The Robots Are Coming: How Cities Can Plan for Autonomous Vehicles

Crista M. Cuccaro, Assistant City Attorney, Durham, North Carolina

Imagine this: you need to get to the airport and catch your flight to the upcoming IMLA Conference. Instead of paying exorbitant airport parking fees, you hail a ride through an app on your phone. After a short wait, a ride share vehicle pulls up to the curb. The trunk opens and you load your luggage. When you climb into the back seat, you're alone in the car. No one is driving; instead, the ride share is an autonomous vehicle (AV).

Apprehensive about this scenario? You're not alone. According to a recent Reuters poll, half of adults in the United States think AVs[1] are more dangerous than cars operated by people.[2] A majority of Americans also believe that self-driving cars should be held to higher safety standards than traditional vehicles.[3] The Reuters poll may underestimate public unease. A 2019 AAA survey found that nearly 75% of Americans are afraid to ride in fully autonomous cars.[4] Despite this, the majority of the public also believes that most vehicles will be fully autonomous by 2029.[5] And the public is probably right.

Currently, automotive and tech companies are in an expensive race to the top. In 2016, GM spent $581 million to acquire AV start-up, Cruise Automation.[6] Next year, GM will likely release a fleet of electric AVs with its affiliate, Lyft, in which GM purchased a share for $500 million.[7] Honda has committed $2.75 billion as part of an exclusive agreement with GM to develop and produce a new kind of AV.[8] Ford has partnered with Argo AI and plans to introduce Level 4 AVs vehicles in 2021 as part of a ride-hailing service.[9] Last year, Volvo and Uber entered into a $300 million joint venture with the goal of having its fully autonomous vehicle on the road in 2021.[10]

Other companies have plans underway to create fully autonomous vehicles, including freight trucks, within the next five years. Some of these firms have tested their AVs on public roadways. In 2009, Google began testing its self-driving cars and by end of 2018, the company had logged more than two million miles of autonomous driving.[11] In December 2018, Waymo, owned by the same parent company that owns Google, launched an "autonomous" ride-hailing service in Chandler, Arizona; however, that service is yet to be fully autonomous, in part because tests have revealed that self-driving technology still has significant shortcomings.[12]

During the past several years, minor and major incidents have shaken industry and public confidence in automated driving systems. In February 2016, a Google research car "made contact" with a public bus.[13] The car and test driver predicted that the bus would yield as the Google vehicle attempted to merge into traffic, but it didn't.[14] Following the crash, Google updated its software to "more deeply understand that buses and other large vehicles are less likely to yield" to its cars than other types of vehicles.[15]

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Later in 2016, the driver of a Tesla Model S died in an accident while the Autopilot was activated.[16] According to Tesla, the vehicle's camera couldn't detect a trailer as an obstacle because of the trailer's "white color against a brightly lit sky" and its "high ride height," and the car's radar classified it as an overhead road sign.[17] And in March 2018, a Volvo SUV owned by Uber and outfitted with Uber's self-driving system struck and killed a pedestrian.[18]

The number of incidents involving AVs pales in comparison to the tens of thousands of Americans who die every year in accidents involving traditional vehicles.[19] The National Highway Traffic Safety Administration (NHTSA) projects that 36,570 people died last year in traffic fatalities in the United States.[20] Remarkably, an estimated 90 percent of motor vehicle crashes are caused at least in part by human error.[21] While juxtaposing human drivers and AVs may not be a fair comparison,[22] advocates insist that AVs will make roadways much safer. Regardless of the specifics, the arrival of AVs is imminent, as is cities' need to plan for and regulate them.[23]

This article explains the current legal framework for AV regulation in Part I and the policy implications for cities to consider in Part II.[24]

I. The Legal Framework

The United States ranks highly in the technology and innovation needed to support AVs, but lags in policy and legislation and infrastructure.[25] These latter two pillars of the AV Readiness Index are squarely within the realm of federal, state, and local governments. This section explores state and federal regulation of AVs to date.

A. State Regulation of AVs: A Mixed Bag

As would be expected, states have varied approaches to regulating AVs. Broadly, state legislation covers: vehicle testing,[26] infrastructure requirements, licensing and registration, operation on public roads, task forces, operator requirements, privacy of collected vehicle data, and more. Nevada was the first state to authorize the AV operation.[27] Florida and Arizona were also at the forefront in AV testing. In 2012, Florida passed a bill allowing AV testing after meeting certain requirements including proof of insurance.[28] In 2015, Arizona's Governor signed an Executive Order enabling pilot programs.[29] More cautious states have adopted laws restricting AV testing to platooning (electronically pairing two or more vehicles to allow smaller distances between them), although some of these have later loosened the restrictions.[30] Currently, the District of Columbia and the following states allow AVs on public roadways[31] in testing with a driver, without a driver, or in a platoon: Arkansas, Arizona, California, Colorado, Connecticut, Florida, Georgia, Illinois, Indiana, Iowa, Louisiana, Massachusetts, Michigan, Minnesota, Nebraska, Nevada, New York, North Carolina, Ohio, Oregon, Pennsylvania, South Carolina, Tennessee, Texas, Utah, Vermont, Virginia, Washington, Wisconsin, and Wyoming.[32]

State-level regulation of AVs does not necessarily confer municipal authority to do so. As cities know all too well, some states preempt local authority over emerging businesses and technologies.[33] One jurisdiction that has not been preempted is Boston, which created a graduated system of AV testing.[34] In the first phase, Boston's model allows AV companies to test only in a limited geographical area during good weather and daylight hours.[35] Once a company reaches certain milestones, permission is expanded to allow testing in other areas of the city, at night and during inclement weather.[36] Additionally, Boston requires companies to enter into a Memorandum of Understanding, covering issues such as accident reporting, minimum safety standards, and, of course, indemnification.[37]

Not all cities have been as friendly to AVs as Boston, however. Chicago's Board of Aldermen stalled a proposal to allow AVs in the city, citing concerns about cybersecurity and loss of jobs.[38] This local resistance did not evade the eye of Illinois' General Assembly. In 2018, the state passed a law prohibiting localities from banning AVs. Not all opposition occurs within City Hall: in Chandler, Arizona, where Waymo has been testing its vehicles, the company's driverless test vehicles have weathered nearly two dozen attacks from irate locals over the past two years, including tire slashings and being pelted by rocks.[39]

This patchwork approach has spurred industry advocates to call for federal regulation of AVs. Volvo Cars President Håkan Samuelsson argued that the United States risks losing its leading global position in the development of self-driving cars if federal legislation is not passed.[40] The next section explains the current status of federal guidance on AVs.

B. Federal Regulation of AVs: Tapping the Brakes

Despite the industry's urging, the federal government has left regulation of AVs to the states – for now. This failure is not for lack of trying. In 2017, The Safely Ensuring Lives Future Deployment and Research In Vehicle Evolution Act, also known by its clever acronym SELF DRIVE,[41] was introduced in the House. The Act would have preempted states from enacting laws regarding the design, construction, or performance of AVs unless such laws were identical to federal standards. In its report, the House Committee on Energy and Commerce highlighted the need for uniformity by pointing out conflicts between proposed laws in North Carolina and New York.[42] The SELF DRIVE Act passed the House in September 2017. A companion bill was introduced in the Senate, with an equally clever acronym of AV START Act, standing for the American Vision for Safer Transportation through Advancement of Revolutionary Technologies Act. However, the AV START Act never made it to the floor of the Senate in part because of objections from several key senators.[43]

Congress has renewed its efforts to regulate AVs and in August 2019, a

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new version of the AV START Act was circulated for comments from stakeholders. The current legislation preempts local regulation of AVs, creates a Highly Automated Vehicles Advisory Council, directs the Comptroller General to evaluate the feasibility of removing personally identifiable information from AVs, proposes a rulemaking process – and more. With a bicameral effort behind the legislation, there is optimism that Congress will act on AVs during its current session.

