Researchers at the U of M’s Accessibility Observatory have developed new methods for assessing accessibility to jobs by transit in the Twin Cities metro area.

The multi-stage study, sponsored by the Minnesota Department of Transportation (MnDOT) and supervised by Observatory director Andrew Owen, focused on accounting for the effects of managed lanes and park-and-ride (PNR) facilities in transit accessibility measures.

*By incorporating new elements of the transportation network into our calculations, we improve*
A transitway trip is more than just the leg spent on light rail or bus rapid transit (BRT). It also includes the modes used to reach transitway stations, such as local buses, walking, and biking. Transit planners need to understand how the connections between modes affect ridership as they plan network changes and expansions.

A recent U of M project helps fill this information need. “We explored how Twin Cities transit users choose to reach transitway stations, and how they choose their paths through the transit system itself,” says Professor Yingling Fan of the Humphrey School of Public Affairs, the principal investigator.

Plans for the Twin Cities transitway system include extending existing light-rail lines and adding new BRT lines. Some new lines will lead to new right-of-way acquisition and the potential for development around station areas, which in turn could shape the types of modes used to access the system.

“This research provides important perspectives on the customer value of transitway connections by mode, informing effective transit planning to transitways,” says Adam Harrington, director of service development with Metro Transit.

For their work, researchers used mode choice modeling to investigate how Twin Cities riders plan their access to transitway stations. Mode choices considered were walking, regular bus, driving, drop-off, biking, and taxi or transportation network company (e.g., Uber or Lyft).

They found that transitway riders consistently choose their access mode based on distance and time and that the overwhelming majority of transitway users walk to a station. “We also found that women are more likely to view biking negatively than men do,” says Alireza Khani, an assistant professor in the Department of Civil, Environmental, and Geo-Engineering and the study’s co-investigator. “This may indicate barriers to bike usage compared to other modes.”

In addition, women participants viewed driving more positively than men did.

Then, the research team combined several algorithms to analyze how riders choose the path they take during their transit trip—the shortest path, a perceived shortest path, or neither. “We found that users primarily choose the path that minimizes their total travel time, which, in most cases, is the same as the fewest transfers,” Khani says. “We also found few back-up options if one path is unavailable.”

In addition to these Twin Cities-based analyses, the research team carried out a ridership analysis using data from 341 transitway stations at 16 designated peer regions across the United States. This analysis focused on estimating how the quality of bus, bicycle, and pedestrian connections to transitways affect station-level ridership.

“One finding stands out: higher-quality bus connections at transitway stations produce higher ridership at those stations,” Fan says. “A high-amenity bus transit center attracts more riders, for example, than a curbside connection a block or two away.” The study could not determine if better bike or pedestrian connections would create more transit trips due to a lack of nationally consistent data, she adds.

Recommendations from the research team include:

• Locate new transitway stations so that they intersect corridors with high transit demand and high levels of connecting bus service.
• Plan local bus service to provide convenient, direct service to transitway stations.
• Improve walkability to transitway stations, and improve bike access and infrastructure.
• Develop detailed, accurate, standardized data on pedestrian and bicycle systems.

The study was sponsored by the Transitway Impacts Research Program.

Boardings at a station

INCREASE 20%
for each additional square mile reachable by bus
from that station on an average weekday.
In Minnesota, lane departures and run-off-the-road crashes cause more fatalities and serious injuries than any other crash type. To help address this safety challenge, U of M researchers have developed an innovative, cost-effective way to deliver a high-accuracy lane-departure and curve warning system. With further development, researchers believe the system could save lives by alerting drivers about lane drift and approaching curves to prevent lane- and road-departure crashes.

“Many current warning technologies rely on cameras that identify lane position based on pavement markings, but these systems are expensive, typically limited to new luxury vehicles, and unreliable in inclement weather or locations where markings aren’t easily visible,” says Imran Hayee, a professor with the University of Minnesota Duluth’s Department of Electrical Engineering and the project’s principal investigator. “Other warning systems rely on the costly combination of lane-level roadway mapping data and high-level GPS, which can be accurate to the centimeter level but has restricted access.”

In this project, funded by the Minnesota Local Road Research Board and the Minnesota Department of Transportation, the research team sought to develop a camera-free curve and lane-departure warning system that uses consumer-level GPS without reliance on sophisticated, expensive digital maps.

