Autonomous Vehicles Serving Local Mobility Needs

Event Report and Observations

On Friday, September 23, 2022, the ASU Office of Applied Innovation and Ira A. Fulton Schools of Engineering TOMNET Center hosted an event as part of a series of events to celebrate the launch of the ASU California Center in Downtown Los Angeles, CA. This event focused on "Autonomous Vehicles Serving Local Mobility Needs", a topic of relevance in the Los Angeles area where mobility challenges are abundant, and the community has embraced innovative strategies for meeting travelers' needs. The event provided ASU an opportunity to share findings from research efforts evaluating deployments of autonomous vehicles and engage with a panel of experts regarding challenges and opportunities that will shape the path forward and may influence research agendas and workforce development needs.

As the new home of ASU in Los Angeles, the ASU California Center at the Herald Examiner Building represents ASU's growing evolution as a university of global impact.

This report captures critical aspects of the discussion and observations gleaned during the initial public panel and the subsequent stakeholder working session. ASU is particularly appreciative of the valuable time commitments of the stakeholders and their willingness to share their insights and experiences. The sincere interest in ensuring that the benefits of automation and other technologies supporting the provision of transportation, particularly to those groups who may have disadvantages accessing mobility opportunities, was on full display throughout the discussions. The panelists and workshop participants are noted at the end of this report.

Public Panel

The public panel session opened with a welcome to guests and a thank you to participants. The ASU California mission was shared, and the program moderator and panelists were introduced. A recording of the panel is available here. Dr. Ram Pendyala next set the context by sharing results from two autonomous pilot programs that the ASU team had been involved in evaluating. These efforts (see an example here) were intended to meet the mobility needs of Phoenix-area residents by providing transportation that would facilitate their access to opportunities and services. In one project, Valley Metro, Waymo, and Arizona State University piloted the use of Waymo AVs for Valley Metro's RideChoice program—a subsidized door-to-door individual mobility service for paratransit-

certified people and older adults aged 65 and over (see the final project report here). In another project, the Maricopa Association of Governments, the City of Peoria, and Arizona State University worked with Beep to deploy a low-speed AV shuttle in a medical district. These projects provide evidence for further exploration into how communities and transportation agencies might facilitate point-to-point mobility via AVs for mobility-disadvantaged residents.

Following that initial presentation, the moderator, Marisa Walker, offered initial comments and invited the panelists to share their observations regarding the critical issues in the path to deploying automated services to support the mobility needs of disadvantaged individuals. The panelists were given an initial question around which to frame their comments:

> *The path toward full deployment of automated vehicle technologies is influenced by research and technology development, policy and regulatory actions, and the public's willingness to advocate for investment. From your perspective, can you identify some critical next steps in one or more of these areas that will facilitate the path toward broader deployment of automated mobility services particularly for individuals where this will provide a meaningful increase in access to opportunities?*

Observations included the following:

- We still have a long way to go before full deployment.
- Knowledge sharing is critical as we move forward.
- Remaining technological advances are required for success.
- Exposure and awareness of automated options are required for acceptance.
- Equity is important and all segments should have access to automated services to share the safety benefits.
- Liability issues remain to be sorted out and could impact the pace of deployment.
- The human-machine interface is especially critical for automated services for disadvantaged travelers.
- Current technology costs make application prohibitive for broad deployment in the near term.
- The opportunity for individualized travel which can be enabled by automated services is critical to disadvantaged travelers' access to economic opportunities and quality of life.
- The prospect of shared use concurrently is important to make automated services sustainable.
- Financial support is critical for use by disadvantaged populations. Thus, there are institutional as well as technical issues.
- The data issues and the accompanying issue of personal privacy and protection of proprietary data are part of the challenges moving toward deployment.
- Safety, including safety perceptions with respect to sharing trips, will be important.
- Automation can also provide benefits through delivery services and virtual connections, potentially reducing the need for and burden of personal travel by disadvantaged persons.
- The public transportation industry will have to address the labor force issues potentially involved in a transition to automated operation.
- The panel strongly emphasized that safety should not become a competing factor amongst private sector automation providers but rather that they collaborate to enhance safety.

