Preparing Your Agency for Transportation’s Autonomous Future

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The state of the art in autonomous and connected vehicle (AV/CV) technology is rapidly evolving for both personal vehicles and transit applications at the same time as new mobility business models continue to emerge. Public agencies have a challenging mandate to develop a framework that will support and manage private investment and opportunity while providing their own set of public services to members of the community in an equitable manner. The transportation community is “buzzing” from all the unique opportunities brought by these technologies, but there isn’t a firm understanding of the role that public sector agencies should have to both drive the evolution and to be ready for its impacts. While questions will continue to arise, this article will focus on exploring answers to the following two critical questions:

• With technology developing so rapidly, how can public agencies make informed decisions on where and how to most effectively devote public resources and investments to support personal AV/CV adoption?

• How can transit agencies incorporate emerging technologies to become more efficient, safe and equitable?

Preparing for Personal AV/CV Adoption

Autonomous vehicles will radically change the travel patterns, vehicle behavior and ultimately the infrastructure needed for safe and efficient travel. While our future is never certain, there are steps public agencies can take to make investments today that balance immediate needs with the flexibility necessary to meet the needs of tomorrow. This activity is frequently referred to as “future-proofing” an agency’s programs, policies, procedures and investments for prospective technology.

Travel Demand Scenario Planning

New technologies and travel options coupled with shifting user preferences necessitate a new approach to long-range transportation planning. The Florida Department of Transportation (FDOT) is beginning to utilize a new next-generation scenario planning tool called “TransFuture” to account for trends in AV adoption, societal changes and travel behavior. TransFuture allows users to define scenarios within regional travel demand models based on variables such as generational travel behavior, AV adoption and shared mobility usage. The output displays probabilistic results and confidence intervals for factors such as annual average daily traffic (AADT) and vehicle miles traveled (VMT). Figure 1 shows the variables considered in building a hypothetical scenario (in this case AV adoption rates), while Figure 2 shows the associated impacts on congestion and safety compared to the baseline.

Microsimulation

Tools like TransFuture can help agencies make more informed facility expansion decisions, but agencies must also validate the impact emerging transportation technologies will have on the operating conditions of facilities. One possible approach for incorporating AV/CV adoption and societal trends for operational analysis is through the use of microsimulation modeling. With microsimulation modeling, the behavior of vehicles that are being driven autonomously can be modeled as a function of various penetration rates. Reduced headways, harmonized speeds and avoidance of speed shockwaves can all be modeled. For example, as part of the Interstate 80 Planning and Environmental Linkages Study, Iowa DOT customized its microsimulation models to account for AV/CV characteristics such as reduced headways, a lower distribution of driving speeds and the ability to form multi-vehicle platoons. A range of AV adoption rates were applied to determine the resulting impact on vehicle throughput. Figure 3 compares 2040 scenarios to existing conditions for a rural segment of I-80 in Iowa. Based on this finding, it was determined that high levels of AV adoption could delay the need for additional Interstate 80

Figure 1. Setting Autonomous Vehicle Adoption Rates for a Travel Demand Scenario in TransFuture

Figure 2. Example Monte-Carlo Simulation Results from TransFuture for a Roadway Segment for a Scenario Considering Congestion and Crashes
expansion by 20 to 30 years or more when compared to standard analyses that omit the impacts of AVs. Similar improvements in safety benefits were also observed.

Roadmapping
There remains considerable uncertainty in AV adoption rates, which can make it difficult for agencies to plan their investment strategies. For example, the predicted adoption rate of AV in the year 2030 ranges from 10 percent to 40 percent, and in 2040 the range is even wider: 20 percent to 85 percent. Whether we see a conservative or aggressive rollout of AVs, agencies can establish roadmaps to characterize facility needs at certain adoption thresholds. Figure 4 shows the middle ground in adoption of AVs, with corresponding technology roadmaps with the includes the following key steps:

• Today: Include AV-CV considerations in project planning and prioritization
• 2020: Equip facilities with infrastructure-based CV equipment and determine the appropriate pavement marking
• 2030: Prioritize construction of dedicated AV lanes on highways
• 2040: Provide additional dedicated AV lanes in response to market demand
• 2050: Equip highways with smart pavement that can dynamically shift lane uses and restrictions based on real-time conditions.

