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/Land Use Subcommittee members
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: 1) data needs, 2) land use planning and greenhouse gas reduction goals, and 3) pricing (including road and curb pricing). This document summarizes that research.

The cities below represent a sampling from across the U.S. and the world. This document is not meant to be comprehensive. For a more complete list of cities that are preparing for automated vehicles, see Bloomberg's "Initiative on Cities and Autonomous Vehicles," which includes a global atlas.[1]

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.[2] This digitizes local rules such as speed limits, school zones and stop signs for automated vehicles.

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[1] "Initiative on Cities and Autonomous Vehicles," Bloomberg Philanthropies and the Aspen Group. https://avsincities.bloomberg.org/global-atlas/
[2] "Inrix Road Rules," Inrix. http://inrix.com/products/road-rules/

The Riverside Corridor is the first site in the country to roll out connected vehicle reference implementation architecture (CVRIA) signal controllers.[3] 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."[4] 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

[3] "ITS Standards Program: Development Activities for Connected Vehicle Reference Implementation Architecture (CVRIA)," U.S. Department of Transportation, Intelligent Transportation Systems Joint Program Office. https://www.standards.its.dot.gov/developmentactivities/cvreference
[4] Michele D. Simoni, Kara M. Kockelman, Krisha M. Gurumurthy, Joschka Bischoff, "Congestion Pricing in a World of Self-Driving Vehicles: An Analysis of Different Strategies in Alternative Future Scenarios," University of Texas at Austin. https://arxiv.org/pdf/1803.10872.pdf

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 twofold. 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. [5] 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.[6] 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

[5] 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/

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

One report, the *Road Map of Autonomous Vehicle Service Deployment Priorities in Ann Arbor,* assessed the opportunities for AV deployment within Ann Arbor. [7] 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."

"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."[8]

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."[9] "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."[10]

Tokyo, Japan

Background

The Japanese government is aspiring to have AV fleets available in time for the 2020 Olympic Games.[11] 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.

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[7] 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
[8] Id. p 45
[9] Id. p 47
[10] Id.
[11] 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

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.[12] 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.[13] 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 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.[14]

Tallinn also tested small automated buses in August 2017. Public reaction was generally positive and there were no major safety incidents.[15]

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.[16]

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

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[12] 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/
[13] Implementing the ART (Advanced Rapid Transit) system https://www8.cao.go.jp/cstp/tyousakai/olyparatf/project/pj4_en.pdf
[14] "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
[15] "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
[16] 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

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,[17] 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." [18]

San Jose, California

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.[19]

Seattle, Washington

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."

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[17] 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

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

[19] "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

The playbook provides a brief history of transportation technologies in Seattle, establishes principles for new mobility, and identifies next steps.[20]

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

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.[21]

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.

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[20] "New Mobility Playbook," Seattle Department of Transportation, 2017. https://www.seattle.gov/Documents/Departments/SDOT/NewMobilityProgram/NewMobility_Playbook_9.2017.pdf

[21] "2017 Free-Floating Bike Share Pilot Evaluation Report," Seattle Department of Transportation, 2018. https://www.seattle.gov/Documents/Departments/SDOT/BikeProgram/SDOTBikeShareEvaluationReport2017.pdf

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: Considerations for Pricing for Highly Automated Vehicle by Occupancy

Purpose of Pricing Automated Vehicle by Occupancy

A common question about highly automated vehicles is whether they will decrease or increase congestion. Automated vehicles could decrease congestion if people share rides, reducing the total number of vehicles on the road. In contrast, automated vehicles could increase congestion if rides are not shared and if increased convenience and lower costs encourage people to take more or longer trips. For example, in 2018 Fehr and Peers tested "how AVs might change the predicted outcomes of nine regional travel models from around the U.S." and found that in all nine models, automated vehicles increased vehicle miles traveled (VMT).[i]

In particular, automated vehicles could enable zero occupancy trips, trips with no human passengers. For example, an empty automated fleet vehicle could circle within an urban area awaiting a customer to call it to a specific location for pick-up. Alternatively, a personally-owned automated vehicle could drop the owner off at work and, rather than pay for parking, drive itself home and then return at the end of the day to pick the owner up. To keep congestion from increasing, the system may need to dis-incent owners (companies or individuals) from zero-occupancy operation. One identified method to discourage these scenarios is to charge fees on vehicles operating with zero occupancy.