As the panel session neared its conclusion, the panelists acknowledged the breadth of issues and complexity of challenges in the path forward. Panelists reconvened in a workshop format after a break to explore issues in greater detail.

Stakeholder Workshop

The panelists as well as additional stakeholders reconvened in a workshop format to explore issues in greater detail. Steven Polzin moderated the discussion which focused on a series of questions posed to the participants. While the meeting was exploratory in nature with no preconceived critical next steps, there was the desire to use this forum to help inform the path forward for both the stakeholders and ASU research initiatives. Specifically, it was envisioned that the discussions would shed light on research needs to support the deployment of automated services to support disadvantaged travelers, gain insight into workforce development needs and curriculum implications, and potentially build relationships that could support future collaborations and knowledge sharing.

The topical questions for discussion were grouped into thematic areas. The questions were provided to seed the discussion and the participants were encouraged to identify any additional issues or topics that merited inclusion in the subsequent discussion. Each topical area is identified below followed by short narrative discussions of observations shared at the workshop.

STRATEGIC/POLICY ISSUES

1. *New technologies are often first deployed for the wealthy, who can afford new technologies and these premium prices enable the continued development of the technology. Are there ways that we can ensure the benefits of automation find their way to those most in need in a timely manner? What strategies will be most effective in this regard?*
2. *The path toward deployment of automated services for disadvantaged travelers involves more than solving the challenge of automated vehicle operation. Capabilities need to be in place to interface with customers with varying physical and cognitive capabilities, accommodate securement/mobility assist devices/service animals, and ensure capabilities to accommodate unanticipated events such as accidents, health incidents, or delays. Can anyone share some thoughts about these challenges and strategies to address them?*
3. *The transportation community is actively seeking ways to enhance the mobility of disadvantaged groups so that they can benefit from the quality of life and economic opportunity that comes with good mobility. Simultaneously, many are trying to minimize overall travel due to the externalities that it creates. Do these competing objectives create challenges or require guidelines regarding the extent of initiatives to enhance mobility for various groups? For example, should trip purposes, trip distance, user cost, and/or trip frequency be governed by policies? Should virtual/digital communications be enhanced as a first priority to mitigate the need to travel for disadvantaged travelers?*
4. *Are there any strategies that might help ensure that the private sector initiatives and investments in developing automation are sufficiently aware of and/or accessible to stakeholders who can ensure the needs of the transportation disadvantaged are addressed as this technology matures?*
5. *While automation has captured people's attention, are there other technology capabilities that we should leverage and support to meet disadvantaged travelers' needs?*

One of the earlier expectations associated with the anticipation of autonomous vehicles was the hope that the ability to remove the driver from the vehicle would result in very low-cost transportation service opportunities. The ability to deliver low-cost autonomous vehicles would make possible the provision of transportation services for economically disadvantaged persons to a far greater extent than relying on driver-driven vehicles with their inherent costs. Be it individuals or agencies, the ability to provide high levels of mobility for disadvantaged travelers has been hampered by the financial reality that constrains currently available services. The prospect of delivering low-cost travel has the potential to dramatically improved mobility and quality of life for persons who are unable to avail themselves of personal mobility. It is that desire that motivates stakeholders to explore and engage in initiatives to ensure that this opportunity is not lost as autonomous mobility matures. Workshop attendees share that vision but recognized that low-cost autonomous services are not yet available and that both capital and operating costs currently preclude broad deployment.

It is recognized that substantial operating subsidies as well as mechanisms to ration supply will be required at least until costs are dramatically less. User share of the cost, trip purpose, hours of operation, service response times, reservation windows, eligibility classifications, and other considerations will continue to influence travel demand. It was also recognized that the fragmented nature of financial support for mobility for disadvantaged travelers, often with a multitude of agencies within a given jurisdiction having mobility assistance programs or funding mechanisms targeted to various user groups and trip purposes, may complicate the evolution of more universal and ubiquitous services. The institutional challenges are certainly not new to stakeholders in the paratransit and mobility disadvantaged services industry, and they may impact the evolution of autonomous services to disadvantaged travelers due to the fragmented nature of funding and stakeholder advocacy in policy forums.

