TASK FORCE ON AUTONOMOUS VEHICLES

Framing the Future for Autonomous Vehicles in Oregon

Memorandum

To: Oregon Task Force on Autonomous Vehicles, Subcommittee on Land Use
From: ODOT Staff
Date: August 13, 2019
Re: Examples from Other Jurisdictions

Introduction

Because there is little national guidance on automated vehicles and land use policy, subcommittee members instead researched examples of land use planning and projects undertaken by cities to prepare for the deployment of automated vehicles. Subcommittee members were asked to focus their research on three specific aspects of a city's AV planning: data needs, land use planning and greenhouse gas reduction goals, and pricing (including road and curb pricing). This document summarizes that research.

Austin, Texas

Background

The state of Texas has passed an AV law that preempts local regulation of automated motor vehicles and automated driving systems. The law specifies that the owner of an automated driving system is the operator of the vehicle when the system is engaged and the system is considered licensed to operate the vehicle. It allows an automated motor vehicle to operate in the state regardless of whether a human operator is present in the vehicle, as long as certain requirements are met.

Waymo has been testing automated vehicles in Austin since 2015, when it had its first truly driverless ride in Northeast Austin. In addition, Cap Metro, Austin's transit agency, is testing 6-8 minibus-style automated vehicles with an operator on board. Mayor Steve Adler said, "Austin should be to automated vehicles what Detroit was to the last century of automakers."

Data

The city partnered with INRIX in 2018 on a platform that will let the city identify traffic rules and obstructions on a road-by-road basis and then share that data with autonomous vehicle providers (see INRIX AV Road Rules). This digitizes local rules such as speed limits, school zones and stop signs for automated vehicles.

The Riverside Corridor is the first site in the country to roll out connected vehicle reference implementation architecture (CVRIA) signal controllers. These are standards the USDOT has established for how intersections communicate with vehicles.

Planning

In February 2019, Austin released its Draft Strategic Mobility Plan. While the plan does not specifically address automated vehicles, it sets goals that could be affected by the deployment of automated vehicles, including sustainability indicators and targets and land use indicators and targets.

Pricing
Austin's Draft Strategic Mobility Plan also discusses pricing, including curb management. While it does not specifically address automated vehicles, it raises issues that would be relevant at the deployment stage:

*"*Parking management could incorporate innovative curb management techniques to help reduce congestion, such as technology that alerts drivers to available spaces so they are not adding to traffic by circling in search of parking spaces. Properly pricing public parking at market rate could also help ease congestion by evenly distributing the demand across the parking system and making other travel choices attractive to more users. Flexible curb use could also enhance mobility by allowing various purposes for parking spaces during different hours of the day, such as valet parking, ride-hail pickup and drop-off locations, or as public spaces such as parklets."

In addition, the University of Texas at Austin conducted a study on automated vehicles and congestion pricing, "Congestion Pricing in a World of Self-Driving Vehicles: An Analysis of Different Strategies in Alternative Future Scenarios." According to the university, "This work develops multiple CP and tolling strategies in alternative future scenarios, and investigates their effects on the Austin, Texas network conditions and traveler welfare, using the agent-based simulation model MATSim. Results suggest that, while all pricing strategies reduce congestion, their social welfare impacts differ in meaningful ways. More complex and advanced strategies perform better in terms of traffic conditions and traveler welfare, depending on the development of the mobility landscape of autonomous driving. The possibility to refund users by reinvesting toll revenues as traveler budgets plays a salient role in the overall efficiency of each CP strategy as well as in the public acceptability."

Lincoln, Nebraska

Background
Nebraska passed statewide legislation authorizing the use of automated driving systems and driverless-capable vehicles. With a federal exemption, automated-driving-system-equipped vehicles may operate on any road in the state with or without a conventional driver physically present in the vehicle. If a conventional driver is present, they are required to hold a valid operator's license. The vehicle must follow all the rules of the road. Automated vehicles may also be used for network transportation, including ride-sharing and public transportation. In the event of a crash or collision, the automated driving system-equipped vehicle is required to stay at the scene of the incident and comply with existing laws for motor vehicle crashes. Nebraska law also includes a provision that clearly states that no state or any political subdivision is required to plan, design, construct, maintain, or modify any road for the accommodation of automated vehicles.

