AUTONOMOUS VEHICLES

By Cooper Bosch

Tesla recalled over 362,000 vehicles due to issues with its self-driving software.

The Guardian

Full Self-Driving (FSD) *– features that allow vehicles to operate completely independently of their human passengers*

INTRODUCTION

In February of 2023, Tesla issued a recall on self-driving software for over 362,000 vehicles after numerous reports of unsafe driving (Isidore 2023). These vehicles would at times roll through stop signs, ignore turning lanes, and even come to complete stops on highways. In one case, a Tesla Model S caused an eight-car pileup in a San Francisco tunnel (Templeton 2023). The recall featured a completely virtual software update that removed the **Full Self-Driving (FSD)** feature from all vehicles.

Tesla, an automotive manufacturer that deals exclusively in electric vehicles, is constantly innovating and adding new features to their cars—one of which has been FSD. Slightly contrary to what its name might imply, FSD still requires a fully licensed and aware driver at the wheel who is ready to take over at any second should the software require user assistance. However, the software was deemed unsafe when it put the user in situations where they would not have enough time to correct the vehicle's errors.

While Tesla leads the industry in technological advancements, not all modifications are successful. Tesla's vehicles take four out of the top five spots on a list of most recalled cars (Vaughn, 2023). Of course, innovation and failure often go hand in hand; however, when software malfunction has the potential to cause loss of life on a large scale, extra precautions must be taken to ensure the safety of our roads. At this conference, you will come up with ways to keep drivers safe, while still allowing for technological advancements to better the lives of consumers across the nation.

EXPLANATION OF THE ISSUE

Historical Development

Dilemma – a situation in which a choice must be made between two undesirable alternatives

The earliest example of an autonomous driving feature is cruise control, a setting that keeps a vehicle moving at a constant speed without input on the brakes or acceleration. Even a feature as basic as this must struggle through the **dilemma** of balancing safety and convenience: while requiring a user to keep their foot on the accelerator keeps the driver aware of their speed, it possibly necessitates redundant input.

In the 1990s, Ernst Dickmanns of Germany fitted a Mercedes-Benz with an integrated computer that allowed it to drive through the stop-and-go traffic of Paris, as well as on highways from Munich to Copenhagen (Gil 2021). The 2000s witnessed a surge in research and development in autonomous vehicles. In 2004, the U.S. Defense Advanced Research Projects Agency (DARPA) organized the DARPA Grand Challenge, a competition to develop fully autonomous vehicles capable of completing a 150-mile desert course. The competition spurred innovation and attracted teams stemming from both academia and industry. Though none of the vehicles successfully completed the course in the inaugural challenge, the competition marked a significant milestone and motivated further progress.

The first car manufacturer to implement cruise control, or auto-pilot, was Chrysler in 1958.

Drive

In 2012, Nevada became the first state to register an autonomous vehicle (AV) in 2012, when Google's Prius passed a driver's test designed specifically for the vehicle (Harris 2014). Google had a large role in choosing the test conditions for the examination, including selecting the route and scheduling for ideal weather. Nevada also at this time had legalized testing AVs on public roads, but under the specifications that a driver and passenger were in the vehicle at all times.

In 2012, Nevada became the first state to register an autonomous vehicle (AV), when Google's Prius passed a driver's test.

In October of 2014, Tesla released the Model S, a vehicle with the Autopilot feature, which employed image recognition and sonar to keep the car within the boundaries of the lane and emergency brake when necessary. As a result, California began issuing individual permits for testing vehicles on public roads (Lowensohn 2014).

Scope of the Problem

Automated vehicles could potentially change the way we move about our country; nonetheless, as with any new technology, they require regulation to ensure the safety of the American people.

Consumer Safety

There have already been a number of accidents related to autonomous driving features. Currently, no consumer-purchasable

fully autonomous vehicle exists, but there are plenty of features that essentially take over the driving process while simultaneously demanding that the driver be ready to take control at any moment. As explained further below, these are Level 3 features on the SAE scale.

The Society of Automotive Engineers (SAE) has developed a level system to quantify and identify the different amounts of autonomy. SAE levels 0-2 indicate that the driver is still in complete control of the vehicle. This includes features such as automatic braking and lane centering. Levels 3-5 mean that the vehicle is controlling the driving process, with the distinction that level 3 requires the driver to take control quickly in cases of emergency (SAE 2021).