It was also acknowledged that there is a diversity of needs for various segments of the population who have mobility disadvantages, ranging from those with income constraints on their travel frequency to those who require specific vehicle features to accommodate mobility assistance devices, service animals, attendants, etc., as well as significantly different needs with respect to human interface necessary for arranging trip scheduling, payment, and emergency communication capabilities. While logistics and operating efficiencies as well as some sense of equity would favor a standardized ubiquitous vehicle and service, the practical and financial realities may favor a spectrum of vehicle and service types designed to meet various market segment needs such that vehicle and service cost and operating efficiencies can be optimized. Panelists acknowledged that not all of the issues can be solved at once and that incremental progress may be required. This raises the issue of equity and challenges such as ADA accessibility and/or the need for alternative services and the prospect that these issues could slow the deployment of automated services. Panelists also acknowledged the challenges with determining eligibility that will be necessary to determine who can use subsidized services.

Finally, it was acknowledged that technological capabilities provide significant opportunities both to facilitate trip-making but also to enable the substitution of virtual connections in lieu of travel which can be beneficial to disadvantaged travelers. Leveraging this opportunity requires the availability of technology and services for the potential users, awareness and training in using the available services,

and efforts by the service operators and other providers of functions and services that might be able to be accommodated without travel, making efforts to ensure digital access to their products or services. It was noted that acceptance of and use of technologies tends to be highly correlated with age and that this will change over time. It was also noted there is the prospect that automation of some public transit fixed route services might be a means of benefiting travelers in the near term as the fully autonomous door-to-door capabilities mature.

POLICY PRIORITIES/GOVERNANCE/FUNDING

1. Currently, dozens of different programs provide different types of mobility support for various segments of the disadvantaged community. Are there changes that need to be made to the institutional framework such that securing sustainable automated vehicle services to support disadvantaged travelers becomes financially viable? Will this fragmented structure deter the deployment of automated services for these market segments?
2. In many communities it may be a decade or more, some say well more, before automated services are available for disadvantaged travelers. Are transportation stakeholders too enamored with automation and should we be focusing on other venues for improving services to disadvantaged travelers as automation matures?
3. Navigating the built environment is already very challenging for segments of the disadvantaged traveling community. Are there any particularly specific aspects of integrating automated services into the built environment that might require additional modifications to facilitate the use of automated vehicles by disadvantaged travelers?
4. Funding, eligibility, and operations of services for disadvantaged travelers are extraordinarily diverse with multiple actors and complex relationships. What steps can be taken to ensure stakeholder engagement and prospects for automated services move toward pilot testing and deployment?

Panelists noted the criticality of pilot projects and carefully designed deployments with careful evaluations and wide dissemination of lessons learned as a critical step in moving forward with the path toward automated services. There was no consensus or suggestions of a systematic collective path forward but rather an acknowledgment of the inherent complexity of the problem and a recognition that progress would be incremental.

The difficulty of bringing all companies to the table when there are also competitors at the table was noted. Similarly, it was noted that community organizations are often focused on near-term challenges with less capacity to engage in longer-term issues. Other stakeholders including medical personnel, social scientists, and others are similarly difficult to engage in this complex topic with no explicit decisions being imminent.

Given the massive investments in automation and the pace of development, the consolidation of the industry, and the focus on profitability in near-term deployments, the private sector's interest in and ability to focus on disadvantaged traveler markets are modest.

OPERATIONS

1. As safety regulations are developed to govern the deployment of automated systems, are there any specific traits or characteristics associated with the transportation of disadvantaged travelers that merit special attention?
2. Currently, several factors influence the demand for paratransit service including the hours of operation, pricing, reservation and wait-time requirements, capacity constraints, etc. With the advent of autonomous services, what mechanism(s) should be used to price or otherwise influence the demand for services such that their operation can be financially sustainable?
3. The range of conditions and contexts for individuals who have mobility disadvantages and would benefit from automated vehicles is very diverse. As one thinks about the automated technologies and the nature of services to provide automated mobility, will it be important to have different designs for different market segments or is it valuable to attempt to have a universal technology/service? For example, can the vehicle and services to meet the needs of economically disadvantaged travelers have different specifications than services and vehicles designed to meet the needs of persons with various physical, emotional, or cognitive disabilities?

