



# Active Transportation Safety and Autonomous Vehicles

*Short-term Actions for State, Regional, and Local Public Agencies*

## SUMMARY

Federal level agencies are planning for safe deployment of AV technology and 35 states have introduced legislation related to autonomous vehicles (AV).<sup>1</sup> This white paper discusses AV technologies' current state of transition. It offers recommendations for short-term actions that state, regional, and local public agencies can pursue to promote active transportation safety.

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## INTRODUCTION

Autonomous vehicle (AV) technology is advancing and moving closer to public adoption. The technology brings opportunities and concerns for safeguarding the safety and comfort of people walking, bicycling, or using other micro-mobility modes.

As of this writing, AV technology is in a state of transition. Public agencies are partnering with or establishing permits for private companies to test AVs using video simulations, within test tracks, and along public streets. Pilot projects on campuses and trails are helping communities envision use cases for AVs.

This white paper helps communities take short-term action to preserve and improve the experience of active transportation as AV technology develops and is deployed. Recommendations are not designed to stay stagnant over time, given the rapidly changing nature of AV technology. However, the basic premises of fostering a safe system, as described in the following section, are likely to continue into the future.

Short-term recommendations relate to testing, street design, and legislation and political will. These topics were selected as general areas over which local, regional, and state agencies have jurisdictions. Although responsibilities overlap between levels of government, not every recommendation pertains to each level of government. The ideas presented here are based on a review of the current state of AV-related guidance from multiple agencies, professional organizations, think tanks, and other entities.

This white paper contains the following sections:

- » Active transportation safety and work towards eliminating fatal traffic crashes
- » Levels of automation
- » Federal, state, and local roles related to promoting roadway safety
- » Short-term needs and recommendations that local, regional, and state public agencies can pursue to support AV safety

## WHY FOCUS ON ACTIVE TRANSPORTATION SAFETY? WHY NOW?

National and international dialogues around AVs often lead with the promise of roadway safety - and specifically, a promise of roadway safety at levels previously unimaginable. A range of assumptions and unknowns are implicit within this promise, including the rate of AV deployment, market penetration, the pace of AV "learning," thresholds of what is considered safe, and the difference in outcomes for people inside a motor vehicle versus those outside of one.

In tandem, communities across the country are increasingly taking action to reduce traffic fatalities and serious injuries. National, state, and local governments are developing a range of strategies to eliminate deaths when walking, bicycling, and driving. The movement is typically called Vision Zero, when organized at the municipal level, or Toward Zero Deaths, when organized by States.<sup>2</sup> Originally inspired by work in Sweden beginning in 1997, these initiatives recognize that changes to our current transportation system are needed to drastically reduce the more than 30,000 deaths that occur on US roads each year.

**AVs have the potential to assist in reducing loss of life from crashes, but safety benefits cannot be assumed. The persons most exposed to risk in the short-term cannot be overlooked for the sake of long-term aspirations. The burden of proof must be on AV developers to interpret human behavior, reactions, and the natural and built environment, including those outside of the vehicle.**

More than 90 percent of the 37,133 traffic fatalities in 2017 involved human driver-related factors such as impairment, speeding, distraction, drowsy driving, and illegal maneuvers.<sup>3</sup> AVs offer the ability to program vehicles that behave more lawfully and safely than human drivers.

Proactive, intentional, and collaborative efforts are needed to work toward the goal of using AVs to reduce traffic fatalities. Potential solutions include:

- » **Testing requirements** that establish clear standards for technology's ability to anticipate and respond to the movements of people using active transportation outside of AVs.
- » **Street design** to promote active transportation and prevent crashes, especially severe and fatal injury-causing crashes without putting the burden of safety on people using active transportation.
- » **Policy choices** that preserve the rights of people using active transportation and consider equity in access to the transportation system.

## DISPROPORTIONATE RISK AND OTHER COSTS

While considering long-term outcomes, as well as the need for urgent, immediate action, local, regional, and state governments can structure the AV transition to reduce disproportionate exposure risk on any specific demographics or transportation users. Disproportionate negative impacts are a reality today. We know that communities have historically experienced marginalization and disinvestment. These communities typically have higher rates of bicycle and pedestrian collisions.<sup>4</sup> Risk of a traffic-related death is linked to socioeconomic factors including race, ethnicity, and income level. Decision makers must work with community members, advocates, and other stakeholders to drastically reduce fatal and injury-causing crashes in these communities and across the country.

