Selecting the right bus for the right route helps improve fuel efficiency

As part of a continuing effort to improve efficiency and reduce emissions in transit buses, U of M researchers are conducting a study designed to help Metro Transit select the right bus for the right route.

The research team, led by mechanical engineering professors David Kittelson and Will Northrop, is analyzing and comparing the performance of advanced hybrid buses, standard hybrid buses, and conventional diesel buses on three types of routes.

The advanced hybrid buses, equipped with all-electric accessory systems, were designed for...
Exploring transportation safety on tribal lands

The fatality rate for motor vehicle crashes is higher for American Indians than for any other ethnic or racial group in the United States. The challenges of roadway safety on tribal lands were discussed during the Roadway Safety Showcase: Safety Innovations for Today and Tomorrow. The event, held in St. Paul in May, highlighted the latest work of Roadway Safety Institute (RSI) researchers.

In opening remarks, USDOT Assistant Secretary for Transportation Greg Winfree noted the importance of the tribal transportation issue not only from a safety perspective, “but from [its] ability to uplift all Americans and guarantee… ladders of opportunity,” he said.

Winfree introduced assistant professor Kathryn Quick and research associate Guillermo Narváez, researchers at the U of M’s Humphrey School of Public Affairs who are exploring this issue. In an RSI-sponsored project, Quick and Narváez are collaborating with American Indian communities to better understand the transportation safety risks on tribal lands and develop strategies to mitigate these risks.

Quick and Narváez are focusing on gathering on-the-ground knowledge about the nature of roadway risks and options to improve safety on reservations in Minnesota. “We’re also actively and intentionally trying to build and sustain relationships with tribal communities to address these kinds of issues over the long term,” Quick said.

The researchers are reviewing crash data, collaborating with the Advocacy Council on Tribal Transportation, and conducting interviews with key stakeholders. They have collaborative research agreements with four tribal governments: the Red Lake Band of Chippewa, Leech Lake Band of Ojibwe, Fond du Lac Band of Lake Superior Chippewa, and Mille Lacs Band of Ojibwe.

Preliminary findings suggest that tribal transportation safety problems may not be so different from rural safety problems, except for a much greater concern for pedestrian safety. Many reservation residents, by choice or necessity, travel on foot in the roadway as a way to get around, and several tribal governments are actively promoting walking, jogging, and biking for their recreational and health benefits. However, people feel unsafe because of narrow road shoulders, poor lighting, vegetation, or wildlife. In addition, there are many concerns that drivers who are not from the reservation do not expect or anticipate pedestrians in some locations, as well as concerns about congestion and speeding by non-locals, especially during peak tourism periods.

Tribal transportation leaders have not mentioned alcohol-impaired driving as a top challenge, Quick said, which is a bit surprising given popular perceptions and some previous studies. “We will be continuing to probe that as we develop relationships and trust with them.”

The team has also heard themes around enforcement and how it’s key not just for supporting safety but also for reporting and monitoring safety issues. “There are some collaborative issues…around data quality, data sharing… and barriers to interpreting that data. There are also many jurisdictional and coordination issues relating not only to data sharing but also around setting priorities for safety resources,” Quick said.

On this issue, the team is collaborating with RSI researcher Tom Horan. That project is investigating the potential of new advances in GIS and how can it enhance the collection, availability, and use of information related to transportation safety within the tribal environment.

FROM 1975–2002, the number of FATAL CRASHES in the United States decreased by 2 percent but INCREASED BY 52 PERCENT ON TRIBAL LANDS.
In-vehicle warning systems reduce risk of run-off-the-road crashes

In-vehicle lane-departure warning systems can help reduce the risk of dangerous run-off-the-road crashes, according to a new study from researchers at the U of M's HumanFIRST Laboratory.

“Run-off-the-road crashes are a huge concern, especially in rural areas,” says project co-investigator Jennifer Cooper, a HumanFIRST Lab assistant scientist. “Crash statistics tell us they contribute to more than half of all vehicle fatalities nationwide and that these crashes occur most often on two-lane rural highways.”

