Sustainable Healthy Cities

A National Science Foundation-supported Sustainability Research Network (SRN)

JOURNAL BRIEF: Regional Modeling of Shared Autonomous Vehicle Travel Patterns, Preferences and Impacts

Sustainable Healthy Cities Journal Brief - 2018, No. 1 - Shared Autonomous Vehicle Modeling

This brief is adapted from the following peer-reviewed journal article: Liu, J., Kockelman, K.M., Boesch, P.M., & F. Ciari. (2017). "Tracking a system of shared autonomous vehicles across the Austin, Texas network using agent-based simulation." *Transportation*, 44(6), 1261-1278.

Study Intent and Research Question

How does a system of shared autonomous vehicles (SAVs) perform in a metropolitan region when modeled to mimic real-world daily travel behaviors? This study simulated SAV system performance under different per-mile fare scenarios in and around the city of Austin, Texas covering a metro-region of 2.3 million residents and some 895,000 households.

Key Background Information

•Fleet-operated SAVs, rather than individually owned autonomous vehicles (AVs), will likely be the primary mode by which AV technology is made available to a mass market given that AV technology is currently cost prohibitive for most consumers (Fagnant and Kockelman, 2014).

•The general practice of car-sharing is already very popular among younger travelers (Gagnier, 2013).

•SAV use in areas with substantial travel demand can leverage economies of scale and density, minimizing empty travel capacity and potentially outperforming other travel modes (Chen et al. 2016).

•Anticipated AV benefits include reducing both the number and severity of crashes (Liu and Khattak, 2016), reducing the in-car travel burden of drivers by freeing them to do other things, and facilitating increased mobility among populations that are unable to drive themselves (e.g., people with disabilities, people without licenses, people without private vehicles etc.) (Anderson et al., 2014).

Key Findings

The results of the regional model offer findings relevant to both travel behavior and sustainability considerations.

TRAVEL BEHAVIOR FINDINGS

•Whether a traveler is likely to rely on SAVs for a given trip depends on trip distance, trip duration, and waiting time, all given a certain fare scenario.

•Under different SAV fare scenarios, the likelihood of a traveler choosing SAVs as their mode of travel varies based on their location in the metro-region, with people in the dense city center making different mode choices than people in suburban or ex-urban areas.

•Riders traveling longer distances prefer SAVs to private, human-driven vehicles (HVs) — because of the reduced in-car burden of SAV travel (i.e., drivers are freed up to engage in other tasks besides driving). However, under higher fare scenarios, fewer riders choose SAVs for longer trips as the cost burden increases.

•For travelers who do not own an HV, SAVs (rather than transit, walking, or biking) are preferred for trips under 10 miles.

•High preference for SAVs may hurt the viability of traditional transit services in areas where robust rail and bus networks are not already well-established and well-traveled.

SUSTAINABILITY FINDINGS

•SAVs generate sustainability benefits compared to HVs as a result of smaller vehicle sizes, warm starts, eco-driving, etc. reducing emissions and yielding energy savings.

•SAVs may increase total vehicle miles traveled (VMT) given that SAVs will allow more people access to car travel and will make travel over longer distances easier.

•Even with increased VMT expected as a result of SAV-enabled mobility, in a metro-wide scenario, the increase in

VMT does not outweigh the overall sustainability gains of SAVs.

Policy and Practice Implications

Early strategic planning is needed to make SAVs and transit services complementary of one another, rather than mutually exclusive, in order to protect the viability of transit in regions where transit services are less developed. Left to traveler preference alone, travel demand is likely to favor SAV mode choice unless policy interventions seek to couple the functioning of SAV systems and transit services.

When evaluated across a region-wide scenario, the cumulative sustainability benefits of SAVs still outweigh the negative sustainability impacts of increased VMT. Policy and technical interventions that promote car-pooling/ride sharing, tight headways, and traffic smoothing are all options that can furhter counteract the negative sustainability impacts of increased VMT associated with SAV-enabled mobility.

SAVs will change trip origin and destination patterns as new traveler groups are served by SAVs. This will cause changes to vehicle traffic flow patterns. Certain origins and destinations that previously saw minimal vehicle traffic may start to see increased vehicle traffic. Certain origins and destinations that already see significant vehicle traffic could see even more vehicle traffic.

Transportation

Environmental Sustainability

Integrative Scenarios

Further Reading and References

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The Sustainable Healthy Cities Network is a U.S. National Science Foundation supported sustainability research network focused on the scientific advancement of integrated urban infrastructure solutions for environmentally sustainable, healthy, and livable cities. We are a network of scientists, industry leaders, and policy partners, committed to building better cities through innovations in infrastructure design, technology and policy. Our network connects across nine research universities, major metropolitan cities in the U.S. and India, as well as infrastructure firms, and policy groups to bridge research and education with concrete action in cities.

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