Autonomous Vehicles and the City:

William W Riggs
Michael R Boswell
Shivani Shukla
Matthew Kawashima
Therese Perez
Autonomous Vehicles and the City

William Riggs, PhD, AICP, LEED AP
Michael R. Boswell, PhD, AICP
Shivani Shukla, PhD
Matt Kawashima
Therese Perez

A Symposium Developing Policies and Plans for Livability

UNIVERSITY OF SAN FRANCISCO
School of Management
SPONSORS AND ACKNOWLEDGEMENTS

Special thanks to sponsors including:

Platinum:

Gold:

Silver:

Organizing Committee

William Riggs (Chair), School of Management, University of San Francisco
Michael Boswell (Co-Chair), Cal Poly San Luis Obispo
Asha Weinstein Agrawal, San Jose State University
Andrea Broaddus, Bosch
Nico Larco, University of Oregon
Hilary Nixon, San Jose State University
Joshua Karlin-Resnick, Nelson Nygaard
Melissa Ruhl, Arup
Gerry Tierney, Perkins+Will

Find us online at: https://www.usfca.edu/management/avcity
Video Available at: https://vimeopro.com/user9732237/avcity
Symposium Speakers:

Nico Larco, Associate Professor, University of Oregon and Co-Director of the Sustainable Cities Initiative

Jeremy Madsen, Executive Director, Greenbelt Alliance

Michael Johnson, Director of Urban Design, Smith Group JJR

Tilly Chang, Executive Director, San Francisco County Transportation Authority

Pierre Maillot, Business Development Director, Bosch North America

Michael Boswell, Professor and Department Chair, Cal Poly San Luis Obispo

Peter Gigante, Transportation Policy Manager, Lyft

Brian Soblet, Deputy Director, Chief Counsel, California DMV

Frank Petrilli, Partner, Arent Fox

Chris Ganson, Senior Planner, Office of Planning Research

Melissa Ruhl, Transportation Planner, ARUP

Ralph McLaughlin, Chief Economist, Trulia

Ben Clark, Assistant Professor, University of Oregon

Jay Stark, President, Integral Investment Management

Rob Rossi, Owner, Rossi Enterprises

Deborah Stamm, Senior Associate, Trammell Crow

TABLE OF CONTENTS

Introduction ...................................................................................................................4

Dialogue ...................................................................................................................5

Policy Actions ..........................................................................................................9

Conclusion ...............................................................................................................11

References .............................................................................................................12

About the Authors ...................................................................................................13
I. INTRODUCTION

Development of the autonomous vehicles (AVs) offers, perhaps, the most groundbreaking and revolutionary change in the way cities are built and function since the advent of the car. AVs present new opportunities to connect individuals to jobs and change the way cities organize space and optimize trips (Fagnant & Kockelman, 2014; Guerra, 2015). As development of AVs continues to move forward, it is estimated that AVs will become a regular part of society in the near future. Although widespread use of AVs offers significant opportunities to better the lives of many, there are also undeniable risks that AVs pose to the cities, individuals, and society as a whole. Specifically, this new technology raises questions regarding the design and land use, social, and economic implications associated with their expansion. Some experts have pointed to the potential of AVs to result in poor land use planning, unequitable effects on low-income individuals, and environmental impacts. With policy targeting the use and expansion of AVs, it is possible to address their detrimental effects. Most agree that fully integrating AVs into the existing fabric of society will face significant challenges that will require extensive coordination between public and private sector parties (Riggs & Boswell, 2016).

To begin to address these challenges, in November 2017, a panel of policy makers, planners, designers, developers, and other industry experts gathered at the University of San Francisco to discuss the role AVs will play in shaping the built environment; issues and opportunities surrounding expansion of AV use; and possible strategies before and after implementation of this technology. Despite high level policy suggestions from organizations such as the Rand Corporation and consultants like Parsons (Anderson et al., 2014; Isaacs, 2016; Litman, 2014), technological change is outpacing urban planning and policy. The purpose of this symposium was to frame and develop policy around the topic of AVs particularly focused on the 1) land use, 2) social and 3) economic implications of the technology. The goal was to begin developing policies to ensure that AVs are best incorporated into society. This report summarizes the issues and challenges that are intrinsically linked to AVs and discusses the possible findings, actions and policies that are critical to an autonomous future.
II. DIALOGUE