While progress has been slow on the Hill, the United States Department of Transportation (USDOT) has been pressing forward. In September 2016, the NHTSA[44] and the USDOT issued a Federal Automated Vehicles Policy that set forth a proactive approach to providing safety assurance and facilitating innovation.[45] One year later, the NHTSA issued Automated Driving Systems: A Vision for Safety 2.0. Most recently, the agency released Preparing for the Future of Transportation: Automated Vehicles 3.0, which builds upon – but does not replace – the voluntary guidance provided in the earlier version. The current 80-page document provides best practices for states for the training and licensing of test drivers. It also offers guidance for testing entities about driver engagement methods during testing. In May 2019, NHTSA and the Federal Motor Carrier Safety Administration (FMCSA), issued advance notice of proposed rulemaking to seek public comment on the challenges of testing and verifying compliance of AVs with existing Federal Motor Vehicle Safety Standards.[46] Clearly, AVs are a priority for federal agencies, but there is no definitive timeline for comprehensive laws. Thus, where they have not yet been preempted, cities are left to contend with AVs on their own. The next section examines the myriad issues to anticipate and contemplate as AVs arrive in municipalities.

II. Policy Considerations

While safety occupies a significant portion of the discussions about AVs, many more issues arise for cities: traffic impacts, shifts in the workforce, effects on transit systems, privacy and data concerns, land use modifications, infrastructure support, equity in access, liability and insurance, and last, but absolutely not least, impacts to municipal budgets. And although AVs may seem relevant only to major cities, the International City/County Management Association (ICMA) advises that suburban and rural residents, because they often commute into larger cities, are the ones who are most likely to take advantage of self-driving technologies, and to participate in first mile or last mile AV ride-sharing from public transit hubs.[47]

The impact of AVs on cities depends largely on whether the dominant model is shared fleets or individual vehicle ownership.[48] A fleet model means that communities will have less need for

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commercial car dealerships and service stations, thereby freeing up significant tracts of land. Additionally, AV fleets will likely be electric, and cities will need to allow for a more expansive electric charging infrastructure. Experts anticipate that the shared fleet model will prevail; one authority states that AV companies "don't actually want to sell people these cars – they want to rent us these services. They want us to pay every month, every trip."[49] Moreover, given the cost of sensor technology and computing power needed to deploy AVs,[50] individual ownership will initially be too expensive. The remainder of this article largely assumes a shared AV fleet model.

A. Impacts to Cities' Bottom Lines

Last year, a headline in Wired magazine read "Autonomous vehicles might drive cities to financial ruin."[51] While the reality may not be so dire, cities would be wise to plan for AVs in their budgets. State and municipal revenue from metered parking and tickets, traffic violations, vehicle registration and licensing fees, and gas taxes will clearly be affected.[52] The Sustainable Cities Initiative characterizes the budgetary impact of AVs as a "secondary impact." However, upon analyzing the numbers, this should be a – if not *the* – primary concern to cities.[53]

One useful benchmark is fuel tax. In 2017, Delaware collected $123 million in fuel tax revenue.[54] While that is considerable, Texas collected a massive $3.7 billion in motor fuel taxes in the 2018 fiscal year.[55] These figures are significant because AVs will likely be electric, and are expected to consume less fuel than standard vehicles even if gas-powered.[56] Additionally, parking revenue from meters and fines will decrease because AVs will not necessarily need to park for short periods of time, or may be sent to free spaces outside of pay-for-parking areas.[57] A sharp decrease in parking fees could cripple a municipality like the tourist town of Rehoboth Beach, Delaware, which is predicted to generate $6 million in parking fees in fiscal year 2019 – constituting 28% of the city's overall budget and its largest single revenue source.[58]

Not all of the news about AVs and cities' budgets is negative. Using San Francisco as its model, scholars at the Sustainable Cities Initiative have projected that alongside a decrease in parking revenues, cities should expect to see an increase in property tax revenues.[59] With a shared fleet model, cities will no longer need as many parking spaces and that land can be put to more productive uses that will generate property tax revenue.

In order to mitigate some of these shifts, states are enacting a robot tax.[60] Floated by Bill Gates, the tax would be paid by companies for every robot or automated system that replaces a human worker, whether in a factory, a mine, or on the roadway. The revenue could help fund training and incentives to move people to occupations less vulnerable to automation, as discussed in the next section. Some states have already made this move. Tennessee recently enacted a law that will establish a one-penny-per-mile tax on AVs.[61] In Massachusetts, proposed legislation would impose a 2.5 cent per mile tax on AVs, increasing when there are no passengers riding.[62]

Even where cities cannot enact taxes, there are creative ways to generate revenue that influences AV use. Seattle proposed a tiered road-pricing mechanism, which incentivizes AVs with three or more occupants.[63] Other mechanisms might include variable congestion pricing, Vehicle Miles Traveled (VMT) fees, and curbside use fees for pickup and drop-off.[64] Regardless of the approach, building pricing into AV use can partially offset revenue losses.[65] Cities are not alone in feeling a financial squeeze with the arrival of AVs; certain sectors of the workforce are also at risk, as discussed next.

B. Shifts in Cities' Workforces

As cities adjust their budgets for AVs, they should also examine their workforces. An estimated 80 percent of the typical city police department is involved in some way with traffic control.[66] As vehicles become able to navigate without human intervention or assistance – including that of law enforcement – cities will need to reallocate police or possibly reduce the size of their forces.[67] On the other hand, cities may need to hire more employees in other sectors. For example, transportation planners will be needed to conceptualize a new physical infrastructure for AVs.

The largest workforce effects of AVs will be felt in industries such as transportation, and particularly the freight sector. A 2016 White House report estimated a potential displacement of 3.7 million drivers of trucks, taxis, and buses.[68] The consequences are likely to be most significant for men of color.[69] These lost jobs will be replaced with lower-wage jobs with few benefits, or jobs requiring additional technology-related knowledge and skills. As AV use increases, workforce shifts will challenge cities' commitment to equity.

One way that cities can influence these outcomes is workforce development. AVs will expand job growth in a number of key industries. Electrical engineers, computer scientists, and software developers will be needed to develop vehicle control systems and the telecommunication networks required for AV functionality.[70] To train displaced employees, cities can support apprenticeships, combining on-the-job training with classroom instruction, and AV sector-specific training – especially in higher education.[71]

A silver lining, perhaps, is that the lower cost and increased efficiency of AV travel may enable people to commute farther, increasing access to job opportunities.[72] But throngs of people traveling to work in AVs could also create more congestion and cripple public transit, as discussed in the following sections.

C. Traffic Impacts: Utopian or Dystopian?

It's obvious that AVs have the potential to significantly affect traffic flows, but there is not yet a consensus about how.[73] There

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are two competing perspectives on the subject.[74]

In the utopian vision, often touted by AV manufacturers, AV fleets consist of shared vehicles, leading to fewer cars and fewer accidents and fatalities, reduced congestion, lower carbon emissions and improved air quality, and compact development patterns in which walking, biking, and transit thrive. In the dystopian version, however, the AV fleet consists of privately- owned vehicles, while zombie cars – those with zero occupancy – roam the streets, resulting in greatly increased traffic, severe reductions in other transportation modes, increased pollution and greenhouse gas emissions, and more sprawl as people live farther from work.

With such disparate predictions, it's difficult to know how to proceed as a city. Clearly, it is imperative to account for AVs.[75] Many current municipal planning processes rely on assumptions about the nature of travel – including models of vehicle ownership, route choice, and residence and work locations – that may not be true for AVs.[76] While not always popular with the public or industry, it may be prudent for cities to approach AV regulation conservatively and plan for added traffic congestion. The Center for Transportation Research at the University of Texas predicts that AVs will increase vehicle miles traveled (VMT) because drivers will experience fewer travel inconveniences.[77] People using AVs will be more comfortable heading to more distant locations and those unable to drive themselves will be able to travel safely.

With that in mind, there are measures that cities can take to influence AV use. As already mentioned, a tiered road-pricing mechanism can incentivize ridesharing in AVs.[78] Cities could also require AVs to be electric, which would minimize emissions.[79] There may be ways for cities to promote small or micro-sized AVs for personal use. Cities could create designated AV lanes, which would have the added benefit of reducing conflict with other modes of transportation. And, as already mentioned, cities could impose a VMT fee. Some challenge these on the basis that sharing vehicles will increase demand.[80] Instead, policies may need to make driving less rather than more attractive relative to other transportation modes.[81] Accordingly, it is necessary to explore the effect of AVs on public transit, which is covered in the next section.

