TECH POLICY LAB UNIVERSITY OF WASHINGTON

Driverless Seattle

How Cities Can Plan For Automated Vehicles

Introduction

The advent of automated vehicles (AVs)—also known as driverless or self-driving cars—alters many assumptions about automotive travel. Foremost, of course, is the assumption that a vehicle requires a driver: a human occupant who controls the direction and speed of the vehicle, who is responsible for attentively monitoring the vehicle's environment, and who is liable for most accidents involving the vehicle. By changing these and other fundamentals of transportation, AV technologies present opportunities but also challenges for policymakers across a wide range of legal and policy areas. To address these challenges, federal and state governments are already developing regulations and guidelines for AVs.

Seattle and other municipalities should also prepare for the introduction and adoption of these new technologies. To facilitate preparation for AVs at the municipal level, this whitepaper—the result of research conducted at the University of Washington's interdisciplinary Tech Policy Lab—identifies the major legal and policy issues that Seattle and similar cities will need to consider in light of new AV technologies. Our key findings and recommendations include:

There is no single "self-driving car." Instead, AVs vary in the extent to which they complement or replace human driving: AVs may automate particular driving functions (e.g., parallel parking), may navigate autonomously only in certain driving scenarios (e.g., on the freeway), or may allow the driver to switch in and out of autonomous mode at will. In some instances, a lead driver may control a platoon of connected vehicles without drivers. We recommend that policymakers recognize the variability in AV technology and employ terms—such as the Society of Automotive Engineer's six-level AV taxonomy, discussed below—that accurately capture the benefits and constraints of particular AV models.

The AV regulatory environment is still developing. AVs are currently legal in Washington state, but AVs could be subject to a variety of new federal and state guidelines and regulations, and municipalities will need to be aware of these developments and the potential preemption of local action. However, municipalities possess their own, varied means by which to channel AVs, including government services powers, proprietary services powers, corporate powers, and police powers..

AVs raise legal and policy issues across several domains, including challenges to transportation planning, infrastructure development, municipal budgeting, insurance, and police and emergency services. Some of these challenges result from the extent to which existing laws and policies assume a particular configuration of automotive technology. Regulations that presume a human driver capable of managing the vehicle, for example, may limit the potential benefits of AVs for populations with special mobility constraints (e.g., those with disabilities). Other challenges will likely arise from new policies and procedures developed in response to AVs. For example, methods of revenue generation developed in response to AVs may inequitably shift revenue burdens onto drivers unable to afford an AV.

The adoption of AVs is likely to be a gradual and geographically uneven process. While some benefits of AVs are likely to be realized as soon as the vehicles reach the road (e.g., improvements to traffic safety) other potential benefits (e.g., reduced traffic congestion) may not be realized until AVs are dominant on a region's roadways. Consequently, the transition from traditional vehicles to AVs will likely generate significant, staged policy challenges over time. We recommend that policymakers focus on planning for scenarios that involve both AVs and human-driven vehicles on roadways through at least 2050.

AV technologies and policies are likely to have significant impacts on stakeholder groups traditionally underrepresented in the policymaking process (e.g., socioeconomically disadvantaged communities), and will consequently raise challenges for social equity. We recommend that policymakers engage in diverse stakeholder analysis to assess not only the impacts of AVs, but also the impacts of proposed policy responses to AVs.

Setting overall priorities

Part of preparing for any new technology involves setting the city's priorities. There are a range of strategic postures Seattle could take toward AVs, including:

1. An *assertive* strategy intended to promote Seattle as an AV innovation hub and to develop an overtly supportive environment for AVs that leverages local technology industries.
2. A *permissive* and hands-free strategy intended to allow AV companies to operate in Seattle free of burdensome regulations, similar to the approach adopted in Pittsburgh.
3. A *cautious* strategy intended to set serious limiting parameters around AVs until the technology is proven elsewhere and until Seattle determines how the technology can help address the city's needs.