Design & Land Use

How should land use planning be conducted in the face of emerging technology such as autonomous vehicles? For example, should we be rethinking greenbelt policy to limit sprawl? Or conversely what kind of infrastructure and land uses should planners be considering across the urban gradient? The dialogue on land use addressed these questions, centering on the connection between AVs and general planning, land use and capital investment strategies. Panelists discussed the wide range of benefits that AVs could provide to society including decreased demand for parking, more available space in cities, and safer driving conditions. While there are a variety of potential benefits with AV technology, panelists also identified a variety of potential negative impacts with AV technology. Three key concepts were: changes in logistics, trends toward urban sprawl and shifts in local land use. Although there are needs for the technology to advance and better detect vulnerable roadway users, one of the primary benefits of AV technology is its potential to provide safer roadway conditions and save lives. AV’s would reduce the potential for collisions related to human error (i.e. driving while distracted, tired, or under the influence of alcohol). It is also anticipated that AV technology will play a role in creating safer conditions for freight and cargo movement—with the posit that AV technology may be first implemented in freight delivery.

The integration into the movement of freight and e-commerce will have a variety of impacts. This is important because the current model for freight distribution centers is that generally are located from the urban core, based on the lower cost of land. Yet, human costs represent a large share of freight company expenses. As distribution centers move further out of metro areas, freight firms pay more money for drivers and other staff needed for successful delivery. AVs disrupt this model from both land use and employment standpoints. Distribution-related uses may move closer to the urban core, and personnel costs will go down.

One of the potential downsides of AVs is the contribution to vehicle miles traveled and the potential for urban sprawl. With the ability to commute longer distances, AVs may give individuals the ability to work farther away from the urban core, where jobs have been historically centralized. With the ability to work in the car, AVs may offer attractive incentives for individuals to live outside the urban core in neighborhoods that are more affordable. This might lead to higher demand in housing on less expensive land far away from existing development and ultimately to more suburban lands and poor land use planning. Panelists noted that planners should consider how to use AVs as a tool to facilitate infill development. In that sense, with regard to autonomous vehicles, planners must engage in assertive land use planning and think about how to fit AVs in to existing high-capacity transit planning frameworks.

In addition to the potential for AVs for spatial shifts in land use, AVs will change the design of both urban and suburban communities. The most notable, is the potential for reducing the number of parking spaces and other automobile serving uses. Panelists noted that in a transportation world centered around AVs, cities may need 90% fewer parking spaces and even fewer services like car washes, filling stations, and servicing facilities. AVs require fewer parking spots because they are in use more often rather than arriving at a destination and staying idle in its spot. Some cities have already significantly reduced or eliminated minimum parking standards, particularly in their urban core. AV technology offers the opportunity to make changes to the existing dimensions for streets and sidewalks. The possible changes include widening sidewalks, adding lanes for bikes, and adding lanes for AV’s that are thinner than lanes for legacy cars. They also include changes to parking technology, including automated parking and residential parking standards—a potential opportunity for developing more affordable housing.
In more suburban settings, panelists hypothesized that changes would likely be more dramatic due to the availability of land. There is the opportunity to design communities from the ground up with AV technology in mind; with reduced roadway space dedicated to the automobile. There also will be the opportunity to encourage and promote community vehicle ownership, where a fleet of AVs are available for use by residents. This transition to using AVs as transit may threaten current mass transportation; however, it may facilitate active transportation, particularly walking, and require more investment in active transportation infrastructure.

**Social & Environmental**

What are the social and environmental issues and opportunities of autonomy? In dealing with the social and environmental factors, experts held a belief that societal benefits of AV technology would outweigh the costs, but asked “who will reap the benefits and who will be affected by AV technology?” Two of the common themes were potential job losses and changes to the neighborhood accessibility and related environmental costs. Panelists were quick to point out that AVs will cost hundreds of thousands of dollars, and unless shared vehicles become widely available, the benefits will not be accessible to the general public. The risk is that AVs could become luxury vehicles, and a form of economic utility that only the wealthy have access to. There was also concern that, absent policy, there may be dramatic environmental costs including increased vehicle miles traveled (VMT) and greenhouse gas (GHG) emissions.