D. The Transit System: A Possible Victim of Convenience

Public transportation advocates are worried that AVs may result in curtailing investment in more communal transit options – and with good reason. While services such as Uber and Lyft are marketed as complements to public ways of getting around, these services actually compete with public transit. Although economic growth is usually accompanied by an uptick in public transit use, this pattern has been disrupted by ride-sharing and ride-hailing services. Public transit ridership is down in San Francisco, where half the residents use Uber or Lyft. Nationally, ride-hailing services have reduced public transit ridership by an average of 12 percent.[82]

AVs may accelerate this trend, and where public transit ridership falls, levels of investment in public transit will decline.[83] Equity remains a vital part of the conversation, because the rise of AVs will put struggling sections of cities at a particular disadvantage.[84] Unemployment tends to be lowest in isolated, majority-minority neighborhoods,[85] where the main barrier to employment is access to transport.[86]

Improved transit systems may persuade users to maintain or increase ridership. Theoretically, one way to do this is to increase the frequency of service. Practically speaking, as dollars for public transit dwindle, this option is probably not viable on its own. Another option, already used in many larger cities, is to provide transit-only lanes. In-vehicle travel time on buses has to be faster to compete with vehicular travel. A particularly creative solution is to provide comprehensive trip-planning information, so the public has the ability to evaluate their travel options with information on travel time, cost, and environmental impact.[87]

Another option for public transit is to become autonomous.[88] Buses on fixed routes are easiest to transition to AV use. Vehicles and transit schedules can be "right-sized" so fleets are used effectively, reducing empty buses.[89] Additionally, autonomous buses could potentially free up public funds because transit operating costs are mostly labor. A driverless model could radically increase public transit frequency, the single most important factor in transit ridership. Ultimately, "people need to see autonomous public transit, and see that it gets them where they need to go just as efficiently, in order for them to choose that over their own car, a ride provided by Uber or Lyft, or, someday in the future, their own driverless car."[90]

E. AV Infrastructure Support in Technology and the Built Environment

Simply put, smart cars (and buses!) need smart cities.[91] For now, most AV applications depend on vehicles with limited connectivity needs. Higher speed uses, such as platooning trucks, rely on vehicle-to-vehicle communications and higher levels of connectivity. These applications demand increasing bandwidth on existing wireless networks, but are currently constrained by the absence of sensor and communication technology embedded in infrastructure. Self-driving cars, and especially connected vehicles, will need significant support to work properly.[92] This means providing radio transmitters to replace traffic lights, higher-capacity mobile and wireless data networks to handle vehicle-to-vehicle and vehicle-to-infrastructure communication, and roadside units to relay real-time data about weather, traffic, and other conditions.[93] Atlanta, as an example, "may need 50,000 environmental sensors, 20,000 pedestrian and mobility sensors

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and 10,000 cameras" to support its plan to move ahead with AVs.[94]

Some states are already building this infrastructure. Colorado's Department of Transportation is installing road- side units along Interstate 70, which are expected to communicate with driverless cars by sharing information about upcoming road hazards and current driving conditions.[95] Virginia has launched SmarterRoads, a cloud-based portal that will provide raw data pertaining to road conditions, incidents, work zones, multi-modal transportation, and road signs to the AV industry, third-party enterprises, and the public.[96] And Wisconsin is using road widening as an opportunity to install infrastructure for AV communication.[97]

Not all improvements to support AVs demand as much effort and money. AVs need clear lane markings and signage in order to operate effectively. An AV at a 2016 Los Angeles Auto Show behaved erratically due to poor road markings, indicating that local governments can ease AV integration by attending to basic roadway maintenance, such as striping.[98] Moreover, the APA advocates that when cities are reimagining streets with AVs, they should design roadways for mixed traffic – not just AVs and conventional vehicles, but also pedestrians and cyclists – so as to avoid conflicts between different modes. Cities should look to recapture this right-of-way and repurpose streets for bikers and pedestrians.[99] The next section is a more comprehensive discussion of how to handle this newly available land.

F. Land Use: Sprawl or Density for All?

Undoubtedly, AVs will disrupt city land use patterns. Self-driving vehicles could encourage unnecessary driving and exacerbate sprawl, or, conversely, a network of predominantly shared AVs could reduce the need for parking and road expansion, creating the potential to repurpose space.[100] The outcome depends, in part, on parking-related zoning regulations, including the conversion of parking lots and decks, curbside management, and placement of infrastructure such as electric charging stations.

If shared AVs are the standard, municipalities probably will be able to reduce their required parking spaces. And the dimensions, location and design of AV parking structures will likely not need to take humans into consideration, resulting in reduced space requirements. Additionally, fewer parking garages may be needed in urban areas, which may lead to conversion into micro-housing unit communities, elevated parks, luxury homes, apartments, and offices.[101] Of course, when they are not being used, AVs will have to go somewhere. Cities should think about the best locations for AV storage, recharging, and maintenance. Municipal lawyers may want to assess whether their jurisdictions' current zoning definitions are adequate for new uses such as AV staging, support services, and electric recharging. Additionally, land use regulations should incorporate guidance for locating and designing on-street drop-off and pickup areas.[102] Providing safe and easy access for riders of hailed AVs may require changes to curb access and traffic flows.[103] In tackling the AV parking puzzle, Chandler, Arizona is poised to the be the first city to adjust its zoning laws to incentivize AVs through parking reductions and creating standards for AV loading zones.[104]

AVs will likely change the retail landscape, particularly for e-commerce businesses. Truck drivers are limited to driving no more than 11 hours in one sitting, and their wages accounts for 75% of shipping costs.[105] AVs in delivery (and at distribution centers) could reduce costs for e-commerce retailers. This means that brick and mortar retail stores may dwindle, as they are undercut by online shopping.[106] On the other hand, the convenience of AVs could lead to more discretionary vehicle trips for shopping, and could expand the customer base of large and regional shopping centers. AVs will also bring with them an enormous amount of data, with which cities will have to contend, as detailed in the next section.

G. Dealing with All the Data

Generally, privacy concerns around AVs fall into two categories: "government access to and use of locational and other personal data, and the private, primarily commercial, use of the personal data."[107] The Bloomberg Aspen Initiative on Cities & Autonomous Vehicles speculates that AVs could be the most important opportunity in history for a city to expand the scope and quality of data about its goings-on.[108] Municipal lawyers know that collection of data about residents is particularly sensitive and raises constitutional concerns.[109] The potential benefits of AV data are compelling, given that automated systems could capture individualized information such as vehicle speed, position, arrival rates, and rates of acceleration and deceleration.[110] This data could allow for a greater optimization of traffic patterns; for example, through manipulation of traffic signals. The data could also provide insights for street and curb space management, and even for noise pollution.[111] Ultimately, users' privacy will be critical.[112] In crafting AV regulations, cities will need to approach data privacy thoughtfully. This section explores privacy issues and touches on cybersecurity risks involving AVs.

Regarding AV data and privacy, cities have a chance to address a void in existing United States law.[113] The federal Drivers' Privacy Protection Act[114] protects motor vehicle records from disclosure only by state motor vehicle departments. Moreover, the Electronic Communications Privacy Act[115] does not necessarily prevent a service provider, such as a shared AV owner, from capturing and using a vehicle's electronic or stored communications. There have been several attempts to address this gap. The Security and Privacy in Your Car Act (SPY Act)[116] instructed NHTSA to develop privacy standards that would force manufacturers to be more transparent in how vehicle data are collected, stored, and used.[117] However, the SPY Act never made it out of Committee. Like federal law, state law has generally failed to address the privacy problems with AVs.

The lack of federal and state oversight does not mean cities can avoid privacy concerns. AVs will create many of the

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same legal questions as cellular data, GPS technology, and internet usage. Courts have already begun to answer some of these questions through the lens of the Fourth Amendment.[118] In *U.S. v. Jones*, the Supreme Court confronted the acquisition of information without a warrant that generated "a precise, comprehensive record of a person's public movements that reflects a wealth of detail about her familial, political, professional, religious, and sexual associations."[119] In *Jones*, the government placed a GPS device directly on a vehicle, prompting the Court to find that the government's action was a search. However, the Court did not rule on the reasonableness of the search, and as Justice Scalia opined, what is considered a reasonable intrusion into privacy may shift as technology advances.