In 2018, more than 1,500 riders participated in the test of a Navya shuttle at Nebraska Innovation Campus. It was like an "autonomous vehicle Uber-pool," simulating the experience of calling a vehicle through an app, engaging residents along the way to identify best pickup and drop-off spots and key application features. General response was positive. The goals of the project included:

- Easing traffic congestion and preserving air quality in response to a growing population.
- Providing safe and efficient transportation systems for Lincoln residents and visitors.
- Accommodating evolving rider needs and new technologies in StarTran's strategic plan.
- Attracting new businesses, residents and visitors to Lincoln and Nebraska.

The team intends a broader rollout, which they hope might help more seniors and others living downtown, but are still pursuing alternative funding.

Planning

Lincoln has not incorporated automated vehicles into their planning documents, but the energy and land use goals identified in the Lincoln Environmental Action Plan could be relevant for electric automated vehicles. Goals include reducing per capita greenhouse gas emissions, increasing the use of renewable energy, and maintaining and increasing greenways.

Ann Arbor, Michigan

Background

Ann Arbor's approach to autonomous vehicles is two fold. The University of Michigan has built a 32-acre ghost town (Mcity) for the purpose of testing AVs. It provides a controlled environment to test cybersecurity, driver engagement, vehicle-driver transitions, and other aspects of how people interact with AVs. [1] The university also explored the deployment of up to 50 on-demand shuttles on its campus, operating on university-controlled roads, outside the confines of Mcity.[2] Additionally, Ford Motor Company and Domino's Pizza are simulating how people might interact with AV-enabled services through a month-long pizza delivery test using AV-capable vehicles accompanied by a human safety engineer in the driver's seat.

Planning

One report, the *Road Map of Autonomous Vehicle Service Deployment Priorities in Ann Arbor,* assessed the opportunities for AV deployment within Ann Arbor. [3] The approach used a travel demand analysis to determine number of trips between zones of interest and estimated the number of trips taken via public transportation in order to develop a "demand profile." They found that private, single passenger AV use does not offer substantial improvements in energy consumption or congestion. They also concluded that more convenient travel may stimulate more frequent/longer trips.

The report also looked at vehicle characteristics required to provide a given autonomous mobility service in an increasingly sustainable and equitable manner. The report notes that shared AVs, because they will be subject to heavier use, can improve transportation sustainability by having shorter lifespans, allowing newer, more efficient vehicles to take their place. While rapid replacement seems counterintuitive, a large majority of a vehicle's life cycle energy consumption occurs during the use phase (burning fuel). Ride-sharing can lead to further improvements in sustainability performance by removing vehicles from the road, but there needs to be a balance between sharing rides and efficiently routing trips to minimize riders' distance and time traveled. If ride-sharing becomes too inconvenient due to longer trips, rider participation will be low. The report recommends prioritizing shared AV deployment to "most efficiently utilize transportation resources and enhance sustainability."

---

[1] Anuj Pradhan, Examination of Operator State Monitoring and Operator Engagement as Strategies for Mitigating Human Factors https://mcity.umich.edu/research/examination-of-operator-state-monitoring-and-operator-engagement-as-strategies-for-mitigating-human-factors-challenges-associated-with-transfer-of-control-during-automated-driving/

[2] Mcity Driverless Shuttle: A Case Study https://mcity.umich.edu/wp-content/uploads/2018/09/mcity-driverless-shuttle-case-study.pdf

[3] Gregory A. Keoleian, Lidia P. Kostyniuk, Tulga Ersal, Cory Wydysh, Geoffrey Lewis, and Jeffrey L. Stein, Report No. CSS16-2,1September 30, 2016 http://css.umich.edu/sites/default/files/publication/CSS16-21.pdf

"Adjusting the mode supplying transit service according to demand will result in higher return on investment and a more self-sustaining business. Alternatively, novel transit modes can be introduced that provide a new service or support existing modes (e.g., last-mile) that may tap into latent demand for travel."[4]