First with regard to jobs, the introduction of AVs poses a threat to thousands of individuals who currently rely on human drivers. With replacement of professional human drivers there is a need to address how these jobs will be replaced in a fair and equitable manner. Job loss and replacement will not be limited to ridesharing jobs but result in far reaching impacts that affect everyone from traditional taxi drivers, mail carriers, and freight and cargo drivers, to name a few. The panelists noted research report suggesting that that only 38% of drivers had no other job and 25% were not looking for another job (Hall & Krueger, 2015). While the issue of impacts on the professional driving industry still need attention, panelists suggested that this data seems to indicate that the number of people impacted may not be as large as is often suggested.

Panelists generally felt that the timeframe for which AVs might replace traditional driving would be gradual and involve incremental changes. In some instances, the traditional jobs might be replaced with alternative jobs. For example, ridesharing companies may need to retain workers to supervise vehicles while they are in use so while there may no longer be a need for a human driver, there is likely a need for individuals to troubleshoot vehicles and supervise cars while in use or helping those with a disability enter and exit the vehicle.

One of the overwhelming concerns from panelists were the impacts of AVs on low-income individuals and neighborhoods. With the ability to commute and live farther distances from urban cores and downtown districts, AVs may incentivize the wealthy to move farther away and commute into the inner city for work. One panelist compared the phenomenon similar to the “white flight” that occurred during the 1950s and 1960s. With the movement of the wealthy to the suburbs, tax dollars and revenues may also move to the suburbs further decaying the inner cities. The loss of tax revenue in these neighborhoods would lead to decreased revenues for services such as social services and schools that the lower income individuals depend more heavily on than the wealthy. Further, as AVs will likely be powered by electric energy, the panel observed that if unconstrained by policy, they may also eliminate the emissions benefits of moving from fossil fuel to electric engines.

In this context the prevailing opinion was that more vehicle sharing mitigates many of the social

---

1 The reference to the report (commissioned by Uber in 2015) during the symposium, cited a figure 7%, however this was erroneous. The report cites that 7.4% of national employees are classified as contingent workers or contractors. This number is reflective of the entire job market, not the professional driving sector.
and environmental costs. Ridesharing may likely provide the gateway to getting people comfortable with using AVs and reducing skepticism through experiential marketing. Current users of ridesharing services are viewed as particularly suited to AV usage because they have demonstrated a willingness to try innovative ridesharing technology. People may be hesitant at first but eventually, but through word of mouth, people will become more and more comfortable with them and make them commonplace. The group dialogued that the key to making shared AV usage the norm may be to get users to view the trip as unremarkable.

AVs also pose the potential to decrease use of mass transit and active transportation options, both of which are more heavily relied upon by those who can’t afford cars. By increasing the number of transportation options, it is possible that AVs will decrease the number of users on mass and public transit. By decreasing usage, the amount of revenue generated by these systems also decreases. While the amount of funding for transportation options may be impacted, there is also the opportunity to leverage AVs in supporting public transportation systems—for example in having autonomous busses transport commuters from transit stations to homes / office parks during off-peak hours.

**Economics & Real Estate**

What are the range of economic impacts on municipal budgets and real estate? There have been dystopic or utopic visions painted for the future of cities with autonomous vehicles. What do policy makers, economists and urban planners need to do as brick and mortar stores suffer based on increased e-commerce and travel via car becomes cheaper. Some of the clearest implications are on local economies including municipal budgets and real estate values. Panelists discussed that the economic impacts of AVs will likely be different from city to city with changes more evident in vibrant communities compared to rustbelt communities.
Megacities may get even bigger, giving more people the opportunity to move to them. At the same time, AVs could also empower commuters to live further from the urban center. This movement of people will result in a key economic change—a shift in land value taxation—possibly increasing land values outside of the city centers—either way, **given the tendency toward migration, municipal tax bases and revenue sources will change.** Change will also be immense in the many auto-based fees that cities, counties and states impose—whether they be vehicle licensing fees, citations or parking revenues. And, although this may remain depended on distance, this change may even extend to air travel. It is plausible that by making vehicular travel more efficient, and reducing the amount of effort that a driver needs to invest in getting from one place to another, people may choose to drive over flying.