Moreover, even with a long-term promise of dramatic gains in traffic safety, short-term cost of sharing the road with "learning" AVs disproportionately impacts persons who walk, bicycle, or access transit by necessity and by choice. These users are already overrepresented in severe and fatal injury crashes.<sup>5</sup> **Creating safe approaches to AV testing and deployment is especially important in these communities because they are in danger of seeing the least benefit from AVs as a mobility option and facing the greatest risk.** Authentic engagement and recognition of these communities' leadership is crucial when planning for our current transportation system as well as future changes.

## DEFINING SAFETY

The concept of safety does not have a standard definition. This white paper uses the definition submitted by RAND Corporation:

*"the overall ability of a vehicle to operate without harm to passengers or other road users within the roadway ecosystem. This definition is broadly consistent with other definitions of safety. It focuses on people."<sup>27</sup>*

Recommendations in this report center on ensuring safety for people outside of motor vehicles. By focusing on the safety of people outside of the vehicles, we are not only addressing the potential risk to shared-road users, but also considering the broader implications to placemaking and access.



A screen mounted to the outside of an AV to describe the vehicle's intention to pedestrians. This method was proposed by drive.ai, a self-driving car company in operation in the US (Image: drive.ai).

## LEVELS OF VEHICULAR AUTOMATION

The Society of Automotive Engineers (SAE) created a widely agreed upon spectrum to define levels of automation from no automation (level zero) to full automation of vehicles (level five).<sup>6</sup> Human drivers have varying responsibility for driving functions along this spectrum. Human drivers retain responsibility for most driving functions when a vehicle has level one automation. Human driver input tapers until level five automation. One visual representation of this spectrum is shown below. Future timelines vary for when widespread high levels of automation are likely to become a reality. In addition to timing variability, automation scenarios will likely vary by context, community size, and geographic region.

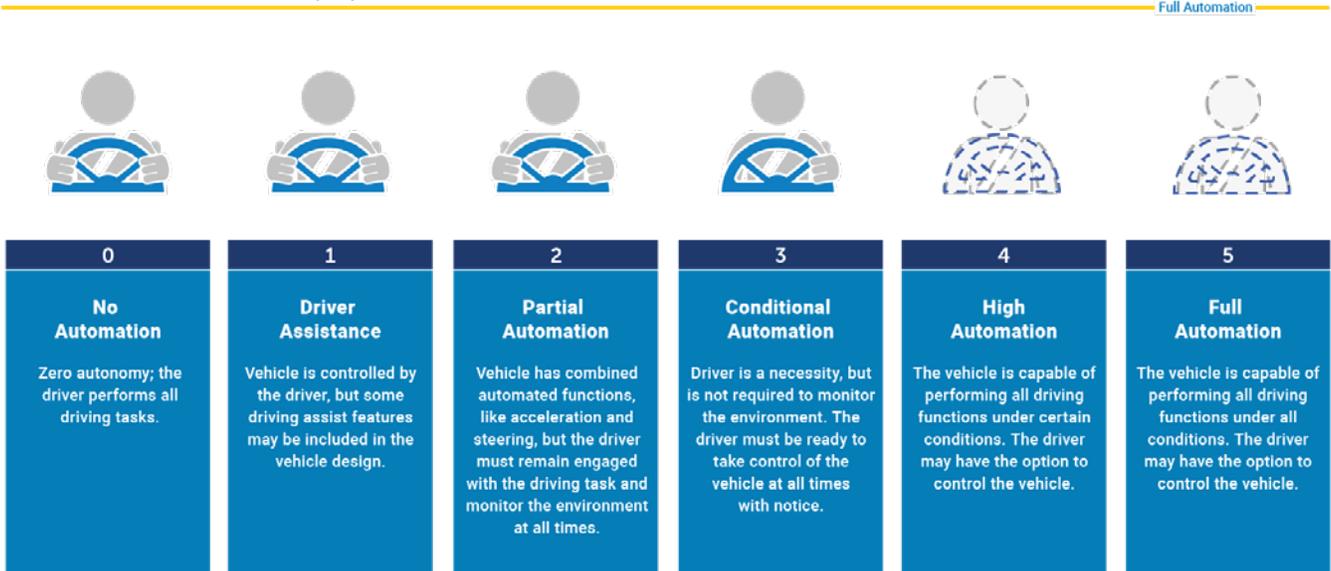
### CURRENT AUTOMATION TRENDS

AV technology is currently in a transition phase. Automation is becoming increasingly common on public roadways. The examples below highlight this trend:

- » **High-Speed Autonomous Vehicles (HSAV):** California no longer requires human ‘safety’ drivers to be present when testing licensed AVs on public roadways.<sup>7</sup> Autonomous ridesourcing is now possible in select cities. Real-world environment testing is underway and Waymo has logged ten million miles of testing as of October 2018.<sup>8</sup> In 2018, an Uber program to test AVs in Tempe Arizona came to an abrupt end when the high speed AV caused the death of a pedestrian crossing a major road, despite having a human safety driver in the vehicle.

- » **Low-speed Autonomous Vehicles (LSAV):** Multiple Pilot projects and testing are underway including Las Vegas, NV, Detroit, MI, and Frisco, TX.<sup>9</sup> Autonomous services for retirement community residents are in operation in San Jose, CA and Orlando, FL.<sup>10</sup> Most recently, in October 2018, the Federal Highway Administration (FHWA) terminated a privately-operated AV school bus being piloted in a master planned development in Florida.<sup>11</sup>
- » **Consumer Products:** Automated features are becoming available to the public. Consumers currently have access to ‘autopilot’ features in vehicles produced by Tesla, which is considered between Level 2 and Level 3 automation.<sup>12</sup> Tesla’s automation features drew national and international attention when a failure of the system led to the death of the driver in 2016.
- » **Regulations and Guidance:** National level legislation is continuously evolving vis-a-vis testing requirements for AVs. The U.S. Department of Transportation (USDOT) released AV 3.0: Preparing for the Future of Transportation in late 2018. The document provides broad guidance and sets the stage for federal legislation to come.
- » **Investment:** Currently, more than \$80 billion has been invested in AV technology. This figure continues to grow with new business deals.<sup>13</sup>

### SOCIETY OF AUTOMOTIVE ENGINEERS (SAE) AUTOMATION LEVELS



One interpretation of the Society of Automotive Engineers (SAE) levels of automation (Image: NHTSA).

## FEDERAL, STATE, AND LOCAL ROLES FOR PROMOTING SAFETY OF ALL ROADWAY USERS

Responsibility for motor vehicle safety is divided between federal, state, and local levels.<sup>14</sup> These roles mirror responsibilities related to AV technology.

At the federal level, National Highway Traffic Safety Administration (NHTSA) establishes Federal Motor Vehicle Safety Standards (FMVSS) for new motor vehicles and other equipment.<sup>15</sup> Manufacturers must meet these standards before beginning to sell vehicles. The federal government enforces compliance of these standards, investigates and manages product recalls, and educates the public about safety issues related to motor vehicles. The federal government, largely through FHWA and USDOT, releases standards and guidance related to roadway design.

State DOTs are currently responsible for licensing human drivers and registering motor vehicles. States enact and enforce traffic laws, conduct safety inspections, and regulate motor vehicle insurance and liability. States follow national street design standards in addition to establishing their own policies and guidance for municipalities.

Local governments also enforce motor vehicle laws. Municipalities and counties control street design on roadways under their jurisdiction. The extent of municipal power depends on the state government’s organization. Metropolitan Planning Organizations (MPOs) plan and program long-term transportation improvements across a region.

Based on this discussion of roles, the following section identifies current actions that state, regional, and local agencies can undertake to support active transportation safety as AV technology develops.

	LOCAL / REGIONAL	STATE	FEDERAL
 Create roadway design standards	✓	✓	✓
 Fund transportation projects	✓	✓	✓
 Educate the public	✓	✓	✓
 Plan and program transportation options	✓	✓	✓
 Enact and enforce traffic safety laws	✓	✓	
 Create and enforce vehicle standards			✓
 Investigate and manage recalls			✓
 Vehicle safety inspections		✓	
 Driver licenses and motor vehicle registration		✓	
 Regulate insurance/liability		✓	

Local, regional, state, and federal roles related to AV safety (Image: Alta Planning + Design).

