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Designing the Future of Transit Work

Mobility21 Project ID #376

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FINAL RESEARCH REPORT

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Problem and Approach

This project seeks to examine how transit work will transform as autonomous vehicle (AV) technology is applied to the complex operating environment of public transit. While there is a legacy of autonomous transport in controlled settings such as airport "people movers," recent technological advancements target both constrained busways and unconstrained street routes. Many municipalities are already piloting AV shuttles or planning to deploy buses with a range of autonomous systems, from driver assistance to fully autonomous routes. As new autonomous vehicle technologies are implemented, our research considers how the nature of transit operations may shift in parallel. With a focus on prioritizing bus drivers' needs, our partnership with the Amalgamated Transit Union, Transport Workers Union, and the AFL-CIO's Technology Institute examines the potential impacts of autonomous technology on transit operators' jobs and roles, given the state of the industry and emergent innovations. Our research examines the following questions:

- What roles and core functions do operators perform or must be qualified to perform?
- How will these roles and core functions shift as AV applications emerge, and what are the limits of automation in a transit operating context?
- What are the critical needs of operators to perform their duties safely and reliably? Where might AV technology development be better targeted to complement operation?
- What elements of fully trained operation and incident management lie outside the technical scope of automation?
- How can transit workers influence the design of emergent AV technologies, and decisions about possible deployment and rollout? How has past experience with technology rollout addressed transit worker needs?
- Will worker and union involvement upstream lead to a human-centered strategy around the role of autonomous technologies in a transit environment that better benefits workers and riders?
- What are the impacts of different levels of automation on transit operators and their roles? What are the impacts on a collective level?

Methodology

This project takes a participatory research approach which involves us working closely with our partners to organize empirical activities such that they are aligned with the conditions and issues facing (or likely to face) operators as AV tech becomes more prevalent in transit operations. In the first phase of the project, we conducted a landscape analysis of AV technologies within the realm of public transit. Specifically, we documented current and pending AV transit pilot programs or development plans (e.g., Automated Bus Consortium's automated performance specification) and conducted a technology readiness assessment to estimate the reality and timeline for the deployment of different technologies. The second phase expanded on this analysis by making recommendations in the form of a policy report, focused on informing federal agencies about the ways in which automated vehicle technology has the potential to fundamentally impact public transit operations. In the final phase of the funding period, we conducted 8 focus groups with operators from a wide range of transit agencies within the US. This has given us a baseline understanding of the issues facing operators currently, as well as how they view emergent AV technologies as applied to the transit context.

Findings

The introduction of new technology will impact transit operators' duties and actions, as well as passenger safety and experience. From our empirical findings, we highlight the responsibility operators feel to intervene when there is conflict, or to ensure that the public space of the bus is kept safe for passengers. Operators reported maintaining safety through their acute ability to evaluate the context of passenger needs. For example, one operator noted that the human element of their job is especially important as they are responsible for assisting disabled passengers, who may need support with various tasks such as boarding. Other operators reported that medical emergencies or other forms of distress are common on buses and that they need to be able to quickly judge the situation in order to react with the appropriate action (e.g., intervening and/or calling for support). Navigating dynamic public space is also critically important for bus drivers and operators. For example, a driver reported the need to be vigilant about sudden pedestrian activity (e.g., a child darting into the crosswalk). Despite the importance of these skills, multiple study participants noted that they were not explicitly taught how to deal with passengers, or how to provide good customer service. They simply learned through experience on the job.

In addition to gaining a deeper understanding of the current work that operators do in addition to driving, we learned about drivers' perceptions of new technologies, which included several positive impacts: greater vehicle awareness, navigation advantages, and increased accessibility. Drivers reported that the implementation of new technology increased driving efficiency in many ways. For example, it offered support in controlling the mechanical and repetitive work of the bus operation and ensured safe driving by providing signals to consider when making driving decisions. The development of navigation systems also enabled drivers to coordinate bus schedules more efficiently, contributing to the increased quality of the service provided to passengers. Lastly, drivers noted the benefits of new assistance technologies targeted at passengers with disabilities, which often alleviated aspects of the physical work bus drivers were required to perform.