Occupancy pricing policies could also promote ride-sharing and the use of high-occupancy vehicles, leading to more efficient use of road space. According to the Federal Highway Administration's 2017 National Household Travel Survey, the mileage-weighted occupancy factor for all vehicles is 1.67.[ii] Increasing the average vehicle occupancy by sharing rides in automated vehicles could decrease the number of vehicles on the road. This could improve congestion, although it's important to note that potential congestion reduction depends on the mode shift; if the people choosing to share rides in automated vehicles previously used transit or active transportation options, vehicle miles traveled and congestion could increase.[iii]

Reducing congestion and the total number of vehicles on the road could also provide a number of co-benefits. For example, reducing congestion has been shown to also reduce greenhouse gas emissions.[iv] Congestion also contributes to air pollutants and increases the risk of crashes. Above a certain threshold, congestion can also begin to negatively affect the local economy.[v] If automated vehicles increase congestion, they could also worsen these second-order effects, making occupancy pricing and other strategies for congestion management more important.

Methods of Pricing Automated Vehicles by Occupancy

Many jurisdictions in the U.S. already price vehicles by occupancy on highways and major thoroughfares through implementation of high-occupancy vehicle (HOV) or high-occupancy toll (HOT) lanes. An HOV lane is a restricted lane reserved for the exclusive use of vehicles with multiple occupants, with a typical minimum of two or three. HOV lanes are designed to encourage carpools, vanpools, and ridesharing as a

means of reducing congestion. Vehicles in the HOV lane are usually exempt from tolls or pay reduced fees. For example, in Virginia drivers with three or more people in their cars can set their E-ZPass Flex to "HOV mode" and use the express lanes on I-495 and I-95 for free.[vi] This type of HOV lane prices occupancy be reducing or waiving fees for vehicles with more passengers.

An HOT lane is an HOV lane that lower-occupancy vehicles can access by paying a fee, which in many cases varies by demand. HOV lanes are attractive even to low-occupancy vehicles because they are often less congested than mixed-use lanes. An HOT lane prices occupancy by both reducing or waiving fees for high-occupancy vehicles and imposing additional costs on lower-occupancy vehicles that use this faster-moving lane.

Both HOV and HOT face challenges with compliance and enforcement. Image processing technologies that could help identify non-compliant vehicles have been hampered by windshield glares and poor lighting, so enforcement has by and large been conducted by police officers. In addition, HOV and HOT lanes are only used on highways or major thoroughfares and are not suitable for pricing occupancy in urban cores or on other types of roads. Furthermore, an unoccupied automated vehicle may not be able to switch an E-ZPass Flex to "HOV mode" or use other similar counting techniques designed for human drivers or passengers.

Researchers are exploring alternative methods of vehicle occupancy verification for purposes of pricing, including in-vehicle detection technology. Possibilities include weight sensors, infrared sensors, ultrasound and image sensors, which are already deployed for advanced safety functions such as airbag systems. Connected vehicle technology could provide another method of reporting vehicle occupancy. However, all of these technology solutions would require widespread adoption by automated vehicle manufacturers and could entail changes to federal motor vehicle design standards. These technological solutions may also raise privacy concerns regarding in individual's geolocation data, which would need to be addressed before implementation.[vii]

Subcommittee Recommendation

The Subcommittee on Land Use has identified the occupancy pricing as a central mechanism to reduce the potential for highly automated vehicles (HAVs) to negatively impact Oregon's adopted policies and goals. The subcommittee suggests further exploration of this method, and others, to ensure automated vehicles further Oregon's adopted goals.

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[i] "Will AVs Dramatically Increase Vehicle Trips and VMT?" Fehr and Peers, 2018. https://www.fehrandpeers.com/autonomous-vehicle-research/

[ii] "National Household Travel Survey," U.S. Department of Transportation, Federal Highway Administration, 2019. https://nhts.ornl.gov

[iii] Lew Fulton, Jacob Mason, and Dominique Meroux, "Three Revolutions in Urban Transportation," UC Davis Institute of Transportation Studies and the Institute for Transportation Policy and Development, 2017. https://www.itdp.org/2017/05/03/3rs-in-urban-transport/