Continuing along this logic, one might suggest that people may choose driving over owning a home as well, changing the real estate market. That said, panelists did not feel this transient lifestyle matched market preferences or trends, and doubted that many would embrace a house-free lifestyle. Conversely, **they felt the most transformative change will be in the area of parking; a key area where policy action can be taken now.** Panelists agreed that there is an imperative need to relax parking requirements. Many jurisdictions still impose stringent parking requirements on existing and new developments. Yet there are successful examples of new developments can reduce or minimize parking requirements. Some that were cited included car-free units being constructed in small or medium sized cities, or businesses that look for urban environments to match market demands. Still, developers are wary to build projects with limited parking out of fear that projects may not interest buyers. Further panelists observed that cities may continue to be reluctant partners in encouraging parking reductions due to continued public concerns about traffic and spillover parking.
III. POLICY ACTIONS

Clearly there is both great promise and great peril in a future that includes autonomous vehicles. It includes potential for both great promise and great peril. Autonomous vehicle proliferation will result in saved lives, helping to avoid many of the over 30,000 fatal collisions in the U.S. each year. They will provide improved mobility for seniors and those with driving restrictions, and increase productivity while driving – increasing economic efficiency and revenues (particularly in the logistics field).

Conversely, as experts indicate, autonomous cars also have the potential to deepen divides in our communities. People may be incentivized to drive longer distances, policy in place to limit vehicle miles traveled. This could have the adverse impact of expanding cities beyond their existing boundaries — a new wave of urban sprawl, gobbling up open spaces and moving people away from downtown areas.

Cities need to be aware of opportunities and constraints of this technology. They should anticipate it and set a clear vision what type of cities they want to be in the future, and take action to achieve that. By backcasting, setting a vision and working backward to achieve those goals, they might better planning for the types of streets, roads and development and built environment they want to see, rather than having it dictated by innovation or industry. Currently too few cities are planning directly for a future with AVs.

A 2016 Bloomberg report lists approximately 30 cities with plans; 17 of which are in the US; less than 1% of major cities. We believe this number is too few. It is clear that technology is swiftly evolving and policy (and our vision for our cities) must co-evolve equally fast. In this light, the most immediate actions that cities can take immediately include:

1. Evaluate your comprehensive and general planning documents: Do they consider AVs; do they use multimodal level of service (LOS) analysis that supports and prioritizes bicycles, pedestrians and transit; do they allow for flexible changes in land use / zoning; do they have adequate sprawl and / or greenbelt controls.

2. Evaluate your downtown parking plan and capital investment strategy: Consider halting investments in roadway or parking capacity (Riggs & Boswell, 2016); continue to lower or eliminate parking minimums; consider transitioning to parking maximums and car-free housing units, and remove parking requirements for accessory/secondary dwelling units.

3. Adopt a vision-zero plan and encourage engineering staff to adopt NACTO guidelines: Support street design guidelines that provide high LOS to non-automotive users and experiment with car-free downtown environments.

Beyond these actions, we suggest the following policy considerations.

Design and Land Use

- Plan and re-zone industrial parcels outside of downtown for future transition to autonomous service areas that provide service for driverless electric fleets (DEFs). Up-zone or provide overlay zoning for existing service stations and repair facilities within the urban core, allowing such facilities to transition to alternative uses as autonomous service facilities become focused on the outskirts of cities in areas targeted for less density. If such uses stay in the urban core, provide for mixed-use capacity above these facilities.2

Such parcels should not be greenfield sites, but focus on transitioning existing production, warehousing, and auto-serving uses to support new industry and jobs that arise as a part of the AV future. Rezoning should be use-specific so it does not have the effect of weakening the attractiveness of tech and mixed-use office investment in downtowns or work in opposition to smart-growth and car-free downtown initiatives.
• Consider rethinking and halting smart road and intelligent transportation systems ITS roadway infrastructure as DEFs and AVs are rolled out so that roadway infrastructure is developed in the most appropriate and cost-effectmanner (Riggs, Boswell, & Zoepf, 2017).³

• Establish a policy to invest in and renew existing “dumb” roadway infrastructure without expanding it to support the visual cues that driverless machine learning processes employ, such as signage and lane markings. In addition, develop clear policy, standards and funding strategies for maintaining up-to-date digital and physical street markings.