For now, the "third-party" privacy doctrine appears to be solid ground, in terms of AV privacy; it affords a loophole in Fourth Amendment constraints where the government can ostensibly obtain AV locational data from private, third-party sources to whom the vehicle users have granted access. Some argue, though, that this loophole could be eliminated by expanding the definition of "papers" under the Fourth Amendment to include data held by third parties.[120]

Ultimately, lawyers cannot be certain how courts will treat governmental use of location data from AVs, especially if the government is not involved in the installation of tracking technology.[121] When accessing or making use of AV data, local governments should proceed cautiously to ensure they are within constitutional parameters.

One of the largest privacy concerns is the capability for (and likelihood of) AV companies to monetize the information. As with smartphones, AVs will generate a tremendous amount of tracking data that will prove valuable for advertising and marketing purposes.[122] One think tank estimates that car data monetization will generate a whopping $450-750 billion by 2030.[123] For now, the industry has agreed to regulate itself. In 2014, 20 automakers signed a voluntary set of automotive privacy principles, effective with 2017 models, agreeing to ask permission before using or sharing sensitive information about occupants, and to limit what they share with government and law enforcement. While there may be some justifications that AV consumer privacy laws should develop at the state level, it is doubtful that these laws would be broad and comprehensive enough to regulate AVs.[124] Due to the interstate qualities of AVs, a federal approach – such as the one currently underway at the NHTSA and the Federal Trade Commission – makes more sense.[125]

Finally, there is a very specific threat to data privacy: cyber-attackers. AVs and their supporting infrastructure will inevitably hold personal data which will be of interest to cyber-criminals.[126] Many experts believe that the installation of ransomware could pose a considerable threat to connected cars. Undoubtedly, AVs will be vulnerable to malicious attacks, which implicates AV technology producers from a liability standpoint, but also presents significant safety concerns for consumers as well as cities, which enforce traffic and criminal laws and respond to emergencies.

While consumer protection and cyber-security protection are not the bailiwicks of local government, municipalities should still press AV operators to under- stand how data about their residents will be collected, used, and protected.

H. Not Boilerplate: Liability and Insurance

Who is to blame if a self-driving car gets in a wreck? The answer, not surprisingly, is complicated. In order to resolve the question of fault, the courts will indeed need to consider "novel and in some cases challenging questions."[127] For now, responsibility for AV accidents will fall on the human driver, the AV technology providers, the car manufacturer (which could be the same entity as the AV technology provider), and, in some instances, cities.[128] This section describes how the legal system may eventually apportion fault in AV accidents.

Much of the complexity about liability lurks in autonomy Levels 3 and 4, during the handover from vehicular control to human control. Experiments have found time lags in drivers retaking control and other delays with humans returning to baseline driving performance.[129] This has led companies such as Waymo and Ford to advocate for fully autonomous cars that avoid the need for handovers – the process through which control shifts to the vehicle. As the Harvard Business Journal points out, this may be too large of a leap. With no driver as backup, there is a risk that AVs will be thrust into environments that they can't yet navigate.[130] The best route is for regulators to establish standards that define an effective handover, and reasonable time periods for a driver to retake control.[131]

Despite this dilemma, legal scholars are confident existing tort and contract legal frameworks are sufficient to address liability questions surrounding AVs.[132]

From a legal perspective, AV liability should shift from the compensation regime applied to conventional driving, largely premised on vehicular negligence, to a compensation regime that increasingly implicates product liability.[133] As technology enables increasing automation of vehicles, AV manufacturers will increasingly bear the burden for liability.[134] While more general theories of tort liability are viable,[135] products liability has emerged as the dominant theory for AV litigation. Thus, the remainder of this section focuses on manufacturer liability.

In a products liability case, liability usually depends on defects, of which there are three types: manufacturing defect, design defect, and failure to warn.[136] A manufacturer's liability for manufacturing defects in AVs will be largely limited to quality-control problems with the hardware of the operating system, including the cameras, lasers, radars, and other physical components of the system

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or vehicle.[137] Experts predict, though, that much of the AV product liability litigation will not involve manufacturing defects.[138]

In contrast, AV software is considered part of the AV's operating system, and defects in software implicate design defects claims. AV users will probably argue that manufacturers did not design the AV adequately to protect its occupants during a crash. Under the "risk-utility" analysis more commonly applied by courts in design defect claims, manufacturers will stress the extraordinary safety benefits of AVs, while consumers will allege that designs can be improved.[139]

Finally, when AV litigation arises based on failure to warn claims, manufacturers will argue that they cannot warn for every imaginable scenario. Yet, the enormous amounts of data available to manufacturers could lead to enhanced obligations. Practically speaking, as regulators craft legislation to clarify the legality of operating AVs on public roads, it is impossible to answer all of the associated liability questions that need to be addressed. Luckily, products liability law has proven to be remarkably adaptive to new technologies.[140]

The Brookings Institute has proposed several guiding principles as governments at the federal, state, and local level grapple with liability issues.[141] First, Congress should not preempt state tort AV remedies, except that liability of commercial AVs should be addressed federally. Second, manufacturers of non-AVs should not be liable for alleged defects introduced through third party conversions in an AV. Additionally, while clarification of liability will take time to sort out, NHTSA's guidance document offers a first-step recommendation: states should explicitly define what is meant by "drivers" of AV for the purpose of traffic laws and enforcement. NHTSA recommends that when the AV systems are monitoring the roadway, the surrounding environment, and executing driving tasks (Levels 3 through 5), the vehicle itself should be classified as the driver, and licensed human operators classified as drivers for Levels 1 and 2 functionalities.[142] This guidance from the NHTSA is instructive for cities, as cities will need to align their municipal codes with trends in state and federal law.

Besides manufacturers, insurance companies possibly stand to lose the most when it comes to AV liability. AV technology could shrink the auto insurance sector by $137 billion by 2050.[143] The number of total claims submitted to insurance companies is expected to decline, but the cost per claim is anticipated to increase due to the expensive components integrated into AVs.[144] Additionally, while AVs have the potential to increase safety and reduce accidents, the severity of those accidents will be much greater if AV systems fail.[145]

State Farm, the nation's largest automobile insurer, notes that the industry will need to overhaul the way it measures risk for auto insurance, which could significantly impact insurance rates.[146] Likely, as a condition of providing insurance for drivers of AVs, insurers may require greater access to data that could be used to reconstruct the actions of the "driver" – whether human or automated – before an accident.

For cities, insurance impacts are relevant for two reasons. First, cities may specify insurance requirements for AVs in their jurisdiction, and need to understand the demands by the insurance industry. Second, cities may employ their own AVs, as part of solid waste management or public transit, and will need to budget accordingly for changes in insurance rates.

Conclusion

Cities need to start planning now for AVs, which clearly create a litany of issues: impacts to municipal budgets, shifts in the workforce, traffic impacts, effects on transit systems, equity in access, infrastructure support, land use modifications, privacy and data concerns, and liability and insurance.

The American Planning Association (APA) urges that localities not take a "wait and see" approach.[147] The APA has numerous checklists that identify AV action items: developing a fact sheet on autonomous technology; forming an internal working group with stakeholders from critical departments, such as IT, transportation, and economic development; and identifying internal barriers for regulation or adoption, such as budgets or legacy technology contracts.[148] The APA resource also recommends how to engage city residents and community stakeholders about AV technology.

Undoubtedly, law and policy will play a critical role in shaping the trajectory of AV development and deployment on municipal streets, and local government lawyers will have a significant role in paving the way.

Transportation 1

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About the Author:

Crista M. Cuccaro is an Assistant City Attorney in Durham, North Carolina, where she focuses on community development, municipal finance, and economic development. Prior to joining the City of Durham, Crista was a Staff Attorney in Knoxville, Tennessee. In Tennessee, her practice included land use and redevelopment, and she served as Vice-President of the Tennessee Municipal Attorneys Association. Crista earned her B.A. degree from the University of North Carolina and her J.D. degree from the University of Tennessee College of Law, but she is a Duke basketball fan. Contact Crista at Crista.Cuccaro@durhamnc.gov

Notes

1. There are five levels of vehicle automation, which are the industry standards established by the Society of Automotive Engineers (SAE). Detailed descriptions of these levels are published in the *Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles*, SAE Recommended Practice J3016. The guide is available online at https://www.sae.org/standards/content/j3016_201806/.