[iv] Matthew Barth and Kanok Boriboonsomsin, "Real-World CO2 Impacts of Traffic Congestion," Transportation Research Record, Journal of the Transportation Research Board, No. 2058, Transportation Research Board, National Academy of Science, 2008. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.367.5168&rep=rep1&type=pdf

[v] Matthias Sweet, "Traffic Congestion's Economic Impacts: Evidence from US Metropolitan Regions," Urban Studies Journal, 2013. https://journals.sagepub.com/doi/abs/10.1177/0042098013505883

[vi] "Learn the Lanes," Transurban Express Lanes. https://expresslanes.com/learn-the-lanes

[vii] Ching-Yao Chan, Fanping Bu, Krute Singa, and Huili Wang, "Implementation and Evaluation of Automated Vehicle Occupancy Verification," University of California, Berkeley, 2011. http://actweb.org/wp-content/uploads/2016/04/CalTrans-Automated-Vehicle-Occupancy-Verification.pdf

TASK FORCE ON AUTONOMOUS VEHICLES

Framing the Future for Autonomous Vehicles in Oregon

August 14, 2019

Recommendations to Use Oregon's Autonomous Vehicle Work to Further Existing State of Oregon Goals

The Land Use Subcommittee recommends the State of Oregon's work to integrate automated vehicles into its transportation system makes certain to:

1. Set the safety of people using the roadways as its first priority, supporting Oregon's Transportation Plan, Transportation Safety Action Plan, Bicycle and Pedestrian Plan, Transportation Options Plan, and ODOT's Key Performance Measures for safety, and ODOT's mission of zero fatal and serious injuries by 2035.

2. Take advantage of key opportunities to meet its commitment to reducing greenhouse gas emissions under 2017 ORS 468A.205, the Statewide Transportation Strategy, and metropolitan planning organization plans. This may include giving preferences to lower-polluting forms of travel, creating incentives for lower-polluting travel by autonomous vehicles (such as electric vehicles or high-occupancy trips), and exploring options to reduce overall trips.

3. Further (and avoid undermining) the goals of the Oregon Public Transportation Plan, particularly equity, mobility, and funding.

4. Further the goals of the Oregon Transportation Plan, particularly funding the transportation system, mobility and accessibility, sustainability and economic vitality.

5. Support Oregon's Land Use Planning Goals, particularly housing, transportation, and urbanization goals.

6. Emphasize Business Oregon's Strategic Plan Priorities, particularly in innovation and growth of small and middle-market companies.

7. Protect underserved populations in Oregon and implement equity-related goals in adopted state-wide plans and policies that ensure that HAV increase access to mobility, reduce environmental pollution, and enhance economic opportunities in underserved neighborhoods and communities.

TASK FORCE ON AUTONOMOUS VEHICLES

Framing the Future for Autonomous Vehicles in Oregon

RECOMMENDATIONS

To: Task Force on Autonomous Vehicles
From: Subcommittee on Land Use
Date: August 14, 2019
Re: Recommendations for Data and Privacy Principles

Introduction

The Land Use Subcommittee recommends the following principles to guide the Legislature in establishing Oregon's policy framework for automated vehicles. They are intended to be reflective of the deliberations of the Land Use Subcommittee on data needs (including the Public Sector Data Needs memo submitted by the Subcommittee) as well as the discussion of the Joint Meeting of the Land Use and Cybersecurity and Data Subcommittees on data management and privacy protection.

Recommendations

1. The needs and use cases for automated vehicles will continue to evolve. Oregon should establish policies and systems that address the current known use cases and risks of automated vehicle data while allowing flexibility to amend these systems in the future.

2. Data should be properly managed by both public agencies and private companies to avoid compromising personal privacy and proprietary information.

3. To the extent possible, Oregon's policies and practices with respect to collecting and managing automated vehicle data should draw on established best-practice policies (such as the California Consumer Privacy Act) and data standards (such as the Mobility Data Specification) to create consistency for both operators and policymakers.

4. Public agencies that have the authority to regulate automated vehicles should have access to data on automated vehicle trips and usage to manage and plan for automated vehicles.

5. Public agencies that have the authority to regulate automated vehicles or transportation services that use automated vehicles should have the authority to require the data as needed to enforce those regulations.

6. Public agencies should create processes for assessing the privacy risks of automated vehicle data and instituting appropriate management practices before they collect data.

7. Public agencies that manage the public right of way should be clear under what circumstances, if ever, they would share automated vehicle data with law enforcement agencies or whether those agencies would have to follow established legal procedures to request data directly from private companies.