The deadly toll of run-off-the-road crashes has made reducing these fatalities a top priority for transportation safety practitioners and researchers. One common countermeasure is shoulder rumble strips, but they come with drawbacks including startling drivers into overcorrection, generating noise complaints from neighbors, and creating a danger for bicyclists.

An alternative solution to rumble strips is in-vehicle lane-departure warning systems that can track the vehicle's position in relation to the lane boundary and issue a timely warning,” Cooper says. “Currently, in-vehicle warning systems are in the early stages of development and have little consistency in the types of interfaces they use, making it the ideal time to study exactly how these systems impact driver behavior.”

To aid in the development of appropriate and timely warning systems, HumanFIRST researchers studied behavioral responses to in-vehicle lane-departure warning systems using a driving simulator. In the study, participants drove two simulated real-world, two-lane rural highways with a history of lane-departure crashes.

During their drives, participants experienced simulated wind gusts that pushed their vehicle out of the lane. On half the drives, the in-vehicle warning system was active, causing the seat to vibrate and warn the driver when the vehicle was traveling out of the lane; on the other half of drives, the system was inactive. The severity of the run-off-the-road event was measured by how long the driver was out of the lane and how far they traveled out of the lane.

The study results did not show any indication that drivers became dependent or over-reliant on the warning system. In fact, when drivers drove without the lane-departure warning system after repeated exposure to it, they maintained significantly reduced time out of lane and distance out of lane—suggesting use of this lane-departure warning system may have significant long-term benefits.

Open Streets Minneapolis
September 12, 2015
University of Minnesota

CTS is cosponsoring an Open Streets event on the U of M east bank campus on September 12. Open Streets creates miles of safe, car-free streets so that residents can walk, bike, shop, and play.

Come learn about healthy living, local businesses, and sustainable transportation—and stop by the CTS booth to say hello! For more information, visit openstreetsmpls.org.
From planning streetscapes to “putting a lid” over a Minneapolis freeway, the University’s Metropolitan Design Center (MDC), housed in the College of Design, is coming up with ideas that transportation planners can use—now and in the future.

Thomas Fisher, former dean of the College of Design, became the center’s director in June. He discusses recent work and shares highlights from his blog and recent articles in the Minneapolis Star Tribune.

What is the role of design in metropolitan planning?
I believe that design has an especially important role to play in imagining and implementing the cities of the future. Our metro areas are encountering dramatic changes: demographic shifts, environmental stresses, and economic disparities. We need to rethink many of the 20th century systems that have come to the end of their useful life.

Tell us about the center’s work.
Our researchers address urban issues in the Twin Cities region and beyond. Our goal is to help communities rethink urban design assumptions and rewrite the rules guiding development so that we create metropolitan areas that we can afford economically, sustain environmentally, and justify ethically to future generations.

What’s a recent example in the Twin Cities?
In one project, we engaged the community to imagine the future of the Midtown Greenway, a 5.5-mile-long former railroad corridor in south Minneapolis with bicycling and walking trails. During the past decade, developers constructed more than 1,200 apartment units on the greenway’s northern edge, but the southern edge remains undeveloped. To explore the possibilities of the southern half, the city of Minneapolis and the College of Design held a one-day workshop with area residents to generate ideas and find those with the greatest benefit and likelihood of success. The workshop’s consensus envisioned a new kind of public right-of-way, accommodating people as much as vehicles. City officials are considering the next steps in rebuilding W. 29th Street along the Greenway, and I know that the workshop has affected their thinking about it.

What ideas are a bit more ‘out there’?
The work we have done on green “lids”—which cover roadways and create open space above the roadbed—is one example. College of Design students analyzed the possibility of a green lid over I-35W in Minneapolis. By developing the air rights above roadways in such areas of high demand, we can generate revenue that can help us repair roads and other infrastructure. We also want to show what a family-friendly neighborhood in the city might be like, with child-safe play space separated from traffic. We have submitted a proposal to MnDOT to research best practices and learn lessons from other U.S. cities that have built over their highways, with the goal of identifying the best way forward for Minnesota. The City of Edina has also expressed interest in exploring this strategy as part of new development along Highway 100.

