

# Policy Memo

Autonomous vehicles and land use

*June 11*

To: Scott Haggerty, chair of governing Commission of Bay Area Metropolitan Transportation Commission

From: Shen Qu, Policy Advisor

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RE: How Bay Area should be planning for autonomous vehicles?

## Summary

This memo is one of the series of policy analysis about autonomous vehicles for Bay Area. It tries to answer how the autonomous vehicles will affect urban land use, and What the MPO and cities should be planning to seize this opportunity and address the challenges.

## Background: Explains the current and projected status of AVs.

*Technology:* The history of exploring autonomous vehicles can date back to late 1950s (???). Since DARPA ran the Grand Challenge in 2004, the autonomous vehicle technologies entered a “critical juncture.” (Docherty, Marsden, and Anable 2018) In the fields of automation control systems, some critical hardwares like processors and sensors are having the ability of undertaking more complex tasks. The improving softwares and algorithm are becoming more fledged. According the definition and taxonomy by (international 2018), the existing technologies are achiving from the Level 3 - Conditional Driving Automation to Level 4 - High Driving Automation.<sup>1</sup>

*Industry:* Since 2009, Google had conducted a series of tests for AVs over 10 million miles on real-world roads in California, Texas, and other states. Waymo, a company founded by Google, hold the only testing permit for driverless testing by California DMV and committed to providing a ride-hailing services in Arizona in 2018. In 2019 Waymo announced their

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<sup>1</sup>SAE defines the concept of AV as ADS-DV (ADS-Dedicated Vehicle), “A vehicle designed to be operated exclusively by a level 4 or level 5 ADS for all trips within its given Operational Design Domain (ODD) limitations.” ADS means “The hardware and software that are collectively capable of performing the entire Dynamic Driving Task (DDT) on a sustained basis, regardless of whether it is limited to a specific ODD; this term is used specifically to describe a level 3, 4, or 5 driving automation system.”

Level 4 AV will be assembled in Detroit. Almost all big automakers such as Ford, General Motors, Volkswagen, etc., are investing heavily in this field.[Fagnant & kockelman, 2015] The leading transportation network companys (TNC) like Uber and Lyft are making up a term of transportation-as-a-service (Taas) to change current travel modes by AVs.

*Academia:* Many scholars start working on the reaserch of AVs with lots of energy. Gandia et al. (2019)'s reserch found 10580 published papers in this field from 1945 to 2018. Since 2012, the number of articles have an exponential growth with 39% growth rate while 8-9% average growth rate in science. Although a large amount of the research are from the perspective of systems control, computer science, robotics, engineering, there are more and more articles that start to focus on the AVs' impact on transportation and Land use.

*Governavce:* In 2011, the Nevada Department of Motor Vehicles issued a first license to google's experimental AVs. Currently, 22 states have passed legislation related to AV. Governors in 10 states have issued executive orders related to autonomous vehicles.

On Sep. 12, the National Highway and Transportation Safety Administration (NHTSA) released new federal guidelines for Automated Driving Systems (ADS). A Vision for Safety 2.0, the latest guidance for automated driving systems to industry and the states. The guidance builds on NHTSA's 2016 guidance.USDOT,

California is playing a leading role in this field. Until January 2019, California DMV has issued AV Testing Permits (with a driver) to 62 companies on public roadways.

<http://www.ncsl.org/research/transportation/autonomous-vehicles-self-driving-vehicles-enacted-legislation.aspx>

What are the crutial effects? What are the crutial response for land use?

**Changes: Discusses how AVs could influence demand for transportation and, in turn land use. For this analysis, use both theory and research.**

**focus on relevant changes**

(Milakis, Van Arem, and Van Wee 2017) Many substantial implications of autonomous vehicles are not considered in this memo, such as safety, liability, and etc. [riple effects]. This analysis focus on the impact on land use, wich have short-term and long-term influences. The short-term influences include che change of parking, urban design, affected by travel demand and behavior

Diamond of Assembly by[] and feedback cylce by []

The long-term influences include the reconstructure of urban forms and spatial distributions.