8. Any restrictions on how the public sector collects or uses automated vehicle data should also apply to private companies that manufacture or operate automated vehicles, except where such restrictions would prohibit basic operation of transportation services.

9. Privacy policies and protections should be tailored to the level of risk involved in the data in question. Entities that collect more sensitive information, or that collect information on greater numbers of people, should enact more extensive policies and protections than those that collect limited amounts of sensitive information.

TASK FORCE ON AUTONOMOUS VEHICLES

Framing the Future for Autonomous Vehicles in Oregon

To: Land Use Subcommittee Members of the Oregon Autonomous Vehicles Task Force

From: Eric Hesse, League of Oregon Cities' Task Force Representative

Date: April 18, 2019

RE: Public Sector Information Needs to Guide AV Policy and Manage AV Testing/Deployment

Background

As Oregon defines its policy and legal framework for the testing and deployment of Autonomous Vehicles (AVs), state, regional and local governments will require certain information to effectively fulfill their roles in implementing and advancing adopted policy goals and enforcing existing and developing new laws to protect and advance the public interest. As managers of the public realm, including the public rights of way in which AVs will operate, public sector entities are rightly aiming to define policies and practices to ensure AVs will improve traffic safety, decrease congestion, boost transportation choices, and support a strong economy and vibrant community development. To enable effective short- and long-term land use and transportation planning as well as ongoing transportation system management, the private sector—using public roads—should be required to share useful information to assist in that effort.

Transportation agencies have always collected information on how people and vehicles travel to make sure that the transportation system and is safe and efficient for all users, and that companies that provide transportation services operate responsibly. Our infrastructure is built with public funds, and the public expects us to use data to oversee it responsibly. This memo aims to outline what information will be most useful in this regard and suggest ways in which it can be provided to ensure efficacy for the purposes above while duly protecting personal privacy and proprietary competitive information.

Why do public sector agencies need information about AVs?

To carry out their responsibility to plan and manage transportation and land use systems AVs, along with other recent developments in technology, both require us to improve the information that we use due to the significant impacts they will have on how people travel, and that they present an opportunity to do so because they collect large amounts of data. In order to fulfill State, Metropolitan Planning Organization (MPO) and local governmental responsibilities for federal and state transportation and land use planning requirements, we need better information to carry out our responsibilities for two key reasons:

- **The transportation system is changing more rapidly than ever before, so we need more up-to-date information.** Most transportation modelling is based primarily on the Household Travel Survey, which is part of the census. These surveys are so labor-intensive and costly, we only are able to update them every decade. Up until recently, this system worked fine because the way in which people traveled did not change that much from year to year, but that is no longer the case. The Portland Metro region's last travel survey was completed in 2010. Uber and Lyft began serving our metro area in 2015, and in 2018 they carried over 12 million trips in the City of Portland alone—and we have no way of accounting for these services in our transportation demand models used for planning and compliance purposes. Some

agencies, including Metro and the City of Portland, are exploring private data sources that promise to capture AVs and shared mobility, but these sources are expensive and are not always reliable. AVs will likely accelerate the pace of disruption, because there are dozens of companies poised to launch an Uber- or Lyft-like service when AVs arrive. We can't keep up with the pace of change unless we update the information we gather more frequently.

- **Vehicles aren't sticking to highways, so we need more geographically detailed information.** Up until recently, when traffic was bad most drivers used to stay on the main road because they didn't know a better route. Consequently, most transportation agencies placed the sensors that they use to conduct traffic counts on main roads. Now, GPS systems and apps like Waze help drivers find opportunities to shave a few minutes off their commutes by taking shortcuts down neighborhood streets to avoid congested areas; AVs will automate this process. In order to manage congestion and ensure that local roads are safe, it will no longer be sufficient for local governments to focus on freeways and major arterials; we will need information on how vehicles are using most streets. We need more detailed information on travel patterns, collisions and near-misses to better design the transportation system to keep everyone moving and prevent traffic deaths.