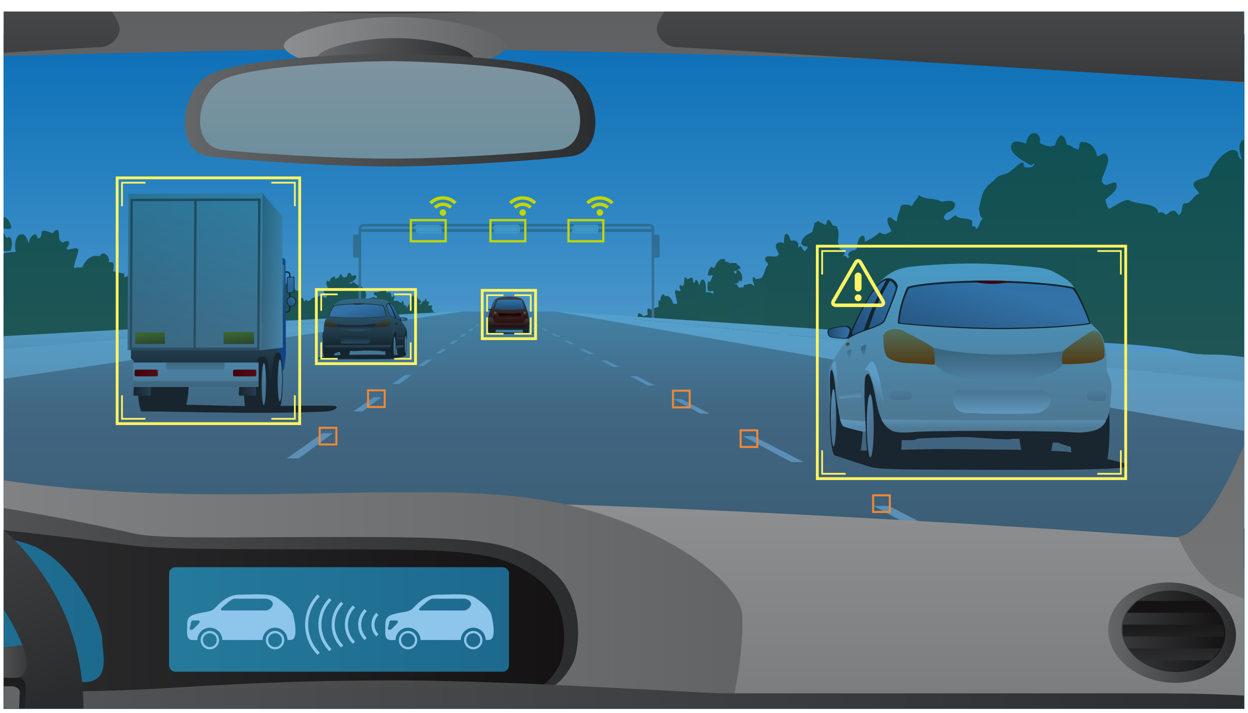
Selecting an overall guiding approach to AVs will enable Seattle to make consistent policy choices and to communicate those choices effectively to stakeholders.

In addition, Seattle will have to determine the level of coordination it anticipates between state and federal authorities. Some of the recommendations assume greater coordination than may exist today.

Technologies that might accompany automated vehicles, like vehicle to infrastructure communication, may also create additional opportunities for nearby cities to experiment with data sharing and also to form cooperative test beds for automated vehicles. Early research, city-to-city coordination, and standardization may alleviate some challenges with automated vehicles that cities have faced with new business models of transportation network companies, and early identification of Seattle's broader philosophy in AV regulation will facilitate these processes.

What are automated vehicles?

All automated vehicles automate some driving functions typically performed by human drivers. However, specific AV models vary in the functions that they automate, the scenarios in which automation is available, and the overall degree to which human intervention is required in the driving process. This variability limits the utility of broad terms such as "self-driving car" to describe AVs, and can lead to confusion over the exact capabilities of a particular AV model. German transportation officials, for example, have criticized the name of Tesla's "Autopilot" technology for misleadingly suggesting that vehicles with these systems do not require the driver's attention.



To provide language for discussing the varied degrees and types of vehicle automation, the Society of Automotive Engineers has developed a six-level taxonomy for AVs, which industry and government have broadly adopted. Each of the six levels describes a different configuration of human involvement and automation across different driving tasks (e.g., steering, monitoring the vehicle's environment) in different driving scenarios (e.g., freeway lane changes, low speed traffic jam):

SAE LEVEL **0**	**NO** AUTOMATION	At SAE Level 0, the human driver performs all driving tasks across all driving scenarios.
SAE LEVEL **1**	**DRIVER** ASSISTANCE	At SAE Level 1, an automated system on the vehicle can complement the human driver's performance of either steering or acceleration/deceleration in some driving scenarios. The human driver is responsible for monitoring the driving environment.
SAE LEVEL **2**	**PARTIAL** AUTOMATION	At SAE Level 2, an automated system on the vehicle can conduct both steering and acceleration/deceleration in some driving scenarios, while the human continues to monitor the driving environment and performs the rest of the driving task.
SAE LEVEL **3**	**CONDITIONAL** AUTOMATION	At SAE Level 3, an automated system, in some driving scenarios, can conduct all parts of the driving task and can monitor the driving environment. However, the human driver must be ready to take back control when the automated system requests.
SAE LEVEL **4**	**HIGH** AUTOMATION	At SAE Level 4, an automated system can conduct all parts of the driving task and can monitor the driving environment in some driving scenarios. Within these select driving scenarios, the human driver does not need to be ready to take control of the vehicle.
SAE LEVEL **5**	**FULL** AUTOMATION	At SAE Level 5, the automated system can perform all driving tasks in all driving scenarios. Human passengers need not be attentive or even capable of driving the vehicle.

Two key elements of the SAE taxonomy are the distinction between levels 0-2 and 3-5, and the distinction between levels 0-3 and 4-5. Only at levels three and above are AVs capable of executing all elements of the driving task (i.e., monitoring the environment and controlling steering and speed) within a specific driving scenario. Only at levels four and above are AVs capable of executing all elements of the driving task without the need for human intervention in emergency scenarios.

