.
- In time-sharing arrangements, each HSP must individually comply with state safety regulations. Some HSPs may not have the resources or expertise to justify the effort required to ensure compliance.
- Ride-sharing arrangements may make HSPs subject to a different set of state safety regulations, creating potential additional risks related to understanding and complying with new rules.
- HSPs that want to share vehicles can encounter vehicle insurance policy terms or prohibitively expensive premiums that discourage or prevent vehicle sharing.

Most of these barriers are related to the high cost of acquiring information about vehicle sharing. Therefore, the researchers suggest that lowering these costs is the most important step to increase sharing arrangements. This can be accomplished through more education and outreach efforts that involve state and local government agencies as well as the HSP community. Suggested efforts include providing user-friendly guidance documents and training on the "how to" of vehicle sharing, creating a website or structured forum allowing HSPs to share information, and collecting data about vehicle-sharing opportunities among HSPs.

As part of their final report, the researchers also highlighted a few organizations that are already successfully engaged in vehicle sharing.

One example is DARTS, a nonprofit community service organization in Dakota County that is involved in several time-sharing arrangements. For instance, DARTS shares one bus with the City of Farmington and two local churches; because of the sharing arrangement, the bus is used to provide service seven days a week.

"This arrangement epitomizes the objective of vehicle sharing," Douma says. "It maximizes the use of existing resources to expand services to those in need."

Because transportation services are a core part of the DARTS mission, its staff has the necessary expertise to arrange and participate in vehicle sharing, which makes it an exception among most Minnesota HSPs. However, it also suggests that successful vehicle sharing is possible for organizations without these resources if information and technical barriers to sharing are removed.

Photo courtesy DARTS

Researchers help organizations optimize transportation routing decisions

Large paratransit operations offering transportation services to those in need often use expensive, sophisticated software packages to make vehicle routing decisions on a daily basis. However, these resources are typically not available to smaller, nonprofit disability service organizations. These smaller organizations must make complex routing and assignment decisions manually—an often time-consuming and inefficient process.

In an effort to help these smaller organizations, researchers in the U's industrial and systems engineering department have developed an algorithm to improve vehicle routing and passenger assignments. Led by Assistant Professor John Gunnar Carlsson and funded by CTS, the study aimed to reduce the number of routes needed to serve all of an organization's passengers while also minimizing inconvenience to these users.

The algorithm was developed and tested using data from two community disability service organizations in St. Paul. The algorithm creates a set of minimum-cost vehicle routes capable of accommodating as many users as possible. It also considers the diverse range of vehicles available and passengers served, multiple destinations, and time constraints, including pickup and drop-off windows and limits on total travel time for passengers.

Test results show that using the algorithm resulted in a more than 12 percent improvement over existing manual routing and assignment solutions. The algorithm's solution included 64 routes that could serve 574 passengers using 53 vehicles. In addition, the algorithm took less than 10 minutes to create routes and assignments based on the data—much less time than it would take staff to make manual decisions.

Additional research is needed to tune and optimize the algorithm's parameters, but the researchers say the algorithm could eventually be integrated into a user-friendly computer application organizations could use to make routing decisions on a daily basis.

Minnesota's Transportation Conference

March 4–6, 2014
Bloomington, MN

Registration is now open for this new three-day conference, which will highlight the latest innovations in transportation from around Minnesota. Network with stakeholders from all sectors of transportation and hear about new implementation and research efforts in a variety of modes at one of the largest transportation events in the state.

Learn more at **mntransportationconference.org**.

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of improper turns decreased by 48 percent and incorrect lane choice was reduced by 53 percent. One year after the changes, the safety improvements were still significant: the occurrence of improper turns was still down 44 percent and incorrect lane choice was reduced 50 percent compared to the "before" scenario.

To improve safety and decrease driver confusion, Hourdos says it may be necessary to look beyond the current design guidelines for roundabout markings, which are still relatively immature. For example, there is no specific guideline in the *Manual on Uniform Traffic Control Devices* for the length of the solid line between lanes at roundabout entrances. This research indicates that extending the solid line improves safety by helping drivers select the correct lane. "This is an area where improvements can be made to the current guidelines," he says.

A research brief summarizing MTO roundabout research—*Safety and Risk in Modern Urban Roundabouts*—is on the CTS website.

Researchers studied this roundabout in Richfield, Minnesota.

READ CATALYST ONLINE

for links to research reports and other resources.

Nice Ride from page 1

Minneapolis and St. Paul. Professor David Levinson and graduate student Jessica Schoner examined how Nice Ride affects accessibility to jobs and developed a model to predict station choice.