Agencies need information to address the unique opportunities and challenges presented by AVs

There are a host of unique issues that AVs present, and we need information on how they are traveling to take advantage of new opportunities and tackle new challenges:

- **Many AVs will likely be operated in shared fleets by private companies.** The first passenger AVs are expected to be deployed as shared vehicles by companies like GM, Waymo, Uber and Lyft, and some believe that AVs will usher in an era when far fewer people own cars. On one hand, this could allow us to convert parking lots into places for people and could make travel more convenient for everyone. On the other hand, it would fall to public agencies to ensure that profit-motivated companies provide safe and equitable service and create regulations or incentives to encourage them to help reduce congestion.

- **Local governments will also likely need to consider new methods of collecting transportation revenue.** As revenue from gas tax, vehicle registration fees, and parking fees decline significantly, mileage charges may be the most efficient and fair way to replace the gas tax. Many cities have enacted regulations on Uber and Lyft to ensure that they provide safe and equitable service, and some even collect fees from these services that they use to fund public transportation or wheelchair-accessible service. Local governments need to continue to have the right to regulate these services and collecting information on how these services operate is key to understanding their impact on the public roads, verifying the accuracy of payments, and developing and administering effective regulations that maximize the full potential of AVs.

- **Dedicating lanes for AVs could make the system more efficient for everyone.** AVs are expected to move more people per lane because they can travel in high-speed platoons—but this won't happen at scale if they are mixed with human-operated vehicles. We need to know how many AVs are using a roadway so that we can identify the point when it makes sense to dedicate roadway space to AVs to help them realize their potential while protecting public safety.

- **AVs can circle instead of parking, increasing congestion and emissions.** If parking is too costly or inconveniently located, travelers could direct their vehicles to circle the block or travel to a faraway lot instead of parking, adding to traffic and pollution. We need information on how AVs behave with no passenger in the car so that we can manage traffic and parking—and we won't get that information from surveying people on their travel behavior.

It is important to note that many of these information needs stem from interests that agencies and the public share with the companies that are advancing AV technology. We all want to reduce congestion and keep the transportation system in good shape so that everyone can get where they need to go, whether they are in an AV, a human-driven vehicle, or a bus. We all want to maximize the potential of AVs to make our streets safer and more efficient and our communities more vibrant. We are aligned with companies like Daimler, GM, Waymo, Uber and Lyft in wanting people to be able to share vehicles and trips. We understand companies' concerns about protecting confidential and competitive information, and we are already addressing these concerns and set the stage for collaboration in meeting our shared goals.

What information do state and local governments need to fulfill their responsibilities?

Information most relevant to understanding the impacts of AVs on travel and maximizing their benefits are listed below. The list is consistent with the National Association of City Transportation Officials' (NACTO) 2017 Data Sharing Principles.[1]

- **Trip origins, destinations, types (passenger, goods delivery, or zero-occupancy/goods), and time of day**, to understand travel demand. NACTO calls for origin/destination data at the block face level (i.e., which side of a city block a trip or ends at). Cities such as Portland, New York and Boston collect TNC data at the block face level or an even finer scale.

- **The number of vehicle occupants**, allowing Oregon to incentivize shared travel and capture value from zero-occupant vehicles. Cities have become more interested in occupancy data as the impacts of TNCs on congestion have become more apparent (New York and San Francisco).

- **Location and severity of collisions and location of instances of rapid acceleration and deceleration and sudden collision avoidance.** As Oregon's vision is to eliminate deaths and serious injuries on its transportation system by 2035, maximizing the safety benefits of AVs is a key opportunity to reach that goal. Transportation agencies use state and federal collision information to identify safety problems. Yet data on non-fatal collisions is not always available, and collisions are often under-reported. AVs can provide that information, including data on near-misses to help identify potentially dangerous locations before collisions occur. Most TNC regulations require collision reporting (for example, see Portland's City Code, section 16.40.280), and NACTO calls for collecting data on collisions and acceleration/deceleration.

- **Route traces and parking information** to understand how AVs are affecting travel patterns (e.g., whether vehicles cruise or park, whether AVs are rerouting onto local streets to avoid congestion and

[1] NACTO is preparing to release a policy paper on "Managing Mobility Data" in May 2019. This policy paper will build upon the referenced Data Sharing Principles and may be useful to this discussion.

how they may be contributing to congestion based on time and location). This is the only data point listed that is not reflected in NACTO's principles nor in existing TNC regulations, but we believe it is critical to fully understanding the impacts of AVs. For public agencies, collecting this data would create the risk of compromising personal information since detailed information on trip patterns could be used to identify individuals, and it would also pose technical issues associated with storing and managing large quantities of data. Potential ways to address these issues are discussed below.