Your thoughts for the future?
In five years—or certainly 10—driverless cars will make your street and neighborhood look very different. Roadways will change, along with parking lots and garages, residential streets, and urban densities. We’re entering a transformative time, one as large as the shift from horses to the automobile. Our center will be there to help chart the way.

For more information, see designcenter.umn.edu.
The University of Minnesota’s Accessibility Observatory will receive more than $1.2 million over five years to create a new, national accessibility dataset at the Census block level.

The Minnesota Department of Transportation is the lead agency and coordinator for the national pooled-fund study. Other participating agencies are the Federal Highway Administration (FHWA) and the DOTs of California, Florida, Iowa, North Carolina, Virginia, and Wisconsin.

“Accessibility metrics indicate how well a transportation system fulfills the goal of connecting users to valuable destinations,” says Observatory director Andrew Owen.

Updated annually, the new dataset will describe accessibility to jobs for both driving and transit. Study partners will be able to use the dataset for local transportation system evaluation, performance management, planning, and research efforts. Each partner will have direct digital access to the accessibility datasets for the jurisdictions of all partners and will receive detailed reports of local accessibility trends and patterns.

“Today’s transportation user wants more than mobility; they want accessibility and they want MnDOT to invest in the appropriate solution, at the right place, at the right time, and at the appropriate cost,” says Tim Henkel, division director of modal planning and program management at MnDOT. “These demands require MnDOT to expand our decision-making data and measures and improve our decision-making tools. The Accessibility Observatory offers solutions to these decision-making challenges and is an excellent example of the timely and practical solutions that research partnerships provide MnDOT.”

The study will also produce and publish a series of reports summarizing the accessibility datasets for the 50 largest metropolitan areas.

Observatory staff led by Owen will perform the accessibility calculations using commercially available, GPS-based speed measurements and published transit schedules. The Observatory has completed a licensing agreement with TomTom, a global leader in navigation and mapping products, for use of its map and historical speed data.

“We’re excited that the Accessibility Observatory has selected TomTom to help provide geospatial and transportation information for this project,” says Ralf-Peter Schäfer, head of traffic at TomTom. “We are confident that the TomTom map and traffic content will contribute to a better understanding of job accessibility nationwide.”

The Transportation Pooled Fund Program, part of the National Cooperative Highway Research Program, allows state DOTs, FHWA program offices, and other organizations to combine resources and achieve common research goals. Additional partners are welcome to join the study. For information, see access.umn.edu/research/pooledfund.
Metro Transit based in part on a previous U of M study that explored how electric-powered accessories could significantly improve fuel efficiency. However, in spite of their benefits, these advanced hybrids may not be the best choice for every route.

“Just like golf clubs, you have to understand what your best application is each time you pull out a tool,” says Brian Lamb, Metro Transit general manager. “Our buses should not be thought of as one-size-fits-all from an application perspective.”

“There are a lot of factors involved in choosing the best bus or optimizing bus specifications,” Kittelson says. “We wanted to look at several types of buses with different degrees of hybridization and electrification and understand the gains we get from these different features.”

The ultimate goal is a modeling tool that considers factors such as route average speed, stops per mile, and climate in order to predict bus performance and emissions. This tool could be used to provide bus specification recommendations for Metro Transit. The study, conducted in collaboration with Metro Transit, was funded by CTS and the U of M’s Institute for Renewable Energy and the Environment.

To evaluate bus performance, the research team collected real-world data on fuel efficiency and emissions from the three types of buses on low-, medium-, and high-speed routes at different times of the year. So far, the team has completed analysis for the advanced hybrid and the conventional diesel buses.