Preparing for Transit AV Adoption
Many transit agencies will find that infrastructure future-proofing strategies are similar to public transportation agency planning for incorporating personally-owned AVs. However, transit authorities can also adopt strategies to help prepare themselves to be autonomous transit vehicle owners and operators. Figure 5 illustrates areas where agencies are planning or already operating pilot projects to determine AV infrastructure needs, evaluate AV microshuttle performance and provide an opportunity for the public to interact with the technology firsthand.

AV adoption in the transit sector could take numerous forms, from full-size AV buses serving high-capacity routes to microshuttle vehicles that act as first- and last-mile circulators. One potential early adoption of AVs in the transit environment is with “microshuttle” vehicles. These vehicles are smaller 12-15 passenger vehicles that operate at low speed and can navigate fixed routes autonomously. These AV microshuttles have enjoyed high visibility at recent industry conferences and limited-scale demonstrations.

Understanding AV Microshuttle Capabilities
The Jacksonville Transportation Authority (JTA) plans to use AVs to modernize and expand its Skyway people mover as part of its Ultimate Urban Circulator (UUC) vision. In support of this effort, JTA recently opened an AV test track where it will rotate through vehicles from different manufacturers to test a range of sizes, speeds, and capabilities. In designing its test track, JTA considered factors such as vehicle monitoring, traffic signal technology, pavement marking and station design to create an AV-friendly environment. Additionally, a concept of operations was developed to describe how AV microshuttles should respond to a range of possible scenarios.

Incorporating AV Microshuttles into Existing Transit Systems
The City of Lincoln, Nebraska, recently kicked off the planning phase to deploy four autonomous microshuttles into a mixed-traffic scenario on public roads. It is one of the most ambitious AV transit projects in the country. This two-year pilot will establish a fully operational service open to the public to help the Lincoln community become familiar with AV microshuttles, and to allow city officials to evaluate how these vehicles can be incorporated into a transit system at a larger scale. The proposed system will be demand-responsive, meaning shuttles will be on an AV test track. Additionally, Eric was a key contributor to the City of Columbus Smart City Challenge application and the initialization of the Smart Columbus Program Office.

Conclusion
Roadway owners and operators should begin incorporating projected AV/CV adoption rates and societal trends into their travel demand and microsimulation models now to avoid over-investing in new capacity or under-investing in infrastructure-based technology. Similarly, transit agencies ought to begin considering the implications of owning and operating AV transit vehicles. Luckily, there are numerous examples of agencies that have successfully launched efforts aimed at achieving each of these objectives.

The advent of these emerging technologies will also enhance the data available to agencies and present the opportunity to respond more directly to the user needs unique to each community. By understanding the capabilities and market penetration of AV/CV technology at the global scale, combined with local conditions and user needs, public agencies can shift their approach to transportation from a problem to be solved toward a mechanism for solving societal problems. Ultimately, the goal of public agencies is to ensure safe, efficient and equitable access to mobility. Emerging technology adoption will enable agencies to meet this mandate in new and better ways.

About the Authors:
Eric Plapper is a Project Manager in HDR’s Transportation Technology practice. He has seven years of experience analyzing transportation systems, from both policy and technical perspectives and advising communities on innovative solutions. He is currently leading the Autonomous Vehicles and Shared Mobility project for the Jacksonville Transportation Authority (JTA), which included a regional stakeholder visioning workshop, concept of operations, and 10% design of JTA’s pilot test track. Additionally, Eric was a key contributor to the City of Columbus Smart City Challenge application and the initialization of the Smart Columbus Program Office.

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