The report concludes that, AV deployment on public roadways should occur in a controlled manner within environments that they are prepared for and which can safely accommodate unmanned vehicles. "When AVs move outside of designated testing centers such as Mcity, permissible roadways must be explicitly defined and enforced."[5] "From serving single origin-destination trips, deployment can then be expanded to confined areas where any origin/destination can be served as long as the AV remains in the permitted area. This sort of service could occur within a shopping or downtown center, or at events such as concerts or sports games, where demand analysis shows high intra-zonal flows."[6]

Tokyo, Japan

Background

The Japanese government is aspiring to have AV fleets available in time for the 2020 Olympic games.[7] AVs provide an opportunity to address challenges posed by Tokyo's growth and aging population. Japanese automotive-tech houses began 3-D mapping the country's roadways to get them ready for autonomous vehicles. In 2018, a self-driving taxi was deployed in Tokyo as a part of the pilot.

Planning

While there is information regarding the efforts to ensure the cyber security of AVs and the technological development of the AVs themselves, there is little information regarding the land use planning aspects of the push.[8] In part this may have to do with the fact that in Tokyo, in particular, individuals are used to public transportation because it is expensive and difficult to own a car in the city. A project conceptualization document identifies urban and rural infrastructure concerns and priorities.[9] Additional information is available on the SIP- adus site: http://en.sip-adus.go.jp/topics/

Tallinn, Estonia

Background

Tallinn is the capitol of Estonia and is home to the Tallinn University of Technology. The city has done a fair amount of work to prepare for the deployment of automated vehicles, including efforts to draw technology companies to Estonia.

Estonia is home to Starship Technologies, which has developed local delivery robots. The delivery robots have been trialed extensively in Tallinn, delivering goods to downtown businesses and to suburban

---

[4] Id. p 45

[5] Id. p 47

[6] Id.

[7] Janet Burns, Japan's Leaders Want To Make Tokyo A Self-Driving City For 2020 Olympics, Forbes, Sep 8, 2016. https://www.forbes.com/sites/janetwburns/2016/09/08/japanese-leaders-aim-to-make-tokyo-a-self-driving-city-for-2020-olympics/#1673e3cf1090

[8] Reuters, June 15, 2017, Tokyo Taxi Firm Teams With This Robotics Maker to Have Self-Driving Cabs for 2020 Olympics. http://fortune.com/2017/06/15/tokyo-2020-olympics-self-driving-cars/

[9] Implementing the ART (Advanced Rapid Transit) system https://www8.cao.go.jp/cstp/tyousakai/olyparatf/project/pj4_en.pdf

residents. The trial results are promising, but interaction between the delivery robots and pedestrians presents challenges. Possible next steps include using a "mothership," a large delivery trucked parked near downtown and from which the robots travel a few hundred yards to deliver goods.[10]

Tallinn also tested small automated buses in August 2017. Public reaction was generally positive and there were no major safety incidents.[11]

Tallinn has a regulatory framework for the delivery robots, but no information was available on efforts in Tallinn to address automated vehicles and planning, pricing or data.[12]

Pittsburgh, Pennsylvania

Background

Pittsburgh has been home to significant automated vehicle testing activity. Carnegie Mellon University has been on the cutting edge of automated vehicle research and development. In addition, Uber and a handful of other companies have testing automated vehicles in the city, although testing was temporarily halted after the fatal Uber crash in Arizona.

Planning

The Pennsylvania Department of Transportation has been relatively open to automated vehicle testing, as has the city of Pittsburgh. In March, the mayor published the Pittsburgh Shared and Autonomous Mobility Principles, which lays out the cities goals,[13] including:

- Supporting cities and street design that prioritizes people and human safety
- Enhancing access and connectivity for all residents across both city and region
- Ensuring equitable service across geography, socio-economic groups, and time
- Protecting public mobility and mass transit as the most accountable, transparent and sustainable mobility option
- Promoting shared, higher occupancy vehicles for people and freight
- Promoting and enabling land development patterns that locate everyday destinations and needs in close proximity to people
- Integrating mobility systems for seamless travel and access