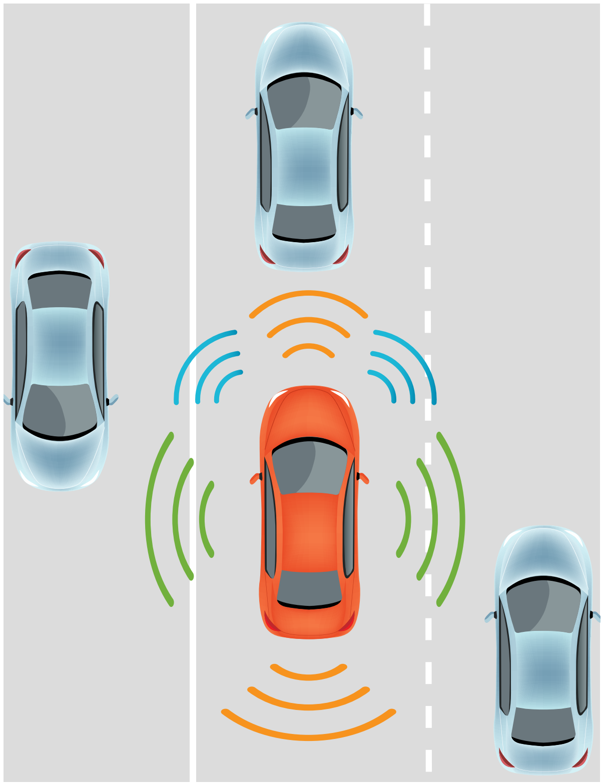
In addition, it is important to note that, although AVs are often discussed in terms of individual transportation, the potential applications and challenges of AV technology extend to and vary between a multitude of vehicle-related tasks (e.g., freight transportation, product delivery, road construction and maintenance), and different applications may draw on related suites of technologies. AV freight transport, for example, may utilize connected vehicle (CV) technology to form "platoons" of AVs—that is, chains of vehicles, traveling closely together but not physically connected, whose automated driving systems are linked by an inter-vehicle communication system—to increase road capacity and to reduce the need for human oversight in freight delivery. Furthermore, the legal status of AVs similarly varies between implementations of the technology: While individual AVs are legal in Washington state, AV platoons are currently prohibited by the regulation of distances between vehicles.

When and how will AVs reach the road?

Partially automated vehicles exist on roadways today and, in some instance, are available for purchase. For example, the Tesla Model S Autopilot system, a SAE level two technology, is already deployed on roadways in the U.S. and abroad. As of June 2016, Google's fleet of AVs has autonomously driven over 1,700,000 miles. Uber is currently testing its own AVs with its customers on the streets of Pittsburgh. In each instance, human monitors are responsible for intervening should the vehicle's performance appear inadequate

SAE level four and five automated vehicles do not yet exist on the market. Although multiple manufacturers project that the first fully automated vehicles will reach the market within a few years (e.g., BMW, Ford, and Nissan expect to introduce level four AVs in the early 2020s), more conservative estimates project a significantly longer time frame (e.g., 2030s or 2040s).

There are several technical challenges to fully automated vehicles, including everything from reducing vehicle manufacturing and retail costs to operating in poor weather conditions. But limitations on AVs reaching the market is not solely a technical hurdle; the reworking of legal and policy frameworks to accommodate AVs may take longer than the development and implementation of full AV technology. The legal framework, meanwhile, depends on at least two factors. The first is the model of AV ownership that is employed within a given region. As with traditional automobiles, AVs may be owned by private individuals, but they may also be deployed in ride-sharing systems (similar to Uber or Lyft), and these ride-sharing AVs—sometimes called "robo taxis"—may be either privately or publically owned. Importantly, the impacts of these different models of ownership will vary considerably. The introduction of AVs under a model of individual ownership, for example, may substantially reduce traffic efficiency by increasing the number of vehicles on the road, whereas AV ride-sharing or mass transit systems could promote more efficient travel.



The second factor relevant to impact of AVs is the rate of adoption of AVs. As a heuristic for discussing the impacts of AVs at varying levels of adoption, we envision three key moments in the adoption of AVs: short, medium, and long-term scenarios. Rather than specifying these scenarios in months or years, we define the *short term* as a period of introduction and accommodation. During this period, level 3+ AVs are on the roadways, but are relatively few in number. By contrast, in the *medium term*, AVs are at parity with traditional vehicles, and level 3+ AVs make up roughly half of all vehicles on the road. The long-term scenario is a period of AV saturation, in which the large majority of vehicles on the road are level 3+ AVs. It must be stressed that these three categories are tools for analysis and explanation; we do not envision the actual adoption process of AVs as segmented, but we do note that the transition between these different levels of adoption each present specific policy challenges and opportunities. For the remainder of this paper, "short term," "medium term," and "long term" refer to these respective scenarios.