To achieve their goal, researchers first developed an algorithm for safe driving on straight roads. Next, they used road-level data from a publicly available digital mapping platform to identify navigational points along curves and develop the curve lane-departure warning system. Finally, researchers brought the two stages together with a warning system that identifies vehicle speed, curvature characteristics, and safe speed limits, then calculates distance for driver response times to issue an audible warning for lane drift and a text warning to indicate when and how much to reduce speed as the vehicle approaches a curve.

In road testing, researchers found that the proposed system can detect a true lane departure with an accuracy of almost 100 percent; the system issued audio warnings for every one of the approximately 200 lane changes. For curve warnings, the system scanned for curves at least a half-mile ahead and issued a timely text warning of the curve ahead and an advisory speed limit. False alarms—warnings issued when the vehicle was not departing its lane—occurred in just 10 percent of the tests. Further adjustment of the algorithm and additional testing reduced false alarms significantly as the system accumulated data over multiple uses on the same roadway.

“The goal of the project is to reduce lane-departure crashes,” says Victor Lund, traffic engineer for Minnesota’s St. Louis County and the project’s technical liaison. “We viewed this as a seed project and demonstrated that the system can be successful.”

“From a technical point of view, this approach works,” adds Hayee. “We developed a warning system with standard GPS that everyone has in a phone or vehicle. In a sense, this is a lifesaving technology.”

Investigators have filed a patent for the technology and will continue to develop and refine the system. In the future, the research team hopes to adapt the new technology to a consumer-level device or a smartphone app for use in any vehicle.
“This study is an important early step in the Minnesota Department of Transportation’s Advancing Transportation Equity Initiative to understand how the transportation system, services, and decision-making processes help or hinder people in underserved and underrepresented communities in Minnesota,” says Hally Turner, planning program coordinator with MnDOT’s Office of Transportation System Management.

The underserved and underrepresented include low-income neighborhoods, communities of color, indigenous communities, rural residents, older adults, people with disabilities, women and youth, and people with limited car access.

Gina Baas, CTS associate director, engagement and education, was the principal investigator. The research team included co-investigator Yingling Fan (professor) and Leoma Van Dort (research assistant) of the Humphrey School of Public Affairs and co-investigator Andrew Guthrie (former Humphrey School research fellow, now assistant professor with the University of Memphis). MnDOT funded the study.

The researchers began by examining current research and practice in the field of transportation equity. They found that societal-level structural inequities cause specific population groups to face disproportionate transportation barriers.

“Some of these structural inequities, such as racialized spatial segregation in metropolitan areas and auto-dependent development patterns, are built into the very fabric of our communities,” Fan says. “The user-pay principle that governs the current transportation finance system is viewed as another inequity, as it does not take into account users’ ability to pay.”

Building on their review, the researchers then explored 24 programs from across the United States that aim to improve transportation equity. The result was structured, generalizable knowledge about the current state of the practice.

Stakeholder engagement was an integral component of the study. “We received key guidance from MnDOT, other public-sector agencies, and...
Kids learn about transportation at Tech Fest

In February, CTS staff introduced about 300 kids to transportation topics at the 15th annual Tech Fest.

The event, held at The Works Museum in Bloomington, Minnesota, is designed for kids ages four and up. It features dozens of hands-on activities and demos related to engineering and technology from the museum and its partners.

At the CTS booth, visitors took on the challenge of managing traffic congestion by playing Gridlock Buster, an online traffic control game developed by CTS. Kids also explored the Roadway Safety Institute’s permanent exhibit, which teaches visitors about reflectivity and why reflective clothing is critical for being seen by drivers at night.

Equity from page 4

external community partners with expertise in addressing disparities and inequities,” Baas says. “We also engaged community members at a community event in Minneapolis to seek direct input from attendees about the day-to-day transportation challenges they face.”

Based on their findings, the research team developed recommendations for MnDOT and other transportation partners to consider in advancing transportation equity. The recommendations, categorized under six overarching themes (see sidebar on page 4), address both societal inequities and the inequities of the transportation system itself. The report identifies which underserved and underrepresented populations are most likely to benefit from each recommendation, along with what modes of transportation each recommendation affects.

“The study lays a foundation for MnDOT to work with transportation partners to meaningfully reduce disparities,” Turner says.

The final report—Advancing Transportation Equity: Research and Practice—and a four-page policy brief will be available at cts.umn.edu/Research.