The SAE levels are as follows: Level 1 automation allows small steering or acceleration tasks to be performed by the car without human intervention, but everything else is fully under human control; Level 2 is like advanced cruise control or original autopilot systems on some Tesla vehicles, so the car can automatically take safety actions, but the driver must stay alert at the wheel; Level 3 requires a human driver, but the human is able to assign some safety-critical functions to the vehicle; Level 4 is a car that can drive itself almost all the time without any human input, but might be programmed not to drive in unmapped areas or during severe weather; and Level 5 means full automation in all conditions. *See* Jon Walker, *The Self-Driving Car Timeline–Predictions from the Top 11 Global Automakers*, EMERJ (May 14, 2019), https://emerj.com/ai-adoption-timelines/self-driving-car-timeline-themselves-top-11-automakers/.

2. Paul Lienert & Maria Caspani, *Americans still don't trust self-driving cars, Reuters/Ipsos poll finds*, REUTERS (Apr. 1, 2019), https://www.reuters.com/article/us-autos-selfdriving-poll/americans-still-dont-trust-self-driving-cars-reuters-ipsos-poll-finds- idUSKCN1RD2QS.

3. *Id*.

4. Ellen Edmonds, *Three in Four Americans Remain Afraid of Fully Self-Driving Vehicles*, AAA NEWSROOM (Mar. 14, 2019), https://newsroom.aaa.com/2019/03/americans-fear-self-driving-cars-survey/.

5. *Id*.

6. Walker, *supra* note 1.

7. *Id*.

8. Kristen Korosec, *Honda commits $2.75 billion to build autonomous vehicles with GM's Cruise*, TECHCRUNCH, https://techcrunch.com/2018/10/03/honda-commits-2-75-billion-in-partnership-with-gms-cruise/.

9. Walker, *supra* note 1.

10. *Id*.

11. Luke Dormehl & Stephen Edelstein, *Sit back, relax, and enjoy a ride through the history of self-driving cars*, Digital Trends (Feb. 3, 2019) https://www.digitaltrends.com/cars/history-of-self-driving-cars-milestones/.

12. Alex Davies, *Waymo's So-Called Robo-Taxi Launch Reveals a Brutal Truth*, WIRED (Dec. 5, 2018), *available at* https://www.wired.com/story/waymo-self-driving-taxi-service-launch-chandler-arizona/.

13. *See* Cal. Dmv, Report Of Traffic Accident Involving An Autonomous Vehicle (Feb. 23, 2016), http://docs.dpaq.de/10437-googleautocrashreportfeb2016.pdf.

14. Associated Press, *Google self-driving car caught on video colliding with bus*, The Guardian (Mar. 9, 2016), *available at* https://www.theguardian.com/technology/2016/mar/09/google-self-driving-car-crash-video-accident-bus.

15. *Id*.

16. Fred Lambert, *Understanding the fatal Tesla accident on Autopilot and the NHTSA probe*, Electrek (Jul. 1 2016), https://electrek.co/2016/07/01/understanding-fatal-tesla-accident-autopilot-nhtsa-probe/.

17. *Id*.

18. Laurel Wamsley, *Uber Not Criminally Liable in Death of Woman Hit by Self-Driving Car, Prosecutor Says*, NPR (Mar. 6, 2019) https://www.npr.org/2019/03/06/700801945/uber-not-criminally-liable-in-death-of-woman-hit-by-self-driving-car-says- prosec.

19. The State of California Department of Motor Vehicles collects reports on accidents involving autonomous vehicles regardless of fault. This year, there have been thirty-three accidents. *See* State Of California Department Of Motor Vehicles, Report Of Traffic Collision Involving An Autonomous Vehicle (OL 316), https://www.dmv.ca.gov/portal/dmv/detail/vr/autonomous/testing last visited (June 24, 2019).

20. U.S. department of transportation national highway traffic safety administration traffic safety facts crash stats, dot hs 812 749 a brief statistical summary (June 2019), *available at* https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812749.

21. Bryant Walker Smith, *Human Error as a Cause of Vehicle Crashes*, The Center For Internet And Society At Stanford Law School (Dec. 18, 2013), http://cyberlaw.stanford.edu/blog/2013/12/human-error-cause-vehicle-crashes.

22. *See* Peter Hancock, *Are Autonomous Cars Really Safer Than Human Drivers?*, Scientific American, *available at* https://www.scientificamerican.com/article/are-autonomous-cars-really-safer-than-human-drivers/.

23. According to a 2018 report from the Autonomous Vehicle Pilots Across America, more than 50 percent of US cities are currently preparing for self-driving vehicles, up from less than ten percent in 2015. *See* Teena Maddox, *Self-driving stories: How 6 US cities are planning for autonomous vehicles*, Techrepublic (Oct. 17, 2018), https://www.techrepublic.com/article/self-driving-stories- how-6-us-cities-successfully-integrated-autonomous-vehicles/. The Bloomberg Philanthropies and The Aspen Institute have created a real-time database of the cities across the globe that are preparing for AVs. As of June 2019, the database is tracking 126 cities, including 45 in the United States and eight in Canada. *See* Initiative on Cities and Autonomous Vehicles, https://avsincities.bloomberg.org/global-atlas/ (last visited June 24, 2019).

24. This paper cannot possibly cover every facet of autonomous vehicles and cities; it is intended to give municipal lawyers an overview of the legal and policy issues most relevant for their clients. A comprehensive resource providing a foundation for this paper is *Autonomous Vehicle Technology*, *infra* note 124, and other municipal lawyers would likely find it useful.

25. *See Automated Vehicle Readiness Index*, KPMG International, https://assets.kpmg/content/dam/kpmg/nl/pdf/2018/sector/automotive/autonomous-vehicles-readiness-index.pdf (last visited June 24, 2019). Canada ranks behind the United States in all aspects of AV readiness.

26. Consumer Watchdog has recommended several safeguards for cities that want to allow AV testing—including that the AV must have a trained test driver, behind a steering wheel and brake pedal capable of assuming control. *See Consumer Watchdog Backs Banning Robot Cars in Chicago Until Feds Act on Safety Regulations*, Consumer Watchdog, https://consumerwatchdog.org/privacy-technology/consumer-watchdog-backs-banning-robot-cars-chicago-until-feds-