Regulatory environment

Seattle's approach to automated vehicles, like that of many cities, is constrained by a legal ecosystem involving federal, state, and local regulatory powers over transportation and traffic safety. Though municipalities have a number of powers available to regulate AVs, guidelines and regulations are still developing at all levels of this ecosystem, so it is essential that municipalities remain up to date on these developments.

In 2012, the Stanford Center for Internet and Society released a comprehensive report on the lawfulness of automated vehicles in the United States. The report concluded that automated vehicles are basically lawful unless prohibited by statute. As of the date of this whitepaper, the State of Washington has not prohibited automated vehicles and may be considering joining Nevada and other states to clarify their lawfulness.

In September 2016, the Department of Transportation (DOT) and the National Highway Traffic Safety Administration (NHTSA) issued guidelines outlining the regulatory roles of federal and state agencies with respect to AVs. The DOT and NHTSA claim broad authority to regulate the safety of automated vehicles through the NHTSA's defects, recall, and enforcement authority. This authority includes setting Federal Motor Vehicle Safety Standards (FMVSS) for new AVs and AV equipment, enforcing compliance with the FMVSS, investigating and managing the recall and remedy of AV defects and recalls nationwide, educating the public about AV safety issues, and issuing guidance for vehicle and equipment manufacturers. AV regulation at the federal level also intersects with the purview of other federal actors, including data privacy guidelines issued by the Federal Trade Commission and the White House (e.g., the Consumer Privacy Bill of Rights).

In turn, states are able to regulate the licensing of human drivers and the registration of vehicles, traffic laws and their enforcement, motor vehicle insurance and tort liability, the testing of automated vehicles, the construction and regulation of infrastructure related to AVs, environmental regulations, and vehicle modification and maintenance. To ensure consistency of regulation across the states, the NHTSA has proposed a "Model State Policy" for state regulation of AVs. This policy recognizes that states retain authority in these areas, but offers a model for state regulation of automated vehicles in order to foster consistency across state borders. Municipalities would be wise to study the Model Policy closely prior to intervention, especially if the state has yet to act on AVs.

Furthermore, the courts will play an important role in determining applications of established tort standards to AVs, including determination of what qualifies as driver's and manufacturer's negligence, design and manufacturing defects, and invasion of privacy. Courts will also need to grapple with relevant criminal law issues, such as distracted driving, reckless endangerment, drunk driving, and vehicular homicide. Courts could come to different conclusions about each of these issues depending on jurisdiction and, in most instances, court decisions can be supplanted by legislation.

Finally, municipalities like Seattle have a variety of powers at their disposal that may be applied to the regulation of AVs. Under their police powers, municipalities have the ability to create and enforce city traffic laws related to AVs, including possibly revising select traffic laws to accommodate AVs, constraining driverless parking without a human in the vehicle, and placing limits on certain levels of automation. The National Association of City Transportation Officials (NACTO), for example, has advocated for municipal bans on partially automated vehicles due to concerns about their contribution to distracted driving. In addition, these powers will allow cities to create training programs and rules governing police engagement with AVs.

Municipalities also have corporate powers to engage in contracts and partnerships with private sector players in the AV market. In Pittsburg, for example, the city government has engaged in a contract with Uber to test its AV services within the city limits. Cities also possess government services powers to build any road infrastructure and systems pertinent to AVs, and proprietary service powers to offer automated transportation services (e.g., a public fleet of AVs).

Key challenges and recommendations

With this background in mind, here are some of the key challenges facing a municipality like Seattle in dealing with greater proliferation of AVs on city and surrounding roadways.

CHALLENGE: Traffic management and transportation planning.

AVs have the potential to significantly affect traffic flows, but there is not yet a consensus about the overall impact of AVs on traffic. At best, AVs could promote traffic efficiency—for example, by reducing the number of vehicle crashes caused by human error, by eliminating human inefficiencies in the flow of traffic, by encouraging ride-sharing rather than individual vehicle ownership, or by promoting the use of public transportation by shortening transit commutes and by solving the "last mile" problem. However, many of the gains in traffic efficiency may only be realized in long-term stages of AV adoption. At the worst, AVs could lead to more vehicles on the road due to the now more enjoyable and productive time in an automated vehicle, promote inefficient single-passenger vehicle choice to the detriment of more traffic-efficient public transportation options, and offer limited improvements in traffic flow due to AV responses to pedestrian behavior (e.g., jaywalking)..

Furthermore, AVs raise challenges to transportation planning processes. Current transportation forecasting in the greater Seattle area, conducted by the Puget Sound Regional Council (PSRC), draws on economic forecasting (including benefit-cost analysis of proposed actions, as well as annual regional projections of total households, persons, jobs, and other economic and demographic variables through the year 2040), land-use forecasting (including projections of future population and employment), and travel demand forecasting (including activity-based travel models, trip-based travel models, and transit sketch planning). These processes rely on assumptions about the nature of travel—including models of vehicle ownership, route choice, and residence and work locations—that may not hold for AVs. For example, drivers may tolerate longer commutes or choose different travel routes if they are able to perform other tasks in the car (e.g., work, sleep) instead of driving, but current travel demand forecasting processes do not account for the variation in driver experience between AVs and non-AVs.