## SHORT-TERM NEEDS AND RECOMMENDATIONS FOR SUPPORTING ACTIVE TRANSPORTATION RELATED TO AV SAFETY

Governments can play an active role in establishing a framework for AV technology that positions AVs within a modal hierarchy that supports public transit, walking, and bicycling, especially in communities where contemporary infrastructure remains focused on moving car and truck traffic. Most communities in the United States fall into this category. AV safety will only progress if states and local communities continue to prioritize funding and building infrastructure that elevates walking and bicycling as transportation options for everyday trips. This is rooted in documented safety benefits that result from increased rates of active transportation and from safety benefits of infrastructure that separates roadway users according to mode and travel speed.<sup>16</sup> **Given the current pace of AV learning and that the short- and mid-term future will be dominated by mixed-mode (and mixed-technology) traffic, AVs will not meet expectations of safety for all road users without fitting into a multi-modal framework.**

As previously mentioned, governments should continue to account for disparate impacts faced by historically marginalized and disinvested communities. With regards to AV development and deployment, this shows a need to equitably establish testing districts and geographic areas for AV access and a need to proactively gain feedback from community members. AV deployment should provide mobility benefits for these communities.

**The following recommendations are short- and mid-term actions to support the successful and safe integration of AV technology into local transportation networks.** Recommendations are divided according to testing, street design, and legislation and political will.

## TESTING RECOMMENDATIONS: ANTICIPATE AND RESPOND TO ACTIVE TRANSPORTATION USERS

National agencies, such as NHTSA are determining appropriate testing formats and criteria.<sup>17</sup> State, regional, and local governments should stay apprised of the latest developments concerning AV testing. Short-term recommendations emphasize responsibility to protect the public. Testing recommendations refer to responsibilities led by State-level agencies due to their current roles related to motor vehicle safety.

### State-level Agencies:

- » Set testing and performance standards that determine which AVs can operate in the state. AVs should demonstrate the ability to anticipate and respond to the movements of people walking and bicycling. A focus on active transportation safety should be integral to planning for AV technology, testing, and ultimately, operation.
- » AV companies should complete a number of tests to demonstrate the criteria described above. These include video controlled simulations, on test tracks, and during trials on public roadways, in that order.
- » Reduce or eliminate AV-related exemptions from safety protocol and associated standards.
- » Avoid testing AVs on public roadways, independent of trained human drivers, until a given system provides proof of performing at a level that equals or surpasses a human driver. Set a lead agency responsible for overseeing testing at the state level.<sup>18</sup>
- » Communicate regularly with the public, especially at key product demonstration milestones.<sup>19</sup>
- » Testing and performance standards should take the respective state's weather and climate into account, including precipitation.<sup>20</sup>

## **STREET DESIGN RECOMMENDATIONS: CREATE ENVIRONMENTS TO SUPPORT WALKING AND BICYCLING**

Regardless of technology, planning, design, and implementation of public projects should focus resources on protecting our transportation system's most vulnerable users. This should occur regardless of the levels of automation on public roadways.

### **Local, Regional, and State-level Agencies:**

- » Collaborate with disability rights activists to learn about design needs for current and future street designs, such as audible and visual communication with AVs. Collaboration should provide paid compensation whenever possible.
- » Use upcoming planning processes such as the development of an active transportation master plan, Safe Route to School plan, or a comprehensive plan to envision how AVs could support community vision and goals. Use these and other processes to proactively update (and make "future-ready") a city/town or state's modal hierarchy, strategies to support Complete Streets, and design choices to encourage and prioritize active, safe, healthy living.
- » Street design projects should continue supporting safety elements that are already proven and not likely to change. For example, the blow of being struck by a car at a high speed will likely continue to kill or injure someone walking, regardless of whether a human driver or a computer control the car.
- » Provide dedicated funding to fixed route on demand public transit as well as bicycling and walking infrastructure. Funding should encourage the growth of networks that support people of all ages and abilities.
- » Association of Pedestrian and Bicycle Professionals, Pedestrian and Bicycle Information Center, National Association of City Transportation Officials, and other agencies and organizations emphasize following Complete Streets-focused principles. Adopt these principles and utilize design guidelines within everyday work.<sup>21</sup>