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act-safety (last visited June 24, 2019).
27. *See Autonomous Vehicles | Self-Driving Vehicles Enacted Legislation*, National Conference Of State Legislatures (Mar. 19, 2019), http://www.ncsl.org/research/transportation/autonomous-vehicles-self-driving-vehicles-enacted-legislation.aspx.
28. H.B. 1207, 2012 Leg. (Fla. 2012), Ch. 2012-111 (2012). Florida has continued to advance its AV program. On July 1 of this year, driverless self-driving vehicles were allowed on Florida roads. *See* Sebastian Blanco, *Florida Will Allow Autonomous Cars with No Safety Drivers on Public Roads Starting July 1*, Car And Driver (June 18, 2019), https://www.caranddriver.com/news/a28073922/florida-autonomous-cars-driverless/.
29. Governor Douglas A. Ducey, Executive Order 2015-09, *Self-Driving Vehicle Testing and Piloting in the State of Arizona; Self- Driving Vehicle Oversight Committee*, available at https://apps.azdot.gov/files/sitefinity-files/Executive-Order-2015-09.pdf (last visited June 24, 2019).
30. Automated driving systems in a platoon use vehicle-to-vehicle (V2V) communications device that receives and transmits data from one car to another. *See How an Automated Car Platoon Works*, U.S. Department Of Transportation Volpe Center (July 31, 2017), https://www.volpe.dot.gov/news/how-automated-car-platoon-works (last visited June 24, 2019).
31. For a full list of state legislation as of 2018, see Brian S. Haney et al., *The Autonomous Vehicle Legislative Survey*, Eckert Seamans, https://www.eckertseamans.com/app/uploads/PLAC_Eckert_Seamans_AV_Survey-1.pdf (last visited June 24, 2019). Several states, including Iowa and Louisiana, have subsequently adopted legislation.
32. *See id*.
33. Several states, including Tennessee, Illinois, and Oklahoma have already exercised such preemption.
34. *See* City Of Boston, Autonomous Vehicles: Boston's Approach, https://www.boston.gov/departments/new-urban- mechanics/autonomous-vehicles-bostons-approach (last visited June 24, 2019).
35. *Id*.
36. *Id*.
37. *See* City Of Boston, Template For Autonomous Vehicle Testing In Boston, https://www.boston.gov/sites/default/files/document-file-01-2017/template-mou-for-av-testing.pdf (last visited June 24, 2019).
38. John Byrne, *Aldermen consider tough regulations for self-driving cars*, The Chicago Tribune (Aug. 22, 2017), *available at* https://www.chicagotribune.com/politics/ct-chicago-driverless-cars-regulations-met-20170821-story.html.
39. Simon Romero, *Wielding Rocks and Knives, Arizonans Attack Self-Driving Cars*, N.y. Times (Dec. 31, 2018), available at https://www.nytimes.com/2018/12/31/us/waymo-self-driving-cars-arizona-attacks.html?login=email&auth=login-email.
40. Volvo Car Usa, *US urged to establish nationwide Federal guidelines for autonomous driving* (Oct. 7, 2015), https://www.media.volvocars.com/us/en-us/media/pressreleases/167975/us-urged-to-establish-nationwide-federal-guidelines- for-autonomous-driving.
41. *See* Diana Stancy Correll, *Safety advocates try to hit the brakes on driverless cars*, Washington Examiner (Oct. 23, 2018), *available at* https://www.washingtonexaminer.com/news/safety-advocates-try-to-hit-the-brakes-on-driverless-cars.
42. North Carolina requires the steering wheel, brakes, and other equipment used to operate a vehicle be stowed away so that an occupant cannot assume control while the vehicle is inself-driving mode, and New York law requires a driver to keep one hand on the steering wheel at all times; therefore, a car designed to comply with North Carolina's law cannot also comply with New York law. *See* H.R. REP. NO. 115-294, at 12 (2017), *available at* https://www.congress.gov/115/crpt/hrpt294/CRPT-115hrpt294.pdf.
43. Letter from United States Senator Diane Feinstein et al., to Senator John Thune, Chairman of the Senate Committee on Commerce, Science, and Transportation and Senator Gary Peters, Committee Member, (March 14, 2018), *available at* https://www.feinstein.senate.gov/public/_cache/files/f/1/f168c367-bec0-48cc-9220-6a13cbd9dd27/D00752809320841613B5F03BB-8517FC2.03.14.2018-av-start-act-letter.pdf.
44. The NHTSA is an agency of the USDOT. According to its website, it is responsible for reducing deaths, injuries and economic losses resulting from motor vehicle crashes, which it accomplishes by setting and enforcing safety performance standards for motor vehicles and motor vehicle equipment, and through grants to state and local governments to enable them to conduct effective local highway safety programs. A search of NHTSA's website for "autonomous vehicle" returns 775 results.
45. U.S. Department of transportation national highway traffic safety administration, AV 3.0, *available at* https://www.nhtsa.gov/vehicle-manufacturers/automated-driving-systems.
46. Specifically, Automated Driving System-Dedicated Vehicles (ADS-DVs) may lack traditional manual controls necessary to facilitate operation of a vehicle by a human driver. *See* Press Release, United States Department of Transportation National Highway Traffic Safety Administration (May 22, 2019), *available at* https://www.nhtsa.gov/press-releases/us-department-transportation-seeks-input-testing-vehicles-automated- driving-systems.
47. Dale Neef, *Preparing for Autonomous Vehicles Is a Local Government Reality*, medium (Sept. 4, 2018), https://medium.com/@webanalytics_31234/preparing-for-autonomous-vehicles-is-a-local-government-reality-a81a2b10f0a9.
48. There could also be a hybrid, where those who own an AV can ride to work, then profit off of their otherwise unused AV by renting it to a ride-sharing company during working hours.
49. *See* Lienert & Caspani, *supra* note 2.
50. Nicholas Stecher, *Mercedes-Benz's Plan for Surviving the Auto Revolution*, Wired (Apr. 30, 2018), *available at* https://www.wired.com/story/daimler-mercedes-case-wilko-stark-interview/?mbid=GuidesLearnMore.
51. Susan Crawford, *Autonomous vehicles might drive cities to financial ruin*, Wired (June 20, 2018), *available at* https://www.wired.com/story/autonomous-vehicles-might-drive-cities-to-financial-ruin/.
52. Philip Barnes & Brett Swan, *Fiscal Impacts of Connected and Automated Vehicles in Delaware*, University Of Delaware Institute For Public Administration (Oct. 2018), http://udspace.udel.edu/bitstream/handle/19716/23894/CAV-Fiscal- Impacts-2018.pdf.
53. After safety, of course!
54. Barnes, *supra* note 52, at 1. Delaware's state gas tax rate is 23 cents per gallon.

