Integrating Autonomous Vehicles into Transit Services for Shared Prosperity

Summary Report

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The Traffic Operations and Safety (TOPS) Lab and the State Smart Transportation Initiative (SSTI) at the University of Wisconsin-Madison, led by Professor David Noyce were supported by the Tommy G. Thompson Center on Public Leadership in carrying out this research. This report summarizes the research effort, major findings, challenges and successes.

Overview

Autonomous vehicle (AV) technology is expected to be more widely available in a decade if not sooner, with far reaching ramifications, particularly for public transit. Our research team worked with two Wisconsin communities, Eau Claire and Madison, to better plan and prepare for integrating AVs into transit service to improve ridership, level of service, safety and efficiency. The project included a state-of-the-art analysis of current transit accessibility in each community, revealing undeserved areas and opportunities for improved first- and last-mile connections. It also incorporates a review of current AV technologies, trends, and key considerations for implementation. In Eau Claire, our research team worked with local stakeholders to identify and model several new transit lines to understand their potential impacts on rider accessibility. A survey was designed and employed to gauge public perception of emerging vehicle technologies and transit in general. Project activities in Madison coincided with planning efforts for launching an AV 12-passenger shuttle pilot program and led to important improvements in modeling transit.

Activities and findings

AV technology: literature review

Our research team reviewed literature on the current state of practice in AV technology.

Eau Claire

Of the two cities the research team worked with, Eau Claire has a smaller population and transit system, and the local stakeholders engaged with our team by forming an advisory panel, providing data and developing land use/planning scenarios. The City of Eau Claire is just beginning to consider the implications of new vehicle technologies and about to write their new transit plan, which our study will help inform.

Advisory panel

The research team first assembled an advisory panel, which included the City's Community Development and Engineering Departments, Eau Claire Transit, the West Central Wisconsin Regional Planning Commission, the Eau Claire Transit Commission, the Eau Claire Area Chamber of Commerce, and the University of Wisconsin-Eau Claire. Our research team met with the panel in Eau Claire and in monthly teleconference meetings.

Community survey

Research team developed and administered an online survey for Eau Claire residents to address five topics:

- Exposure and opinions about vehicle automation and driving assistance technologies
- Transit usage
- Travel habits
- Attitudes towards technologies, driving, and transit

- Demographic information

The survey was made available on Eau Claire Transit's webpage from April 16th to June 10th and publicized through the Chamber of Commerce, the University of Wisconsin-Eau Claire, and an article in the local magazine, Volume One.[1] We collected and analyzed 217 survey responses. The survey was open to anyone in the public and the responses were not filtered. The findings, which will be detailed in a final report for the City, revealed the following:

- Public awareness of vehicle automation is high and more than three-quarters of the respondents would like more driver assistance technologies in their vehicles.
- More than half of the respondents are unsure or skeptical about driving assistance technologies improving safety of transit vehicles.
- More than three-quarters of respondents are hesitant/unsure about riding a fully automated transit vehicle without a human operator. However, a similar percentage are comfortable with riding a fully automated transit vehicle with human operator on-board. This suggests that having human operators onboard transit vehicles is essential at least in the near- to mid-term to gain user trust and acceptance.

Our research team has offered the survey to several other Wisconsin communities and will obtain additional survey responses to draw more robust, generalizable conclusions about public perception toward emerging vehicle automated technologies and self-driving vehicles.

Scenario modeling

Working closely with the advisory panel, our team identified two new potential transit lines and several possible future development patterns, then modeled the outcomes of 15 different combined scenarios using advanced accessibility analysis. Accessibility analysis provides metrics which describe the ability of people and goods to access destinations by different modes, are often thought to be useful indicators of transportation performance, land use efficiency, travel demand, environmental justice and other important transportation outcomes. From these analyses, we produced maps showing the impacts to different neighborhoods throughout the city (Figure 1) and summarized the outcomes in terms of their impacts on transit accessibility for the average household and the average low-income households. These analyses showed that new service to outlying underserved areas could have a larger impact than a new downtown circulator, but the impacts depend largely on future development patterns. As with the survey results described above, the details of these analyses will be described in a final report for the City.