• Rethink street design and plan for the gradual recapture and transition of road right-of-way to increase bicycle and pedestrian level of service (LOS) and continue to implement road diets (Schlossberg, Riggs, Millard-Ball, & Shay, 2018).

Social & Environmental

• Plan for and implement regional roadway pricing to incentivize development within the urban core, limit increases in driving and greenhouse gas emissions and pay for the infrastructure burdens of driving. These might include pricing by: cordon/congestion zone; VMTs, person-miles traveled (PMT); vehicle occupancy; fuel type/efficiency; road type; and speed of trip (e.g., traffic priority payments).⁴

³ Literature indicates that fully autonomous vehicles will eventually be capable of handling all urban and rural driving conditions without surrounding roadway infrastructure. Pausing all but the most basic infrastructure investments would be wise, particularly roadway expansions and vehicle-to-infrastructure (V2I) and vehicle-to-vehicle (V2V) investments. An important role that V2X (vehicle connecting to both infrastructure and vehicles) technology might play in the future would be to provide additional system redundancy for bicycle and pedestrian safety. We believe that both the infrastructure and the vehicle technology will likely co-evolve in a way to best optimize safety in a connected system.

⁴ Two key challenges will be making these policies transparent to end users while meeting land use and mobility objectives and ensuring that these policies do not create insurmountable barriers to access and affordability. Policymakers should explore how citizens (and corporations) interpret and respond to potential policies as specific alternatives are developed.
• Consider appropriate locations for drop offs, to ensure lively downtown environments. Such locations should not only focus on the convenience bought by AVs (or TNCs like Lyft and Uber) but on creating interaction and vitality through exchange with urban features at the pedestrian scale, designing spaces for human interaction. In conjunction, consider limiting automobile access to downtowns, especially in the most congested areas. Such restrictions can be accomplished through street closures, traffic calming, and time-of-day pricing or access.

• Explore job retraining programs as professional driving roles become obsolete.

Economic & Real Estate

• Stop building new parking as a part of existing land use policy and make plans to repurpose existing parking and parking structures. If parking structures are in the pipeline, design and build them so that they are convertible to other uses in the future.

• Ensure general plan and local planning documents provide for on-street parking conversion to parklets, pocket parks, and other pedestrian and bike friendly amenities.

• Establish a revenue replacement plan for the loss of parking revenue, citations, license fees, and other sources of municipal (Clark & Larco, 2018).

IV. CONCLUSION

Our cities are ecosystems that can evolve, and AVs will necessitate an acceleration of that evolution. Planners should not wait for certainty about the timing or methods whether that be 5 years or 15 years out. We should nudge our cities and our streets toward sustainability and develop policies and plans for livability. The time to act is now. Onward.
REFERENCES


ABOUT THE AUTHORS

William (Billy) Riggs, PhD, AICP, LEED AP is an Assistant Professor in the School of Management at University of San Francisco. He is a thought leader in the areas of transportation, real estate, economics and technology, having worked as a practicing planner and published widely in these areas. He is also the principal author of Planetizen’s Planning Web Technology Benchmarking Project, the co-creator of the ReStreet app, and author of a forthcoming book on re-envisioning future streets. He can be found on Twitter @billyriggs.

Michael R. Boswell, PhD, AICP is a Professor of City & Regional Planning at Cal Poly, San Luis Obispo and is one of the preeminent expert on strategies to reduce greenhouse emissions and and local climate action planning. He is lead author of the book Local Climate Action Planning and most recently advised UN-Habitat on climate planning as a part of COP 21. His Twitter handle is @mboswell.

Shivani Shukla, PhD is an Assistant Professor in the School of Management at the University of San Francisco. Her work lies in the research and education of operations research, analytics, and economics. She mainly focuses on the applied and theoretical aspects of dynamic systems and their modeling, particularly in the areas of transportation, supply chains, and network security.

Matt Kawashima is a Research Assistant to Professor Riggs in his research on autonomous vehicles, an Environmental Analyst for the Contra Costa County Public Works Department, and a Master of Public Administration Candidate at the University of San Francisco. He received his B.S. in City & Regional Planning from Cal Poly, San Luis Obispo and is interested in how transportation and emerging technologies will shape the future. In his free time, he enjoys travel and photography.

Therese Perez is a second year undergraduate student studying towards a BS in physics at the University of San Francisco.