However, despite these advantages, drivers noted the side effect of many new technologies was a reduction in the interaction between passengers and drivers, which drivers often reported as being one of the most rewarding aspects of their job. Drivers also stated that the implementation of new technologies was not regularly accompanied by sufficient training, which operators noted as creating more uncertainty. Drawing on these experiences, operators expressed deep concern about the efficacy and safety of the potential for AV technologies to be introduced into public transit contexts. Bus drivers across our focus groups reiterated that regular operations are only a small part of the job; instead, dealing with emergencies and uncertainties is the real challenge, and often the norm. Bus operators need to quickly respond to medical situations, conflicts between passengers, or reach out to emergency responders for assistance. They also deal with extreme weather conditions and vehicle malfunctions requiring immediate, skilled response. It was therefore difficult for operators to imagine how this degree of flexibility and responsiveness could be approximated by autonomous systems, particularly given the high stakes involved.

Conclusions and Recommendations

Across our research, we have found a critical need for continued analysis of the core human operator functions (e.g., hazard response, on-board incident reaction, etc.) that are necessary regardless of the type or level of AV technology deployed, considering the realities of the complex operating environment of public transit. For example, driver assistance automation such as pedestrian warnings and lane-centering may have the potential to improve the safety and workload of trained operators, while also creating new kinds of safety issues caused by the interactions in human-autonomy teams and intensifying work as people primarily take over from automation in the most challenging situations. In a policy report targeted at Federal agencies, we highlight the importance of public transit authorities preemptively considering the safety of incorporating automation technologies into their fleets and training operators to work effectively with such technologies. Furthermore, we argue for the need for the government to collect data on automated systems via improvements in communications and data sharing infrastructure to hone regulations and safety requirements.

Building on this year's research activities, our next phase of work focuses on conducting participatory design with members of transit unions to collaboratively generate concepts for technology and transit policy such that bus operators' experiences and expertise are centered in the future of transit. We are also in the process of planning a bus simulator that would allow testing of new driver assistance technologies for operators, while also prototyping rider experience. The aim is to bring together various community members and government officials to not only design future transportation technology, but also inform the reporting and oversight mechanisms used by the government to ensure they are safe and equitably deployed.

Final Report URL(s) or PDFs for any resulting publications:

Martelaro, N., Fox, S.**, Forlizzi, J., Rajkumar, R., Hendrickson, C., Caldwell, S. 2022. "How to Make Sense of Bus Transit Automation? Considerations for policy makers on the future of human-automation teaming in the transit workforce." Traffic21.
**First two authors contributed equally*

https://www.cmu.edu/traffic21/research-and-policy-papers/traffic21-policy-brief-22.1---apr-14-002.pdf

URL(s) to, and associated descriptive metadata for, any final datasets from the research project

N/A

Any documented project outputs or outcomes resulting from the research project.

Martelaro and Forlizzi featured on Panel at the 29th AFL-CIO Constitutional Convention:
https://www.youtube.com/watch?v=2ltlQOxCf04&ab_channel=AFL-CIO

Media coverage of "How to Make Sense of Bus Transit Automation?" policy report:

1. Report: These recommendations are what policymakers should consider while pursuing autonomous transit, *Pittsburgh Business Times*, 5/31/22

2. Autonomous transit buses will still need skilled operators, researchers say, *SmartCitiesDive*, 5/20/22

3. Human operators still essential in autonomous vehicles, says new CMU report, *Pittsburgh City Paper*, 5/27/22

4. Policy brief highlights challenges of autonomous mass transit adoption, *Autonomous Vehicle International*, 6/7/22

5. Will 'Autonomous' Buses Force Drivers Out of a Job — Or Make Them More Important Than Ever?, *StreetsBlogUSA*, 5/31/22

6. New research offers recommendations for integrating autonomous driving tech into public transportation, *News8Plus*, 6/6/22

7. Policymakers Considering Introducing Autonomous Driving Technology Into Public Transit Should Examine The Following Recommendations, *QSPapers*

8. Automated buses will still need skilled human operators, *GCN*, 6/2/22

9. Mass transit agencies need to examine autonomous technologies, researchers find, *Transportation Today News*, 6/8/22

10. Recommendations for policymakers considering integrating autonomous driving tech into public transportation, *TechStreetNow*, 5/20/22

11. Headlined the ITS America Momentum Newsletter