Initial findings indicate that the advanced hybrid has the largest fuel economy and carbon dioxide emissions advantage on low-speed routes that have many starts and stops. In particular, the advanced hybrid bus equipped with start/stop capabilities—which allows the engine to shut down at bus stops and traffic lights—has up to a 60 percent fuel savings.

The researchers also examined nitrogen oxide (NOx) emissions for both types of buses. Although advanced hybrids performed better, emissions were still high in some locations.

Based on these findings, the research team is partnering with the Department of Computer Science to use geospatial mapping to identify NOx hot spots in the Twin Cities. They will also use big data tools to recognize operational and environmental patterns associated with high NOx emissions.

The team is also continuing its work with funding from Cummins, an engine manufacturer, to test emissions on a new 2015 Cummins bus.

According to Lamb, the step-by-step progress being made through this research has already led to large fuel savings for Metro Transit—and agencies across the country. For example, findings from the U’s study on electric-powered accessory systems led to changes that are now used by the entire industry.

“That’s the importance of this research on a practical basis,” Lamb says. “It makes a difference not just from an academic standpoint, but from the livability standpoint of the communities.”

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Roadway Safety Institute seminar series begins September 17

The Roadway Safety Institute will kick off its safety-focused seminar series on September 17 in Minneapolis. Seminars will be held Thursdays from 3–4 p.m. throughout the fall semester on the U of M’s east bank campus. The seminars, which will also be streamed live on the web, will feature the latest work of Institute researchers and other industry experts.

Stay tuned to [roadwaysafety.umn.edu/events](http://roadwaysafety.umn.edu/events) for details.
to attract and introduce the brightest young minds from diverse segments of society to education and career opportunities in transportation. It was sponsored by CTS with funding from the Federal Highway Administration administered by the Minnesota Department of Transportation (MnDOT).

As part of the program, attendees toured campus, visited the U of M’s transportation-related labs, and learned tips on researching, studying, public speaking, and writing. In addition, participants learned about many aspects of transportation, including human factors, roadway safety, bridge design, surveying, and traffic simulation.

Campers also had the chance to see transportation in action on a variety of field trips, including outings to several MnDOT facilities, UPS, Metro Transit, the Minneapolis–St. Paul International Airport, the Minnesota Transportation Museum, and boat tours of the St. Croix River Crossing construction site and St. Paul Port Authority.

Highlights for attendees included riding the light rail and going behind the scenes in a Metro Transit control room, watching airplanes take off and exploring maintenance equipment at the airport, getting up close to bridge construction on the St. Croix River Crossing boat tour, and using a driving simulator to learn about distracted driving at UPS.

“I really enjoyed using the driving simulators," said one of the ninth-grade program participants. “It was a hands-on experience that truly taught me the dangers of texting while driving and how much harder it really is.”

Students also had the chance to apply what they learned to envision the future of transportation. As part of a group project, participants were asked to imagine what aviation, freight, transit, traffic engineering, and water transportation will look like in 2050.

Students in each group presented their ideas—including things like self-driving hover vehicles, drones, and alternative fuels—at the program’s closing ceremony.

In post-program evaluations, parents reported that their children had learned valuable information about transportation topics, careers, and related education opportunities.

“This was one of the best camps we have ever experienced," one parent said. “There was always a plan for college, and this program increased enthusiasm, preparedness, and maturity.”

“(The program) opened up my daughter’s horizon for future career choices and major focus areas after high school," another parent said.

For other parents, lessons learned by students became evident on the car ride home.

“What a wonderful experience this camp was for my son," said Jessica Findell, a parent of one of the seventh-grade students. “He was inspired...He learned about all kinds of traffic laws and data... and I now have a new back-seat driver.”
Researchers are providing guidance on selecting the RIGHT BUS for the RIGHT ROUTE.

A new study is exploring TRANSPORTATION SAFETY RISKS on TRIBAL LANDS.

In-vehicle warning systems could help reduce LANE-DEPARTURE CRASHES.

Engaging the next generation of the transportation workforce