RECOMMENDATION: Utilize AV data for traffic management, revise transportation planning processes, and explore efficient ownership models.

For both AVs and non-AVs, the complexity of traffic flow management derives from the often chaotic nature of human behavior, the diverse needs generating individual trips, the constraints imposed by regulations, and the objectives that traffic managers pursue (e.g., congestion or emissions reduction). AVs will likely present new technical means for addressing these challenges. More specifically, given that AVs will likely feature wireless communications, on-board computer processing, vehicle sensors, GPS, and connections to smart infrastructures, over the medium and long term AVs provide the opportunity to utilize the data generated from these sources for traffic management purposes. Seattle's Advanced Traffic Management System (ATMS), for example, is currently limited in its ability to collect on-street traffic data. Data transmitted wirelessly from AVs to Seattle's ATMS could measure previously estimated or unknown traffic data at the individual level, such as vehicle speed, position, arrival rates, rates of acceleration/deceleration, and queue lengths, and in turn these data could allow for a greater optimization of traffic patterns, either through manipulation of traffic signals or direct communication with vehicles via connected vehicle technology. Seattle should be prepared to take advantage of these new data made available by AVs to facilitate greater traffic efficiency.

In addition, Seattle should be conscious of the extent to which current planning models assume older automotive technologies, and should develop models better suited to capture the changes to vehicle ownership, route choice, and residence and work locations prompted by AVs. The same data streams utilized for traffic management purposes, if standardized, mined, and analyzed, could be used to develop more robust travel demand forecasting, and economic and land use forecasting models will need to account for potential increases in commute length among AV passengers, changes to business locations, and changes to parking-related land use. A decreased need for proximate parking, for example, could lead to an increase in density in the city center. Models will also need to account for the dynamics of AV adoption, including determining what populations are likely to modify their current travel behavior to utilize AVs, for what purposes, and at what economic costs.

Finally, Seattle should consider the ways in which AV traffic impacts are closely tied to models of AV ownership, and that areas of AV policy (e.g., AV sales taxes) that promote or discourage particular ownership models (e.g., ridesharing) are likely to significantly influence Seattle traffic and its externalities (e.g., in the case of non-electric AVs, greenhouse gas emissions). Consequently, Seattle should both utilize AV data for traffic management and revise transportation planning processes to account for AVs, and also explore models of AV ownership that will promote traffic efficiency.

CHALLENGE: Infrastructure.

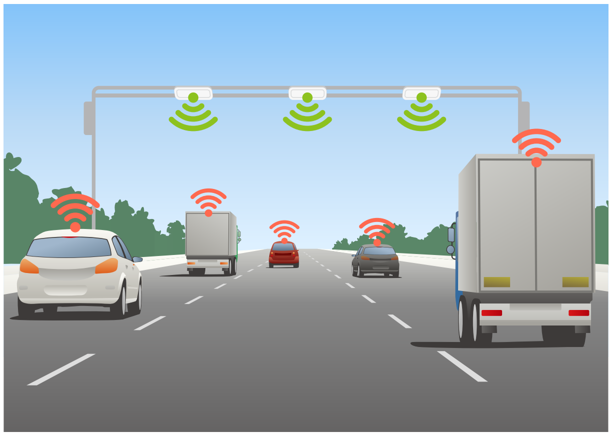
While the specific capabilities of AVs will vary between models, AV technologies are likely to either require or benefit from the development of new communications, data storage, energy, and transportation infrastructures. The potential benefits of AV data for traffic management, for example, will

likely depend on the development of vehicle-to-infrastructure communication systems capable of collecting AV data in real time. Such systems will raise their own challenges: Given that they benefit from network effects—that is, the infrastructure capable of managing the greatest number of AVs will operate at the highest efficiency—new AV communication infrastructures could lead to a monopoly or oligopoly market. Furthermore, the collection of AV data will also necessitate new data storage facilities, which introduce cybersecurity concerns—including risk of data theft and cyber-attack—as well as concerns about compliance with data protection and privacy regulations.

AVs will also introduce challenges in more traditional transportation infrastructures. For example, AVs may increase the demand for energy infrastructures directly (e.g., electric vehicle charging stations) or indirectly (e.g., to support AV communications and data storage infrastructures), and in medium and long-term scenarios, transportation agencies may need to redesign or create virtual counterparts for road signage and lanes for both AVs and non-AVs. Additionally, different challenges are likely to arise with different models of AV ownership and utilization. While AVs in general will have a significant impact on the location and size of parking infrastructures, widespread AV ridesharing could generate increased demand for curb space access in some locations (e.g., transit stations).