- **Traffic volumes and length of trips (in minutes) and/or vehicle speeds** to identify congested trips and causes of delay.

- **Information on traffic violations by AVs.** While hopefully a small set of data, it would be helpful to understand if there are any underlying challenges of safely integrating law-constrained AVs into the transportation system with human-driven vehicles, bicycles and pedestrians. Information about AVs violating local traffic laws, speed limits, traffic signals, etc., would be useful.

Additional information from Transportation Network Companies (TNCs) operating AVs would be helpful to help ensure shared fleets provide safe and equitable service.

- **Service provider (e.g., Uber, Lyft) and type (e.g., UberBLACK, UberPOOL).** This is a standard requirement in city-TNC data sharing agreements. Cities are increasingly interested in service type since the introduction of shared TNC services, but few collect it.

- **Booking type (advance/real-time); wait time; cost of trip; and location, date, and time of unfulfilled, declined, and cancelled rides.** This information helps ensure shared fleets are meeting people's needs throughout our communities. Shared fleets might be able to provide travel options for those who need them the most. The evidence is mixed. Some studies of TNCs have found people of color, people in wheelchairs, and other marginalized groups face longer wait times and greater numbers of unfulfilled rider requests. Overlaying data on wait times, costs, and cancellations with Census demographic data can help us understand whether Oregonians are receiving equitable service.

- **Number and type of passenger complaints** can be a valuable resource for understanding safety and equity. Portland collects TNC complaint data (see pp 19-20 of the Greyball Audit Report).

How should information be provided?

Data must be properly managed to avoid compromising privacy and proprietary information, yet public agencies already manage a variety of sensitive data, including data on people's health and employment, while protecting privacy. Aggregation is the most common method to protect sensitive data, and one of the simplest to execute. Aggregation can enable agencies to readily use data to fulfill its responsibilities. Data can be aggregated spatially, temporally, or both. Other techniques such as truncation and synthesis can also help yield actionable information while protecting individual privacy.

Public agencies are not interested in individual trips per se; agencies are interested in travel patterns. That said, many transportation agencies may lack the technical capabilities and financial resources to manage large quantities of data. These agencies may need to rely on third parties to aggregate and manage geolocation data on their behalf. Third party data aggregation and management could be done through contracts with for-profit

companies; public- or private-universities; other cities, regional or county governments; transit agencies; and/or, state transportation agencies. The decision about whether a specific entity should aggregate and manage AV data likely depends on a variety of factors, such as, but not limited to, its technical capabilities; financial resources; cybersecurity measures; data retention requirements; any allowed secondary uses of the data; any allowed sale, disclosure, transfer, and assignment of the data to other affiliated and non-affiliated organizations; and, its privacy protections, including the ability to exempt sensitive data from public release.

At this point, it is difficult to recommend a one-size fits all approach to aggregating AV data. Needs vary by agency type (local agencies need finer-scale data than regional or state agencies) and type of data (we typically need more detailed data on safety than we do on travel patterns because we need to pinpoint collision "hot spots"). The level of data aggregation is also driven by the amount of data available. When less data points are available, data is aggregated at a larger scale in order to avoid revealing personal information or drawing conclusions based on samples that are not statistically significant. Eventually, AVs will likely carry enough trips that it will be possible to aggregate data at a very fine scale without compromising private/personal data or the validity of results, and the recommendations we offer below are based on this assumption. However, it may be necessary to rely on more aggregate data during the coming transition when AVs account for fewer overall trips. NACTO's 2017 Data Sharing Principles recommend aggregating different data to different scales, and our recommendations below, which are largely consistent with NACTO's recommendations, follow suit.

Data type	Spatial aggregation	Temporal aggregation
Trip origins and destinations	Block face	Hourly averages
Number of occupants	Street segment	Hourly averages
Safety (collisions, sudden acceleration/ deceleration)	Point (disaggregate)	Real-time
Route traces	Street segment or by origin/destination pairs, or disaggregate with trip ends truncated	Hourly averages
Traffic volumes and speeds	Street segment	Hourly averages
Booking type; wait time; cost of trip; unfulfilled, declined/cancelled rides	Census tract	Hourly averages
Passenger complaints	N/A (complaint data does not need to be spatial)	Real-time