[1] http://volumeone.org/articles/2019/05/03/29417_look_ma_no_driver

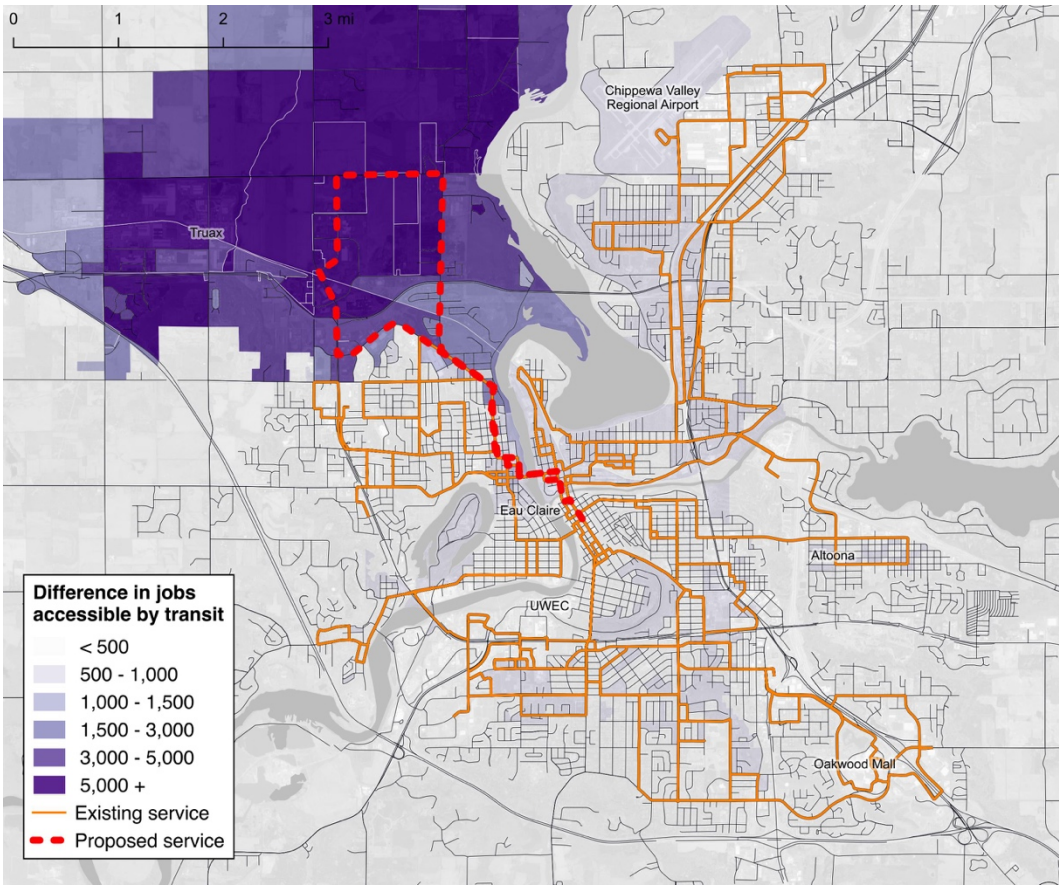

Figure 1. Accessibility impacts from proposed "Gateway Loop" transit service

Madison

Our team met with the Madison Department of Transportation and Madison Metro Transit to understand their current needs and identify opportunities to support their planning efforts for AV-integrated transit service. This work produced two important outcomes.

Scoping for AV shuttle pilot

Through the course of this project, our team worked with the City to plan an AV shuttle pilot program in Downtown Madison. This project provided additional insight for planning the pilot and developing proposals for additional funding and it gave us more opportunities to interact with key stakeholders. The proposed shuttle pilot would serve to raise public awareness and user trust in AV technologies and also provide valuable information to transportation agencies in how best to incorporate AV technologies into the transportation network effectively, efficiently, and equitably.

Transit ridership modeling

During our initial meeting, the City expressed two important goals of the transit system: 1) maintaining high levels of ridership, and 2) providing essential transportation services to underserved neighborhoods. Our team then worked with the City to obtain and process transit boarding data and model ridership using advanced transit accessibility metrics. This effort is still

a work in progress, but the data have so far proven useful for evaluating the impacts of future transit investments, including AVs and AV-enabled transit connections, while weighing the two (sometimes conflicting) goals. Pending further analysis, we will submit our findings for publication later this year.

Major successes and challenges

Success: new partnerships

This project was the first collaborative effort for our team. The TOPS Lab and SSTI have distinct but complementary skills and knowledge, which we recognized through this effort. Since beginning this project, we have successfully applied for another joint research grant and we have identified other projects that we plan to continue working on together.

The project also built upon and strengthened our existing relationships with the City of Madison and helped cultivate a new relationship with the City of Eau Claire. The TOPS Lab applied for a federal grant to run an autonomous shuttle in downtown Madison and SSTI applied for a grant to continue working with Eau Claire Transit and a local community college, understanding barriers to transit accessibility.

Success: framing new technologies

There is a lot of interest among planners and transportation professionals in the near-term possibility of AV technologies, but generally not a clear understanding of what is a realistic timeframe for these technologies, how best to prepare, and how the general public will respond. This project let our team and our local partners gain a better understanding of the following:

- Near- and long-term AV transit deployment scenarios—i.e., near-term deployment within controlled environments at low speeds.
- Workforce deployment—i.e., human operators will continue playing an important role in providing transit service, not only in vehicle operations but as an important consideration in the rider experience.
- Safety assurance considerations, including both “vehicle-focused” and “systems-focused” approaches.
- Community understanding and acceptance of new vehicle technologies.

Success: improved modeling techniques

This project led our research team to develop new approaches for modeling future transit accessibility, which proved helpful for our partners in weighing the costs and benefits of different transit investments and land use policies. Our analysis techniques are commonly used to model existing conditions and future transportation improvements, but this was the first time our team also incorporated various land use scenarios. The project also let us combine these metrics with Madison’s transit ridership data to explore new methods for estimating ridership on new transit lines, including potential AV shuttles.

Challenge: implementation of new technologies

There are inherent challenges in trying to plan for new technologies that are in initial stages of testing and establishing reliability and user trust as AVs are. Research team also dealt with two communities that are at different stages of transit deployment: Madison, which is planning major transit investments and pilots, and Eau Claire, which is planning more modestly for future

investments. This gave the research team broad perspective for thinking about the issues but made it more difficult to provide concrete recommendations, particularly in Eau Claire's case.

Challenge: short project timeline

The grant was constrained to a fairly short timeline—less than six months—during which time our team purchased customized data, organized with local stakeholders in each community, agreed on the goals and scopes of work, and executed the work. We were ultimately successful, but our success depended partly on preparatory work in anticipation of the grant and our ability to work flexibly around our stakeholder's schedules and other constraints.