RECOMMENDATION: Plan for AV infrastructure and collaborate with public and private actors in developing AV infrastructure and standards.

Over the medium and long terms, Seattle will need to decide if the positive externalities of new AV infrastructures (e.g., safety, reduced congestion, pollution reduction) or the need to prevent market failures (e.g., monopolies) warrants public investment in AV infrastructure. If public investment is warranted, Seattle will need to consider how to prioritize investment in the areas of AV infrastructure that

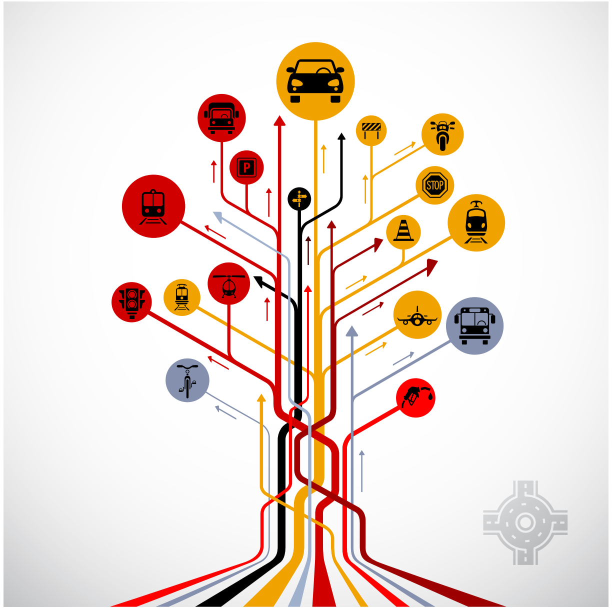


the market either fails to provide or provides at a high social cost, and infrastructure prioritization decisions will need to consider whether to expand existing infrastructures or establish new infrastructures for AVs. However, given that the cost-benefit approach common to current transportation investment evaluation may not accurately capture the social costs and benefits of AVs, and may not adequately respond to or anticipate the potentially rapid changes in AV technology, Seattle should engage in scenario planning, robust decision making, and multi-criteria analysis to compare costs of different technology alternatives across categories of infrastructure. Furthermore, once infrastructures are identified as areas of investment, Seattle should recognize that the potential for rapid AV developments to generate information asymmetries. In turn, these asymmetries may affect the distribution of risk in infrastructure investment, and Seattle should account for this when considering whether to develop infrastructures through a public agency or to involve private entities.

In the short term, Seattle could cultivate relationships with strategic industry partners active in developing and implementing AV infrastructure technologies. Establishing collaborative relationships with local companies and research organizations will not only help the city to gain a more precise vision of future demand for AV infrastructure, but will also serve the interests of those organizations by enabling the research and development of AV application and services. Furthermore, Seattle might consider appointing a particular individual to work with AV industry partners to evaluate the emergence of any potential to organize or participate in a standards group for AV infrastructure technology. An individual with specific expertise on emerging vehicle to infrastructure technologies could provide the Seattle with important information to make successful infrastructure plans.

CHALLENGE: Revenue and budgeting.

AVs are likely to have significant impacts on municipal revenue streams. Over the long term, AVs could result in decreased municipal costs—for example, substantial decreases in the number of traffic accidents due to AVs could reduce the need for police services and reduce operational and maintenance costs—but these reductions will likely require substantial AV adoption to produce notable budgetary benefits. Additionally, these reductions may be offset by new costs presented by AVs (e.g., new infrastructures) as well as possible economic adjustments (e.g., replacement of transportation jobs by AVs). Beginning in the short term, however, municipalities will lose revenue from reduced parking fees and fewer traffic fines, and this loss is likely to become more significant in the transition from short to medium term adoption. In the specific case of Seattle, traffic fines constitute 2.6% ($29.2 million) of the city's primary operating fund. Historically, a significant majority (70% to 85%) of this traffic fine revenue comes from parking citations, while photo enforcement of intersections and school zones constitutes 10% to 15% of traffic fine revenue. Traffic and other tickets constitute the remainder. Notably, AVs have the potential to revenue losses in all of these categories: If empty AVs are allowed to seek out parking spaces and move when the allotted time is up, parking citations will be impacted, and if AVs are more consistent in following traffic regulations than human drivers, photo enforcement and other traffic tickets will be impacted. Even infrastructure design scenarios which might generate revenue from AV parking fees—for example, combined AV parking and electric vehicle charge stations—may potentially present budgetary losses due to the costs associated with the additional infrastructure. Furthermore, these broader impacts on municipal revenue may spur government agencies (e.g., law enforcement) to recoup revenue by means that may inequitably impact different populations—for example, by instituting additional costs for police services such as a per-use fee for dialing 9-1-1.



RECOMMENDATION: Develop alternative revenue sources.