- » Plan, design, and construct separated bike lanes, sidewalks, sidepaths, and trails along corridors and at intersections. Install these and other infrastructure options that have demonstrated safety benefits throughout the country and the world. Physical separation between forms of transportation will continue to be important as AV technology becomes more common.
- » Follow national guidance and standards related to pavement markings, signs, and signals. Current dataset development and testing shows AVs may have an increased reliance on pavement markings and traffic control devices. As the previous section noted, systems should detect and anticipate human movements and should expect humans outside of marked areas (i.e., marked crosswalks, bike lanes).<sup>22</sup>
- » Maintenance practices and pavement condition should be assessed. In the future, poor pavement condition may define places where AVs do not operate.

### **State-level Agencies:**

- » State DOTs should prioritize safe vehicle operation over vehicle throughput. In addition to setting State level speed limits, State DOTs should allow local jurisdictions the ability to lower speed limits and begin discussions regarding setting future AV speed maximums related to land use, street typology, and street purpose.



Streets of today and tomorrow should support safe and comfortable travel by many forms of transportation (Image: Alta Planning + Design).

## LEGISLATION AND POLITICAL WILL RECOMMENDATIONS:

### PRIORITIZE PEDESTRIAN AND BICYCLIST SAFETY

Political will is needed to continue initiatives that work towards reduced traffic fatalities and to prioritize the safety and comfort of persons of all ages and abilities accessing the transportation system.

#### Local, Regional, and State-level Agencies:

- » Review statutes and ordinances involving active transportation. Language should be easy to understand and should prioritize vulnerable users' safety. These principles are important for creating a system that works with motorized vehicles driven by humans or driven by machine learning.<sup>23</sup>
- » Adopt a Vision Zero / Toward Zero Deaths policy and approach to the agency's mission and priorities.
- » Collaborate with public health practitioners and activists including individuals in the fields of disability rights and elderly residents' rights, active and public transportation, and climate change.

#### State-level Agencies:

- » Create an advisory team charged with tracking national best practices related to AV testing, safety, and integration with multi-modal transportation systems.<sup>24</sup>
- » Ensure that existing laws regarding motor vehicles allow for testing autonomous systems, including Levels 3, 4, and 5 to reduce ambiguity or lack of clarity in the application of laws. For example, the definition of "driver" may need to be expanded.<sup>25</sup>
- » States can create a public database of limitations, capabilities, and safety evaluation reports related to AV performance.<sup>26</sup>

- » Publicly create and share a vision for how AVs could be used in the future. Elements of the vision should focus on finding solutions that will advance established agency goals, such as congestion management, mode shift, reduced greenhouse gas emissions, improved air quality, and improved public health. This could include emphasizing shared vehicles over ownership, renewable energy sources over fossil fuels, and the needs of all roadway users systems that exclusively serve cars.

## CONCLUSION

Although advanced levels of automation will continue to develop in the future, State DOTs, MPOs, counties, and cities/towns should continue working toward a future that supports all roadway users, regardless of vehicles' level of automation. Federal, state, and local governments should continue to advance and prioritize strategies to reduce traffic fatalities. This proactive approach will set the stage for responsible incorporation of advanced AV technology within our transportation systems.

Like any future scenario, mid- and long-term needs and recommendations will change over time. Continued focus on street design, legislative action, and continued partnerships and coordination will help AV technology develop in a way that prioritizes human lives, inclusive access to the transportation system, and a sense of place in our communities.