Data

Other goals outlined in the Pittsburgh Principles address data issues, including the goal of "increasing open and shared data while protecting civil liberties and individual and system security." [14]

---

[10] "The Future of Transportation in Tallinn, Estonia," Tallinn Transport Department and Freight Tails, 2018. https://urbact.eu/sites/default/files/media/freight_tails_case_study._the_future_of_transportation_in_tallinn_estonia._april_2018_0.pdf

[11] "Driverless buses traveled 1,300 km in month in Tallinn," *Postimees*, 2017. https://news.postimees.ee/4224601/driverless-buses-traveled-1-300-km-in-month-in-tallinn

[12] Thomas Hoffmann and Gunnar Prause, "On the Regulatory Framework for Last-Mile Delivery Robots," MDPI, 2018. https://www.mdpi.com/2075-1702/6/3/33/pdf

[13] Ashley Murray, "Mayor Peduto, self-driving car companies announce 'Pittsburgh Principles,'" *Pittsburgh Post-Gazette*, 2019. https://www.post-gazette.com/local/city/2019/03/04/Mayor-Peduto-self-driving-car-companies-announce-Pittsburgh-Principles/stories/201903040058

[14] "Pittsburgh Shared and Autonomous Mobility Principles," City of Pittsburgh, Office of the Mayor. http://pittsburghpa.gov/domi/autonomous-vehicles

San Jose

Background
California has passed some of the most detailed laws regarding automated vehicle testing and deployment in the U.S. Over sixty companies have applied for and received permission to test automated vehicles on public roads in California, and testing is ongoing in several locations throughout the state.

Several companies are testing automated vehicles in San Jose, including General Motors and Waymo.

Planning and Data
In 2017, San Jose issued a Request for Information about pilots for automated vehicle technology. San Jose was "most interested in understanding how autonomous vehicles could advance" various city goals, including reducing the environmental impact of vehicle miles traveled, creating a more livable and walkable city, and sharing and utilizing data to optimize the transportation system and protect residents' privacy.[15]

Seattle

Background and Planning
In 2017, the Seattle Department of Transportation published the "New Mobility Playbook," which they described as "a set of plays, policies, and strategies that will position Seattle to foster new mobility options while prioritizing safety, equity, affordability, and sustainability in our transportation system." The playbook provides a brief history of transportation technologies in Seattle, establishes principles for new mobility, and identifies next steps.[16]

The principles for new mobility are as follows:

- Put people and safety first
- Design for customer dignity and happiness
- Advance race and social justice
- Forge a clean mobility future
- Keep an even playing field

The playbook also identifies five "plays" or parameters for new mobility:

- Ensure new mobility delivers a fair and just transportation system for all
- Enable safer, more active and people-first uses of the public right of way
- Reorganize and retool SDOT to manage innovation and data
- Build new information and data infrastructure so new services can "plug-and-play"
- Anticipate, adapt to, and leverage innovative and disruptive transportation technologies

Data

---

[15] "Request for Information: Pilot for Autonomous Vehicle Technology," City of San Jose, 2017. https://moti.sanjosemayor.org/wp-content/uploads/2018/10/AV-RFI-SJ.pdf
[16] "New Mobility Playbook," Seattle Department of Transportation, 2017. https://www.seattle.gov/Documents/Departments/SDOT/NewMobilityProgram/NewMobility_Playbook_9.2017.pdf

In 2018, Seattle conducted an evaluation of their bike share program, including data collection methods. For example, Seattle learned that "rides per bike per day is a less useful metric for free-floating than for dock-based bike share systems." Seattle also learned that while trip start and end data was useful, waypoint data from the middle of a trip was also essential to fully understanding how people were using the bike share.[17]

While this information does not pertain directly to automated vehicles, lessons learned from other new mobility options may be applicable to automated vehicle pilots and deployments.

[17] "2017 Free-Floating Bike Share Pilot Evaluation Report," Seattle Department of Transportation, 2018. https://www.seattle.gov/Documents/Departments/SDOT/BikeProgram/SDOTBikeShareEvaluationReport2017.pdf