55. Texas's gas tax rate is 20 cents per gallon. Texas Comptroller Of Public Accounts, Revenue By Source For Fiscal Year 2018, https://comptroller.texas.gov/transparency/reports/revenue-by-source/.
56. Barnes, *supra* note 52, at 1.
57. *Id*.
58. *Id*. This is atypical, though, as parking related revenues usually are not large portion of most cities' revenue streams. *See* Benjamin J. Clark et al., *The Impacts of Autonomous Vehicles and E-Commerce on Local Government Budgeting and Finance* 6, Sustainable Cities Initiative (Aug. 2017), https://www.researchgate.net/publication/324665812_The_Impacts_of_Autonomous_Vehicles_and_E- Commerce_on_Local_Government_Budgeting_and_Finance.
59. *See* Clark, *supra* note 58.
60. While tax creation is not usually within the authority of cities, they can advocate for it at the state level. This effort would be worthwhile, as the numbers are staggering. Due to displacement of humans in occupations vulnerable to automation—such as truck drivers, bus drivers, and taxi drivers—the federal income tax shortfall could exceed $13 billion annually. *See* Stanford Turner & Greg Rogers, *A Robot Tax Would Help or Harm the Transportation Sector– Maybe Both*, Eno Center For Transportation (Apr. 14, 2017), https://www.enotrans.org/article/robot-tax-help-harm- transportation-sector-maybe/.
61. See id.
62. Id.
63. David C. Rouse et al., *Preparing Communities for Autonomous Vehicles*, American Planning Association 30 (2018), https://planning-org-uploaded-media.s3.amazonaws.com/document/Autonomous-Vehicles-Symposium-Report.pdf.
64. *Id*.
65. Ronald T. Milam & William Riggs, *The Future of Transportation Disruption and How Public Agencies Can Respond*, Meeting Of The Minds (Sept. 5, 2018), https://meetingoftheminds.org/the-future-of-transportation-disruption-and-how-public-agencies- can-respond-28098.
66. Neef, *supra* note 47.
67. At the very least, cities should develop specific training procedures for police interactions with AVs. *See* Tech Policy Lab, *Driverless Seattle* (2017), https://techpolicylab.uw.edu/wp-content/uploads/2017/10/TPL_Driverless- Seattle_2017.pdf.
68. Turner & Rogers, *supra* note 60.
69. Rouse, *supra* note 63, at 11 (describing remarks by Laurie Schintler of George Mason University at a symposium convened by the American Planning Association (APA), NLC, Mobility e3, George Mason University, Mobility Lab, the Eno Center for Transportation, and the Brookings Institution).
70. Philip Barnes et al., *Economic Impacts of Connected and Automated Vehicles in Delaware*, University Of Delaware Institute For Public Administration (May 2018), http://udspace.udel.edu/bitstream/handle/19716/23152/CAV-Economics-2018.pdf.
71. Richard Ezike, *Transitioning the Workforce in the Era of Autonomous Vehicles: Meet Dr. Algernon Austin*, Union Of Concerned Scientists (Aug. 28, 2018), https://blog.ucsusa.org/richard-ezike/transitioning-the-workforce-in-the-era-of- autonomous-vehicles-meet-dr-algernon-austin.
72. Some advocates take this a step further. Securing America's Future Energy (SAFE), a group of industry and automotive leaders, argues that AVs will generate productivity gains in the employment sector: A one percent improvement in accessibility to a region's central business district improves regional productivity by 1.1 percent. Similarly, a 10 percent increase in average speed, leads to a 15-18 percent increase in the labor market size., This, in turn, leads to a 2.9 percent increase in productivity. *See* Amitai Bin-Nun, et al., *America's Workforce and the Self- Driving Future*, Securing America's Future Energy (June 2018), https://avworkforce.secureenergy.org/wp- content/uploads/2018/06/Americas-Workforce-and-the-Self-Driving-Future_Realizing-Productivity-Gains-and-Spurring- Economic-Growth.pdf.
73. *See* Tech Policy Lab, *supra* note 67.
74. These two visions were described by Creighton Randall of the Shared-Use Mobility Center at the symposium convened by the American Planning Association (APA) and other stakeholders. *See* David C. Rouse, *supra* note 63, at 21.
75. For a detailed discussion of incorporating AVs into comprehensive plans, functional plans, and subarea plans, see Rouse, *supra* note 63,at 22.
76. *See* Tech Policy Lab, *supra* note 67, at 10.
77. Kara Kockelman, et al., *An Assessment of Autonomous Vehicles: Traffic Impacts and Infrastructure Needs—Final Report*, The University Of Texas At Austin Center For Transportation Research (Mar. 2017), available at https://library.ctr.utexas.edu/ctr-publications/0-6847-1.pdf.
78. Rouse, *supra* note 63.
79. Milam & Riggs, *supra* note 65.
80. Sergey Naumov, et al., *The Impact of Autonomous Vehicles on Demand for Driving: Is Pooling the Solution to Avoiding Traffic Gridlock?,* International System Dynamics Conference (Aug. 2018), https://www.industrystudiesconference.org/conference/papers/download/136.
81. *Id*.
82. Neef, *supra* note 47.
83. *See* Milam & Riggs, *supra* note 65.
84. *See* Crawford, *supra* note 51. At the same time, and not without its own merit, AVs will be transformative for individuals who are physically unable to drive, such as elderly individuals who have "retired" from driving, disabled individuals, and adults without drivers' licenses.
85. *Id*.
86. Policy analysts stress that AVs will exacerbate disparity, even for those not dependent on public transit. Early on, AVs will be financially unfeasible for low-income individuals. Consequently, affluent drivers who can afford to purchase AVs will receive the full benefit of enhanced speed and safety in dedicated lanes, while the less affluent are left with slower, more dangerous conditions. Some AVs will pay a smaller share of gas tax revenue even as they travel greater miles compared to conventional vehicles. Under the the current pay-at-the-pump model, traditional vehicles will effectively be subsidizing AV users. See Philip Barnes & Eli Turkel, *Autonomous Vehicles in Delaware: Analyzing the Impact and Readiness for the First State* 23, University Of Delaware Institute For Public Administration (April 2017), https://www.bidenschool.udel.edu/ipa/content-sub-site/Documents/autonomous-vehicles-2017.pdf.
87. Lauren Isaac, *Driverless vehicles and the future of public transit*, Metro For Transit & Motorcoach Business (Dec. 28, 2017), https://www.metro-magazine.com/mobility/article/724770/driverless-vehi-

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cles-and-the-future-of-public-transit.
88. Milam & Riggs, *supra* note 65.
89. Isaac, *supra* note 87.
90. Andrew Zaleski, *The future is coming—at 11 miles per hour*, Curbed (Apr. 17, 2019), https://www.curbed.com/2019/4/17/18410988/autonomous-vehicle-local-motors-navya-may-mobility.
91. Mapanauta, *How Will Autonomous Vehicles Impact the Public Transport Sector*, Medium (Jul. 12, 2018), https://medium.com/@mapanauta/how-will-autonomous-vehicles-impact-the-public-transport-sector-2cb62cc67660.
92. Not all AV innovators take this stance, however. British startup Wayve, for example, has indicated its vehicles will rely only on a camera, GPS, and its computer system. *See* Sasha Lekach, *Wayve says self-driving cars don't need sensors. Experts aren't so sure*., Mashable (Apr. 8, 2019), https://mashable.com/article/self-driving-cars-lidar-radar-wayve-sensors-perception/. However, the overwhelming opinion in the industry is that AVs will operate better if they receive additional data and operate as connected vehicles.
93. Nick Oliver, et al., *To Make Self-Driving Cars Safe, We Also Need Better Roads and Infrastructure*, Harvard Business Review (Aug. 14, 2018), *available at* https://hbr.org/2018/08/to-make-self-driving-cars-safe-we-also-need-better-roads-and- infrastructure.
94. Dan Fagan, *How States Can Shore Up Infrastructure for the Autonomous Vehicle Boom*, Statetech (Feb. 27, 2018), https://statetechmagazine.com/article/2018/02/how-states-can-shore-infrastructure-autonomous-vehicle-boom.
95. Travis Khachatoorian, *Colorado among the leaders for driverless vehicle testing*, 9NEWS.COM (July 18, 2018), https://www.9news.com/article/news/travel/colorado-among-the-leaders-for-driverless-vehicle-testing/73-572788284.
96. Virginia Department Of Transportation, Smarterroads, https://smarterroads.org/login.
97. Lee Bergquist, *Tech upgrades for autonomous vehicles to aid Foxconn are part of widening plans for I-94*, Journal Sentinel (Sept. 25, 2018), *available at* https://www.jsonline.com/story/news/local/wisconsin/2018/09/24/autonomous-vehicle-upgrades- foxconn-part-94-widening-plans/1361547002/.
98. Fagan, *supra* note 94.
99. *See* Barnes & Turkel, *supra* note 86, at 19 (The assistant secretary of Florida's DOT suggested that 12-foot lanes could be reduced, and it may be possible to "get by with 9 ½- or 10-foot lanes. We could turn that four-lane express highway into a six- lane express highway with literally the same right-of-way footprint.").
100. Richard Ezike, *Explaining Land Use Implications of Autonomous Vehicles: Meet Dr. Jonathan Levine*, Union Of Concerned Scientists (July 9, 2018), https://blog.ucsusa.org/richard-ezike/explaining-land-use-implications-of-autonomous-vehicles- meet-dr-jonathan-levine.
101. G. Evan Pritchard, *Autonomous Vehicles: Zoning, Land Use, and Infrastructure Issues to Consider Right Now*, Envirostructure (Oct. 23, 2017), https://www.envirostructure.com/2017/10/autonomous-vehicles-zoning-land-use-and-infrastructure-issues-to-consider-right-now/.
102. Rouse, *supra* note 63, at 26.
103. Neef, *supra* note 47.
104. Paul Maryniak, *Chandler, Ariz., May Be the First City to Adjust Zoning Laws for AVs*, Government Technology (May 9, 2018), https://www.govtech.com/fs/infrastructure/Chandler-Ariz-May-Be-the-First-City-to-Adjust-Zoning-Laws-for- AVs.html.
105. Jack D'Errico, *What will Automated Cars Mean for the Future of eCommerce?*, The Trellis Blog (Sept. 6, 2018), https://trellis.co/blog/what-will-automated-cars-mean-for-the-future-of-ecommerce/.
106. Another consideration for autonomous delivery vehicles is added traffic congestion. Los Angeles contemplates that data shared among vehicles and infrastructure could provide real-time pricing information for automated parcel delivery across the city. *See* Jaclyn Trop, *How Self-Driving Cars Can Help Make Cities Better*, Fortune (Feb. 22, 2019), *available at* http://fortune.com/2019/02/22/self-driving-cars-cities/.
107. See William J. Kohler & Alex Colbert-Taylor, *Current Law and Potential Legal Issues Pertaining to Automated, Autonomous and Connected Vehicles*, 31 Santa Clara High Tech. L.J. 99 (2014), *available at* https://digitalcommons.law.scu.edu/chtlj/vol31/iss1/3/.
108. *Taming the Autonomous Vehicle, A Primer for Cities*, Bloomberg Aspen Initiative on Cities & Autonomous Vehicles, https://www.bbhub.io/dotorg/sites/2/2017/05/TamingtheAutonomousVehicleSpreadsPDF.pdf (last visited June 26, 2019) (*hereinafter*, Bloomberg Aspen Initiative).
109. One creative solution is being employed in Ontario, where Waze has made an agreement with the City of Toronto to trade data for mutual benefit. *See* Deloitte LLP, *Connected and autonomous vehicles in Ontario: Implications for data access, ownership, privacy and security,* (2018), https://www2.deloitte.com/content/dam/Deloitte/ca/Documents/consulting/ca-consulting-CVAV-Research-Final-Data- Privacy-Security-Report-20180412-AODA.pdf (*hereinafter* Deloitte). Waze will have access to city data such as road and lane closures and areas of heavy and light traffic, and the city will get anonymized data from more than 560,000 local Waze users, which will help transportation staff ease congestion. *Id*. Anonymization may not be foolproof, though. *See* Dorothy J. Glancy, *Privacy in Autonomous Vehicles*, 52 Santa Clara L. Rev. 1171 (2012), *available at* https://digitalcommons.law.scu.edu/cgi/viewcontent.cgi?article=2728&context=lawreview.
110. *See* Bloomberg Aspen Initiative, *supra* note 108, at 19.
111. Id
112. *See* Glancy, *supra* note 109, at 1172.
113. *See The Privacy Implications of Autonomous Vehicles*, Norton Rose Fulbright (July 17, 2017), https://www.dataprotectionreport.com/2017/07/the-privacy-implications-of-autonomous-vehicles/ (*hereinafter* Norton Rose Fulbright).
114. 18 U.S.C. § 2721, *et seq*.
115. 18 U.S.C. § 2510, *et seq*.
116. Kristen Hall-Geisler, *Senators reintroduce a bill to improve cybersecurity in cars*, Techcrunch, https://techcrunch.com/2017/03/23/senators-reintroduce-a-bill-to-improve-cybersecurity-in-cars/ (last visited June 26, 2019).
117. Id