## **essence**

Four stage

Theory: bid-rent theory, utility maximize.

Research: Identifies the benefits and costs of these possible outcomes.

focus on Characteristic:

cut off labor cost,

round-the-clock services.

full ridesharing by realtime matching

Time cost (Singleton 2019)

## **Methodology**

high risk in use sufficient principle, and likelihood principle. another option is covariance principle.

Internet, Air Transport system, TNC

## **inference:**

Behavior and land use (Soteropoulos, Berger, and Ciari 2019)

(Hawkins and Nurul Habib 2019)

previous research had give many estimation of the change on road capacities, parking lots, curve space.

use cost and transaction costs - full match

deals fail

## **The short-term Response**

(Legacy et al. 2019)

Presents policy and planning options for mitigating or otherwise addressing the possible land use effects.

designating pilot area

housing,

parking,

urban design

## The strategic planning

long-term effects (Milakis 2019)

Discusses how the MPO and cities may need alter the tools and analyses they use to consider AVs.

Zoning, Division, and partion, not uniform

## Conclusion

overestimated and under estimate

from link to node

CA should play a leading role. responsibility

## Notes

## References

Docherty, Iain, Greg Marsden, and Jillian Anable. 2018. “The Governance of Smart Mobility.” *Transportation Research Part A: Policy and Practice* 115. Elsevier: 114–25. <https://doi.org/10.1016/j.tra.2017.09.012>.

Gandia, Rodrigo Marçal, Fabio Antonialli, Bruna Habib Cavazza, Arthur Miranda Neto, Danilo Alves de Lima, Joel Yutaka Sugano, Isabelle Nicolai, and Andre Luiz Zambalde. 2019. “Autonomous Vehicles: Scientometric and Bibliometric Review.” *Transport Reviews* 39 (1). Taylor & Francis: 9–28. <https://doi.org/10.1080/01441647.2018.1518937>.

Hawkins, Jason, and Khandker Nurul Habib. 2019. “Integrated Models of Land Use and Transportation for the Autonomous Vehicle Revolution.” *Transport Reviews* 39 (1). Taylor & Francis: 66–83. <https://doi.org/10.1080/01441647.2018.1449033>.

international, SAE. 2018. “Taxonomy and Definitions for Terms Related to Driving Automation Systems for on-Road Motor Vehicles.” *SAE International*,(J3016).

Legacy, Crystal, David Ashmore, Jan Scheurer, John Stone, and Carey Curtis. 2019. “Planning the Driverless City.” *Transport Reviews* 39 (1). Taylor & Francis: 84–102. <https://doi.org/10.1080/01441647.2018.1466835>.

Milakis, Dimitris. 2019. “Long-Term Implications of Automated Vehicles: An Introduction.” Taylor & Francis. <https://doi.org/10.1080/01441647.2019.1545286>.

Milakis, Dimitris, Bart Van Arem, and Bert Van Wee. 2017. “Policy and Society Related Implications of Automated Driving: A Review of Literature and Directions for Future Research.” *Journal of Intelligent Transportation Systems* 21 (4). Taylor & Francis: 324–48. <https://doi.org/10.1080/15472450.2017.1291351>.

Singleton, Patrick A. 2019. “Discussing the ‘Positive Utilities’ of Autonomous Vehicles: Will Travellers Really Use Their Time Productively?” *Transport Reviews* 39 (1). Taylor & Francis: 50–65. <https://doi.org/10.1080/01441647.2018.1470584>.

Soteropoulos, Aggelos, Martin Berger, and Francesco Ciari. 2019. “Impacts of Automated Vehicles on Travel Behaviour and Land Use: An International Review of Modelling Studies.” *Transport Reviews* 39 (1). Taylor & Francis: 29–49. <https://doi.org/10.1080/01441647.2018.1523253>.