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 increase the net benefits of HAVs.

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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