118. Nonetheless, some significant questions remain following *Riley v. California*, 573 U.S. 373 (2014), where the Court decided that a warrantless search of a cellphone as part of an arrest was unconstitutional, but did not establish a clear standard for what warrant is necessary to search a cellphone. Lower courts are split between the "container" analysis (a smartphone is a "container" and a warrant essentially need only describe the phone and the probable cause) and the "computer" analysis (smartphones are computers with tens of thousands of files; thus, to satisfy the Fourth Amendment, a warrant must describe the phone and files sought, as well as explain the probable cause). This is important because the Fourth Amendment law developing now will shape how AVs are eventually treated under the law.
119. 565 U.S. 400, 416(2012).
120. Michael W. Price, *Rethinking Privacy: Fourth Amendment "Papers" and the Third Party Doctrine*, 8 J. Nat'l Security L. & Pol'y 247, 271 (2015).
121. Norton Rose Fulbright, *supra* note 113.
122. Barnes & Turkel, *supra* note 86, at 14.
123. Gareth Watson, *Infographic: Data Privacy and Connected Cars*, 2025AD (Oct. 17, 2018), https://www.2025ad.com/updates/driverless-cars-data-privacy-infographic/.
124. Anthony Jones, *Autonomous Cars: Navigating the Patchwork of Data Privacy Laws That Could Impact the Industry*, 25 Cath. U. J. L. & Tech (2017), available at https://scholarship.law.edu/cgi/viewcontent.cgi?article=1024&context=jlt.
125. *See id*.
126. Nigel Parker, et al., *Autonomous and connected vehicles: navigating the legal issues* 12, ALLEN & OVERY LLP (2017), http://www.allenovery.com/SiteCollectionDocuments/Autonomous-and-connected-vehicles.pdf.
127. Bryant Walker Smith, *Automated Driving and Product Liability*, 2017 Mich. St. L. Rev. 1, 2 (2017), available at https://digitalcommons.law.msu.edu/cgi/viewcontent.cgi?article=1187&context=lr.
128. Some local governments are fortunate enough to have statutory tort immunity and may not be liable for defects in the intelligent infrastructure that will aid AV navigation.
129. *Are we ready to 'handover' to driverless technology? Venturer Insurance and Legal Report*, Venturer (2017/18), https://www.venturer-cars.com/wp- content/uploads/2018/04/J419144_Venturer_Insurance_and_Legal_Report_2018_V08_Cover_V434.pdf (*hereinafter* Venturer) (last visited June 24, 2019).
130. Oliver, *supra* note 93.
131. Venturer, *supra* note 129.
132. *See* John Villasenor, *Products Liability and Driverless Cars: Issues and Guiding Principles for Legislation*, Brookings (April 2014), https://www.brookings.edu/wp-content/uploads/2016/06/Products_Liability_and_Driverless_Cars.pdf; *see also*, Smith, *supra* note 127. Some scholars have approached the problem from other angles. For example, Ryan Calo, Director of the Consumer Privacy Project and the Center for Internet and Society at Stanford Law School, suggests that manufacturers of autonomous technology should receive selective immunity like the immunity enjoyed under federal law by firearms manufacturers and websites. *See* Ryan Calo, *Open Robotics*, 7 Md. L. Rev. 101 (2011), *available at* https://ssrn.com/abstract=1706293.
133. Smith, *supra* note 127.
134. Gary E. Marchant & Rachel A. Lindor, *The Coming Collision Between Autonomous Vehicles and the Liability System*, 52 Santa Clara L. Rev. 1321 (2012), *available at* http://digitalcommons.law.scu.edu/lawreview/vol52/iss4/6/.
135. For example, self-driving cars could be viewed by courts as unreasonably dangerous activities, and manufacturers or owners could therefore be held strictly liable. Another claim theory could be breach of warranty, if AVs fail to perform as they should. Negligence may still remain relevant, too; a negligence claim would "focus on whether the car's decision or act showed a lack of reasonable care under the circumstances, not whether the computer could have been better designed." *See Torts of the Future: Autonomous Vehicles*, U.S. Chamber Institute For Legal Reform (May 2018), https://www.ali.org/media/filer_public/6a/26/6a26ebc5-3dfa-4c60-b1ba-7e596819ef43/dc-656837-v1- torts_of_the_future_autonomous_emailable.pdf. The U.S. Chamber Institute for Legal Reform additionally suggests no-fault insurance and a victim compensation fund as options in lieu of tort liability altogether. *See id*. at 6.
136. James M. Anderson, et al., *Autonomous Vehicle Technology: A Guide for Policymakers*, RAND CORP. (2014), *available at* http://www.rand.org/pubs/ research_reports/RR443-1.html.
137. Mark A. Geistfeld, *A Roadmap for Autonomous Vehicles: State Tort Liability, Automobile Insurance, and Federal Safety Regulation*, 105 Calif. L. Rev. 1611 (2018), *available at* https://scholarship.law.berkeley.edu/cgi/viewcontent.cgi?article=4381&context=californialawreview.
138. *See* Anderson, *supra* note 136, at 123.
139. *See* Andrew P. Garza, *Look Ma, No Hands!: Wrinkles and Wrecks in the Age of Autonomous Vehicles*, 46 New Eng. L. Rev. 581 (2012), available at https://newenglrev.com/volume-46-issue-3/v46b-3garza/.
140. See Villasenor, *supra* note 132.
141. *Id*.
142. 158 U.s. Dept. Of Transportation National Highway Safety Administration, Federal Automated Vehicles Policy 39 (Sept. 2016), https://www.hsdl.org/?view&did=795644.
143. David Zetoony, *Autonomous Vehicles–Data Privacy Issue*, JDSUPRA (June 14, 2018), https://www.jdsupra.com/legalnews/autonomous-vehicles-data-privacy-issues-68232/.
144. Barnes & Turkel, *supra* note 86, at 13.
145. Peter Hancock, *Kansas lawmakers preparing for fully autonomous vehicles—and all the issues that come with them*, Lawrence Journal World (Jan. 16, 2018), available at https://www2.ljworld.com/news/2018/jan/16/kansas-lawmakers- preparing-fully-autonomous-vehicl/.
146. One change auto insurers are making is basing policies on the number of miles driven. *See* James M. Anderson, *supra* note 136, at 18, fn 8.
147. Rouse, *supra* note 63, at 18.
148. *Id*. at 35-36.