Seattle has a variety of tools available to address revenue losses introduced by the advent of AVs, including the increase of vehicle registration fees (e.g., an AV-specific registration fee), the reallocation of other revenue streams, the introduction of new taxes on AVs, and the introduction of broader taxes such as road tolls and vehicle miles traveled (VMT) taxes. However, each of these actions has its limitations. Revenues from vehicle registration fees are significantly smaller than those generated by parking and traffic fines, so fee increases would need to be substantial to compensate for potential losses elsewhere. The reallocation of revenue streams necessarily shifts the budgetary burden elsewhere, and the addition of an excise or sales tax on AVs could risk slowing the rate of AV adoption and delaying the impact of the potential positive externalities provided by AVs (e.g., improved traffic efficiency and safety). Tolls for AV-specific lanes would require a critical mass of AVs to be worthwhile, and the lanes themselves may potentially introduce undesirable traffic inefficiencies at points of entrance and exit—and by extension, additional costs. Given these limitations, Seattle should avoid relying too heavily on a single mechanism to replace revenue lost due to AVs, and should instead investigate a combination of solutions. Furthermore, as alternative revenue sources are developed, it will be important to consider that, although AV-initiated losses to revenue will be experienced by Seattle beginning in the short term and will grow in significance over the medium and long term, the political feasibility of the mechanisms for alternative revenues may vary with the level of adoption of AVs. For example, while a tax specific to AVs—for example, an AV-only VMT tax—may be more feasible than VMT tax on both AVs and non-AVs in the short term, the reverse may be the case in long-term scenarios with widespread AV adoption. Consequently, Seattle will need to consider not only means of replacing revenue losses, but also potential opportunities to address broader budgetary restructuring (e.g., shifting from a fuel tax to VMT).

CHALLENGE: Liability and insurance.

The advent of AVs brings matters of both criminal and civil liability into sharp focus. Criminal infractions such as DUIs and speed infractions rest on legal standards that become substantially less useful when an automatic vehicle handles a substantial portion of the driving task. With respect to civil liability, the various SAE levels present challenges for adequately covering costs related to accidents and apportioning fault according to equitable standards. Primary obstacles to consistent application of liability policies to AVs requires a refactoring of the definition of "driver" and "control" that currently inform criminal driving penalties, while civil standards require rethinking who should pay for damages when a vehicle collision occurs. In turn, these challenges, in addition to the vulnerability of AVs to new modes of disruption (e.g., cyberattacks) and the possible adoption of new models of vehicle ownership, will prompt insurers to develop new products for AVs. As with traditional vehicles, states retain the responsibility for regulating the insurance requirements for automated vehicles, though the NHTSA's Federal Automated Vehicle Policy requires manufacturers to insure for a minimum of five million USD—an amount that far exceeds Washington State mandatory insurance minimums for individuals.

***RECOMMENDATION: Develop relationships with companies providing AV products and services*.**

Seattle should consider opportunities for partnering with AV companies to facilitate the smooth introduction to AVs. For example, Seattle can work with AV companies to develop parameters for testing new AVs within the city limits. Similarly, though the regulation of liability and insurance for AVs is largely

outside of municipal purview, Seattle should maintain awareness of developing liability policies and new AV products offered by insurers, and should also work to build relationships with local insurers developing new products for AVs, both to facilitate potential municipal deployment of AVs (e.g., fleets of AVs for public transportation) and for economic development of regional industries.

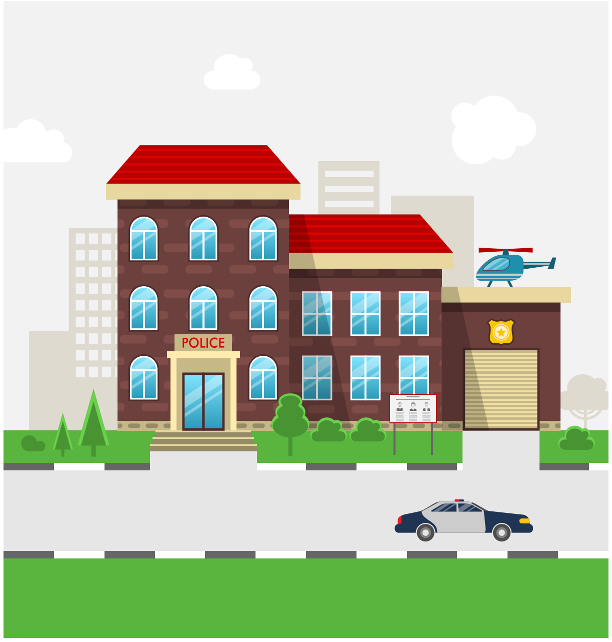
CHALLENGE: Police and emergency services.