CTS Research Conference Call for Presentations

CTS has issued a call for presentations for its Annual Transportation Research Conference, scheduled for Thursday, November 7, 2019, at the Graduate Minneapolis hotel.

We invite you or your organization to share the results of your research or innovations in transportation. If you’re interested in presenting your work at the conference, please submit a brief abstract by Monday, April 29, 2019.

For more information or to submit your abstract, please visit cts.umn.edu/events/conference.

READ Catalyst ONLINE for links to research reports and other resources.
our ability to track accessibility changes across a region,” says Observatory researcher Kristin Carlson, the lead researcher on the project. “This ultimately expands the role accessibility can play as an assessment tool for planners and engineers.”

As part of the project, the researchers were especially interested in exploring the potential of managed lanes and PNR facilities to boost the competitiveness of the transit network compared to auto accessibility at similar time thresholds.

To begin their analysis, the researchers designed a new methodology to calculate how the MnPASS managed lane network contributes to accessibility. This work included developing and implementing a special computer program to edit transit schedule datasets for the 60 express buses that run at least partially on the existing managed lane network in the Twin Cities. The modified data were then used to evaluate the system-wide accessibility impacts of managed lanes.

Findings indicate that, at the regional scale, managed lanes result in only modest accessibility gains. However, at the local level, the impacts are much larger. The average worker living within a half-mile of a transit stop on a route that uses a managed lane can experience a nearly 13 percent increase in accessibility to jobs within 30 minutes.

Next, the team developed a mixed-mode methodology to examine the effects on accessibility of the 114 PNR locations across the Twin Cities. This involved creating a blend of auto and “walk-up” transit accessibility profiles to account for the driving and transit components of each PNR trip.

“By incorporating access to transit service via automobile, we found that suburban and exurban areas have higher levels of transit accessibility where they had previously been considered low,” Carlson says. “Overall, PNR accessibility is three times greater than walk-up transit accessibility for the average Twin Cities worker.”

When taken together, managed lanes and PNRs increase transit’s competitiveness with auto by 19.1 percent at the 60-minute travel time threshold. The largest gains are in first- and second-ring suburbs located near the MnPASS lanes operating on I-35W, I-35E, and I-394. These accessibility benefits are strengthened in areas with active PNR facilities, such as I-35W at Highway 36 and I-94 at I-694.

Going forward, the researchers plan to apply what they’ve learned on this project to additional work. The computer program created to analyze the effects of managed lanes, for example, has already been used for accessibility analyses related to the Rethinking I-94 project.

In addition, Carlson says the methodology developed to analyze the contributions of PNR facilities could serve as a launch point for future evaluations of accessibility related to shared mobility, since it allows for mixed-mode trip analysis.

“The growing prevalence of transportation network companies and their potential to help or hinder transit ridership makes this area especially fitting for further study,” Carlson says.
An 18-page report is now available that synthesizes the findings of the ABC Ramps Transportation Options Program Plan.

The Minnesota Department of Transportation (MnDOT) sponsored the 18-month study to take a look back at the parking ramps’ history, understand current usage and challenges, and plan the future of these facilities. Components of the project were split among U of M researchers and several transportation consulting firms. Frank Douma, director of the State and Local Policy Program at the Humphrey School of Public Affairs, was the principal investigator.

The ABC Ramps are the ending point for I-394, which connects Minneapolis to its western suburbs. Completed in 1992, the ramps were designed to ease congestion and improve air quality by encouraging carpooling and transit use. Now, however, the ramps are increasingly used by solo drivers and fill up during peak times, and surrounding roads and streets are congested.

Through surveys and other activities, the researchers found that ramp users want flexibility, and many who drive alone want to take transit at least some days. Users are also interested in new technologies, such as mobile apps for multimodal trip planning or carpool match-making.

New programs and innovations could reduce solo driving and help fulfill the ramps’ original mission, the researchers say. Options include flexible contracts, employer incentives that bundle parking and transit, and mobility hubs that let commuters switch easily between transportation choices.

The report also calls for continued assessment of a potential game-changer: connected and automated vehicles, which may—or may not—cut parking demand or dramatically change the ways the ramps could continue their mission.

To read the report and other materials, visit cts.umn.edu/ABC-Ramps.
Study recommends strategies for reducing transportation disparities.