In the first part of the study, the researchers created maps showing accessibility to jobs by census block for both Nice Ride and walking—as well as the difference between the two—at time thresholds ranging from 5 to 55 minutes. At lower thresholds, fewer census blocks have job accessibility via Nice Ride because of the time it takes for a person to walk to the Nice Ride station. However, at higher time thresholds, Nice Ride provides an improvement over walking. Overall, in blocks with both Nice Ride and walking job accessibility, Nice Ride provides access to 0.5 to 3.21 times as many jobs as walking.

By comparing Nice Ride to walking, the study demonstrated that walking can successfully be used as a baseline to show how a bike share system improves job accessibility. The results also pinpointed when and where Nice Ride had the strongest accessibility advantage over walking.

"This type of information can be used by bike share system planners to identify where new stations could be built to maximize their impact on job accessibility," Schoner says. "They could also look at accessibility to other destinations, like parks, grocery stores, or tourist attractions, depending on the goals of their system."

Levinson and Schoner also developed a theoretical model for bike share station choice. The model considers users' choice of a station based on their preference for the amount of time spent walking, deviation from the shortest path (the closest station may not be in the direct path of the person's destination), and station amenities and neighborhood characteristics.

Findings show that people generally prefer to use stations that don't require long detours to reach, but a station's surroundings also play an important role. For example, stations located near a park and in neighborhoods with lower crime rates were more likely to be chosen as the starting point of a bike share trip. Results also show that commuters value shorter trips and tend to choose stations that minimize overall travel time, while users making non-work-related trips choose stations that allow them to spend more of their time biking, even if the total travel time is longer.

Understanding people's station preference can help provide guidance to planners for bike share system expansion, densification, and optimization, Schoner says.

"For instance, even though spacing stations along a route would allow people to walk in the direction of their destination to pick up a bike, people's strong preference to spend more time biking indicates that clustering stations near where they are starting and ending their trips might make more sense," Schoner says.

In 2013, Nice Ride operated

170

STATIONS

with about

1,550

TOTAL BIKES

in Minneapolis and St. Paul.

NEW RESEARCH REPORTS

Recently published reports on transportation-related research at the University of Minnesota explore the following topics:

FRICTION MEASUREMENT SYSTEM
(MnDOT 2013-26)

OPTIMUM MOISTURE FOR SOIL COMPACTION
(MnDOT 2013-28)

IMPLEMENTING PAVEMENT EVALUATION TOOLS
(MnDOT 2013-29)

Research reports are available at **cts.umn.edu/Publications/ResearchReports**.

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the downtown business district and in several urban neighborhoods. "Hurricane Katrina allowed—or required—more redevelopment to occur at a faster pace than normal, potentially allowing existing streetcar lines' latent development impacts to appear," Guthrie says. "This created an unfortunate yet rare opportunity for study."

The researchers estimated how the frequency of commercial and residential permits changed with distance from streetcar stops, controlling for hurricane damage, proximity to existing commercial areas, and pre-Katrina demographics. The streetcar system at the time of data collection (2005–2008) included three lines totaling roughly 12 route-miles, including the central business district, several residential neighborhoods, two universities, and the French Quarter riverfront. (New Orleans has since chosen to expand its streetcar network.)

They found that throughout the system, building permits strongly reflect the distance to stops—and that commercial and residential permits move in opposite directions within the first 750 feet. "Commercial permits clearly decline the further away a location is from a streetcar stop," Guthrie says. Downtown commercial permits fell about 20 percent with each 100-foot increase from a streetcar stop. In the residential areas, commercial permits showed some variation depending on neighborhood characteristics, falling 5.6 percent per 100-foot increase in one precinct, for example, and almost 20 percent in another.

In contrast, the number of neighborhood residential permits rose about 24 percent with every 100 feet from a stop. "These trends suggest that commercial uses may have outbid residential uses in the immediate areas near streetcar stops in residential neighborhoods," Guthrie says. "The result is a diversity of land uses near stops."

Based on their results, Guthrie and Fan conclude that traditional streetcar lines can help increase commercial development not just in downtown business districts, but in other urban areas as well.

The findings also indicate that streetcars shape development in urban neighborhoods in a fundamentally different fashion than light rail. "Streetcars appear to have impacts that are less intense at each stop, but because they run on continuous corridors with close stops, they act on large geographical areas," Guthrie explains. "In the right neighborhoods, streetcars may be capable of similar or even larger overall impacts than light rail."

The researchers caution that New Orleans is a unique city, and Hurricane Katrina a unique event, so applying the findings to other cities or corridors would require consideration of similarities with and differences from the study area.

The full research paper is in the *Journal of Planning Education and Research*, **http://jpe.sagepub.com**.

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