Given that AVs will be used by both civilians and law enforcement, AVs present challenges to many dimensions of police and emergency services. Some of these challenges result from the application of existing laws and regulations to AV technology. The enforcement of DUI and distracted driving laws, for example, assumes that driving requires a sober and attentive driver—which is not necessarily the case with full AVs—and some crimes that typically necessitate human involvement (e.g., illegal drug delivery) might be conducted with the aid of AVs. Furthermore, AVs challenge the role of police discretion in routine encounters, such as traffic stops, and will necessitate the development of new standards for such interactions. Other challenges to police and emergency services arise not from the application of existing regulations, but rather from new affordances that may be built into AVs. Vehicles may be designed to allow police or emergency services to direct the vehicle in special situations—for example, to force an AV traffic stop, or to move an AV out of a fire lane. Furthermore, over the long term, certain police activities—for example, surveillance of a suspect—may become substantially cheaper to conduct with the aid of AVs, which may result in increased frequency of particular police practices.

In addition, AVs present unique opportunities for more efficient and better coordinated responses to problems that arise in the Puget Sound region (e.g., AVs that help locate and mark an accident scene or provide transportation for injured or unsafe drivers).

RECOMMENDATION: Train police and emergency services for AVs, and investigate police and emergency services-related AV technologies.

In the short term, Seattle should develop specific training procedures for police and emergency services interactions with AVs. For example, police will need guidelines and rules for conducting routine interactions in relation to AVs, such as traffic stops and accidents. Seattle should also investigate emerging standards for AV technologies in relation



to police and emergency services, such as technologically-implemented AV responses to police (e.g., a police-activated "kill switch" to stop an AV) or emergency services (e.g., mandating AVs make way for ambulances or fire department vehicles). In the medium term, Seattle should also work with the county and state on a coordinated approach to the procurement and deployment of AVs for emergency response.

CHALLENGE: Social justice and equity.

Many of the challenges raised by AVs in the areas addressed above—and potential responses to these challenges—have implications for social justice and equity. For example, overly restrictive regulation of AV technology, or policies that closely follow the pattern and assumptions of non-AV regulations, might suppress the benefits of AVs to public safety, or inhibit the potentially tremendous mobility benefits to groups previously unable to take advantage of independent driving due to age or disability. Alternately, in the short and medium terms, if AVs are predominantly a luxury item, the financial burden of traffic fines is likely to shift to the economically disadvantaged (i.e., those who cannot afford to drive anything other than a traditional, non-AV). Similarly, if AVs lead to an increase of congestion, these effects will not necessarily be experienced in the same way by those in AVs and those in non-AVs, especially if AV passengers are able to perform other tasks (e.g., work, sleep) while driving, and thus AV externalities will be unequally distributed.

RECOMMENDATION: Proactively address implications for equity.

In order to adequately address the equity concerns of AVs, Seattle should proactively consider both the positive and negative impacts of AV technologies and policy responses on disadvantaged groups at every stage of regulation development and infrastructure funding. Throughout its policymaking process, the city should consult diverse stakeholders, including those not traditionally well-represented in policymaking processes, to address potentially unanticipated consequences of AVs and AV policy. The Tech Policy Lab has developed a set of methods aimed at this problem as part of our Diverse Voices Project. In the short term, Seattle should also consider convening an ethics panel to evaluate how the advent of autonomous vehicles will affect the transportation capacities for disabled individuals, and should immediately consult with interest groups, public transit, and social welfare organizations to fund an impact study on the use of autonomous vehicles on indigent populations.

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In short, companies are slowly introducing AVs into city environments, and now is the time for Seattle to begin planning for AVs. As immediate first steps, we recommend that Seattle identify a general AV strategy to guide the decision making processes of policymakers, and initiate coalition-building with research institutions, public agencies, NGOs, and businesses throughout the region, with an eye towards developing clear and consistent policies for AVs in the Seattle area. Taking these steps now will better position Seattle to continue to thrive in an eventual world of far greater automation in transportation.

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About the Tech Policy Lab

The Tech Policy Lab is a unique, interdisciplinary collaboration at the University of Washington that formally bridges three units: Computer Science and Engineering, the Information School, and the School of Law. Its mission is to help policymakers, broadly defined, make wise and inclusive technology policy. Research is driven exclusively by faculty interest and supported through gifts and grants. In this instance, Challenge Seattle as part of its investment in the newly established UW Mobility Innovation Center provided funding to support graduate students across four disciplines (Urban Design and Planning, Law, Business, and Communications) to research the challenges for municipalities of planning for greater automation in transportation under supervision of Lab staff and faculty.

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About Challenge Seattle

Challenge Seattle is a private sector initiative led by many of the region's CEOs working to address the issues that will determine the future of our region—for our economy and our families. Building on our region's history, we are focused on taking on the challenges that must be addressed to ensure our region continues to grow, transform, and thrive, while maintaining our quality of life.

About the Mobility Innovation Center

The University of Washington and Challenge Seattle are committed to advancing our region's economy and quality of life by helping to build the transportation system of the future. Together, they have partnered to create a multi-disciplinary Mobility Innovation Center. Housed at CoMotion at the University of Washington, the Center brings together the region's leading expertise from the business, government, and academic sectors to tackle specific transportation challenges, using applied research and experimentation. Cross-sector teams will attack regional mobility problems, develop new technologies, apply system-level thinking, and bring new innovations to our regional transportation system.