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## NOTES

- 1** USDOT, "Preparing for the future of transportation: Automated vehicles 3.0" (AV 3.0), <https://www.transportation.gov/av/3/preparing-future-transportation-automated-vehicles-3> (2018) and National Conference of State Legislatures (NCSL), "Autonomous vehicles: Self-driving vehicles enacted legislation" (2018), <http://www.ncsl.org/research/transportation/autonomous-vehicles-self-driving-vehicles-enacted-legislation.aspx>
- 2** Vision Zero Network, "Vision Zero Network", <https://visionzeronetWORK.org/> and Toward Zero Deaths, "TZD: The National Strategy vision is a highway system free of fatalities", <https://www.towardzerodeaths.org/>
- 3** National Highway Traffic Safety Administration (National Center for Statistics and Analysis), "2017 fatal motor vehicle crashes: overview", Traffic Safety Facts Research Note. Report No. DOT HS 812 603, 2018, <https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812603>.
- 4** Maciag, Mike. "Pedestrians dying at disproportionate rate in America's poorer neighborhoods", *Governing* (August 2014), <http://www.governing.com/topics/public-justice-safety/gov-pedestrian-deaths-analysis.html>
- 5** Pedestrian and Bicycle Information Center (PBIC) "Pedestrian and Bicyclist Crash Statistics", [http://www.pedbikeinfo.org/data/factsheet\\_crash.cfm](http://www.pedbikeinfo.org/data/factsheet_crash.cfm)
- 6** Society of Automotive Engineers, "Taxonomy and definitions for terms related to driving automation systems for on-road motor vehicles", J3016\_201806 (2018), [https://www.sae.org/standards/content/j3016\\_201806/](https://www.sae.org/standards/content/j3016_201806/)
- 7** State of California Department of Motor Vehicles, "Driverless testing of autonomous vehicles", (2018), <https://www.dmv.ca.gov/portal/dmv/detail/vr/autonomous/auto>
- 8** Waymo, "On the Road" (2018), <https://waymo.com/ontheroad/>
- 9** Hawkins, Andrew J, "Self-driving pods are slow, boring, and weird-looking- and that's a good thing", (2018) *The Verge*, <https://www.theverge.com/2018/9/17/17859112/self-driving-cars-shuttle-pods-delivery-services>
- 10** Ibid.
- 11** NHTSA, "NHTSA directs driverless shuttle to stop transporting school children in Florida", (October 19, 2018) NHTSA Press Releases, <https://www.nhtsa.gov/press-releases/nhtsa-directs-driverless-shuttle-stop-transporting-school-children-florida>
- 12** Tesla, "Full self-driving hardware on all cars", <https://www.tesla.com/autopilot>
- 13** Kerry, Cameron F. and Karsten, Jack, "Gauging investment in self-driving cars", *Brookings Institute* (2017), <https://www.brookings.edu/research/gauging-investment-in-self-driving-cars/>
- 14** USDOT
- 15** NHTSA, "Regulations", <https://www.nhtsa.gov/laws-regulations/fmvss>
- 16** GHSA, "A Right to the road: Understanding and addressing bicyclist safety" (<https://www.ghsa.org/resources/bicyclist-safety2017>). See also: Fyri, et al., "Safety in numbers for cyclists- conclusions from a multidisciplinary study of seasonal change in interplay and conflicts, Accident Analysis and Prevention 105 (2017), <https://www.sciencedirect.com/science/article/pii/S0001457516301555>
- 17** NHTSA, "Technical assistance to States" from "Automated driving systems 2.0: A vision for safety", [https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/documents/13069a-ads2.0\\_090617\\_v9a\\_tag.pdf](https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/documents/13069a-ads2.0_090617_v9a_tag.pdf)
- 18** Ibid.
- 19** RAND, ix.
- 20** See for instance, Minnesota DOTs testing projects: <http://www.dot.state.mn.us/automated/index.html>
- 21** Among them: APBP Policy Statement: Automated Vehicles (<https://www.apbp.org/news/402457/APBP-Adopts-AV-Policy-Statement.htm>); NACTO Blueprint for Autonomous Urbanism (<https://nacto.org/publication/bau/blueprint-for-autonomous-urbanism/>); PBIC "Discussion guide for automated and connected vehicles, pedestrians, and bicyclists" ([http://www.pedbikeinfo.org/pdf/PBIC\\_AV.pdf](http://www.pedbikeinfo.org/pdf/PBIC_AV.pdf))
- 22** Coyner, Kelly, "5 ways cities and counties can make sure autonomous vehicles and bikes mix safely", Mobility Lab, <https://mobilitylab.org/2017/09/05/5-ways-cities-counties-can-make-sure-autonomous-vehicles-bikes-mix-safely/>
- 23** USDOT
- 24** NHTSA
- 25** Ibid.
- 26** APBP
- 27** RAND Corporation, "Measuring automated vehicle safety: Forging a framework", pg 6, <https://www.rand.org/pubs/research-reports/RR2662.html>
- 28** RAND Corporation, "Measuring automated vehicle safety: Forging a framework", pg 6, <https://www.rand.org/pubs/research-reports/RR2662.html>