In addition to the acknowledgment of the above questions, the panelists offered several observations regarding operating issues associated with the movement towards automated vehicles for serving disadvantaged travelers. It was acknowledged that several supportive actions can be prioritized and initiated in the near term such as highly visible lane markings, specific construction zone markings, designation/construction of boarding and alighting areas, etc. Disadvantaged travelers are often very vulnerable and the sensitivity to vulnerable parties in the operating environments of automated vehicles should be given substantial attention in vehicle programming.

Finally, it was noted that there may be an inequity introduced by virtue of the fact that the deployment of automation is influenced by the physical nature of the operating environment. Areas more conducive to the deployment of automated services may not correspond with geographies in which there are concentrations of disadvantaged travelers who might most benefit from the availability of these services.

RESEARCH NEEDS/OPPORTUNITIES AND OTHER ISSUES

1. Can you identify any research needs to help advance disadvantaged mobility in the areas of technology, policy, government, market needs, etc.?
2. Do you feel there are any unique challenges or opportunities in the southwestern United States as it relates to making progress with using automation to meet mobility needs for the disadvantaged population?
3. In your experience, what challenges are you seeing in your domain regarding moving forward with initiatives to enhance mobility for disadvantaged populations?
4. In light of today's discussion and your experience, are there any other observations you would like to share with our audience regarding the use of automated services to address mobility needs for disadvantaged travelers?

One of the issues mentioned here was the impact on the workforce associated with automation in light of the prospect that it may reduce the number of drivers required. There is a great deal of

sensitivity to this issue within the public transit community and numerous initiatives have explored workforce impacts both within the transportation and in the broader economy as automation matures. Public transit stakeholders appear to favor strategies where operators revert to customer service functions and automation takes over driving capabilities. While providing beneficial improvements in the level of service, such an action would impact overall productivity as the investment in automation would not be able to be leveraged to produce lower costs and could undermine the financial sustainability of public transit services. Throughout history increases in technology and automation have historically produced economic growth creating more total jobs, however, there could be significant mismatches in capabilities and skill requirements associated with a rapid shift to automation. The academic community will need to play a role in preparing workforces for transitions.

Other workshop participant comments focused on the role of automated vehicles in enhancing the transition to electric vehicles and discussed the challenges associated with vehicle sharing to increase productivity and offset what might be empty miles between assignments.

Final Observations

The totality of discussions reinforced the complexity of the issues and the diverse nature of the sets of challenges that will have to be addressed as automation matures and is deployed to assist in meeting mobility needs and disadvantaged travelers. The spectrum of research opportunities embraces a host of disciplines and a broad set of stakeholders. The technology associated with enhancing automation is only a piece of the totality of the organizational, administrative, and social challenges that will have to be addressed as the full spectrum of issues associated with providing safe, affordable, automated services matures. There was a consensus that progress would implicitly need to be incremental. There was also a consensus that project evaluation and knowledge sharing will be critical on the path forward. The academic community can play a critical role in helping with the technical and institutional challenges of moving toward the deployment of automated vehicles for disadvantaged travelers by providing a source of ideas and innovations, objective assessments, and independent perspectives in working with the multitude of stakeholders.

Public Panel

Marisa Walker	Executive Director, Institute for Automated Mobility, Arizona Commerce Authority
Ram Pendyala	Professor and Director, the School of Sustainable Engineering and the Built Environment, ASU; Director, TOMNET UTC, ASU
Carol L Ketcherside	AICP, Deputy Director, Service Planning & Innovation
Gwo-Wei Torng	Director, Mobility Innovation, Office of Research, Demonstration, and Innovation, Federal Transit Administration, USDOT
Bill Tsuei	Access Services
Evelyn Blumenberg	Director, Lewis Center for Regional Policy Studies, UCLA; Professor, Luskin School of Public Affairs, UCLA

Workshop

The above persons plus:

Steve Polzin	Research Professor, Ira A. Fulton Schools of Engineering, ASU
Philip Law	Manager, Mobility Planning and Goods Movement, SCAG
Bayarmaa Alexandr	SCAG
Juan Matute	Deputy Director, Institute of Transportation Studies, UCLA
Anurag Komanduri,	Cambridge Systematics
Siwei Hu	UC Irvine
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