Nearly all of the accidents that AVs have been involved in can be at least partially explained by human error. In many cases, the AV was simply hit by a regularly-operated vehicle, making it difficult to fault the AV. However, there are some instances where AV drivers were not paying diligent attention, with distractions ranging from being on a call to even watching television (Kopestinksy 2023). Here, the liability is unclear.

In light of this, some driving instructors warn against using features as basic as cruise control, since taking responsibilities away from a driver can lead to decreased focus.

Alternatively, some argue that AVs are safer than manual vehicles. AVs are not susceptible to inebriation or distractions, which can cause accidents when humans are at the wheel. Furthermore, as more and more vehicles are integrated with software, there is potential for AVs to communicate with other cars around them, making lane changes and intersections much safer and more efficient. Notably, connecting with other vehicles over a network makes this software susceptible to cyberattacks and **malware**, which will be discussed further in the Cybersecurity subsection.

Economic Strength and Impacts

As of February 2022, the current global investment in AV technology exceeds $200 billion (Yeruva 2022). A large portion of this money is being directed towards mobility-as-a-service (MaaS), such as Uber or other taxi services. Removing the labor cost from MaaS (since drivers would no longer be needed) would drastically decrease the price for consumers, potentially even leading to a decline in car ownership. This would mean lower costs for commuters, and less demand for parking, freeing up space for other public uses.

For many congressmen, it is important that the United States maintain its position as a leading nation in technological advancement. On February 11, 2019, President Donald Trump issued an executive order that reaffirmed the US as the world leader in AI research and development, as well as deployment. The order also

The Society of Automative Engineers developed a system to qualify AV vehicles.
SAE International

***Malware** – malicious software that allows wrongdoers access to information or even control of technology*

The introduction of autonomous trucking has the potential to disrupt labor markets.
Fleet Owner

affirmed that "continued American leadership in AI is of paramount importance to maintaining the economic and national security of the United States" (Trump 2019).

Importantly, with the introduction of AVs, specifically autonomous semi-trucks, many workers will be forced into a career transition. It is estimated that at peak impact, about 100,000 jobs will be disrupted per year due to AV development (Fortuna, 2022). Although in the long run this new technology may create jobs as well, it is important to consider the welfare of those whose careers are negatively impacted by the introduction of this new technology.

Cybersecurity

Autonomous vehicles are especially vulnerable to cyberattacks, a matter complicated by the fact that any slight malfunction in a car's software could cause a small car crash at best and a massive accident at worst. As mentioned previously, the possibility for thousands of American vehicles to be on a connected network makes them susceptible to malicious communications from other vehicles. For example, a bad actor could alter their car to send out incorrect driving information to other cars around it.

More generally, any device that operates through software is vulnerable to a cyberattack. Automotive companies must take precautions to protect vehicles against malware, not only for the safety of the driver of that vehicle but also for the safety of persons in cars around them. As members of Congress, you also have the power to shape regulation around the cybersecurity of cars, setting forth best practices and policies within this in-flux industry.

Data Privacy

Autonomous vehicles collect a massive amount of data in order to be able to make safe and data-backed driving decisions. They possess sensors of all kinds, including audio, visual, and even infrared. These vehicles also store personal information for their drivers in order to authenticate authorized use. This would likely be enough information to identify a person if that data were to be leaked. Additionally, these vehicles collect data on location and travel history in order to give more helpful navigation information to the user—should a vehicle be stolen or hacked, this valuable and oftentimes sensitive information would be vulnerable.

Autonomous vehicles collect a massive amount of data in order to be able to make safe and data-backed driving decisions.

Congressional Action

Congressional action on AVs is quite limited. On September 6, 2017, the House passed the SELF-DRIVE Act, which established the federal role in ensuring the safety of highly automated vehicles (HAVs). It defines "highly automated vehicle" as a motor vehicle equipped with an automated driving system capable of performing

the entire dynamic driving task on a sustained basis. It was introduced in the Senate in 2017 but did not go any further.

The Senate introduced a similar bill, the AV START Act, which again established a federal role in ensuring the safety of HAVs. It also creates the conditions for which these vehicles can be entered into the public for testing and evaluation. This bill did not pass in the Senate.

Other Policy Action

*Truck platooning –
the practice of placing
many semi-trucks
closely behind each
other to minimize
wind resistance*

Since Congress has been unable to pass any comprehensive bill on AVs, many state legislators have taken it upon themselves to create the necessary structures to welcome AVs into society. As of January 2023, seven states do not require a driver behind the wheel of an AV provided that the vehicle is evaluated to be SAE Level 4 or 5 (Banner 2023). Other states allow varying levels of AV features but require a licensed user behind the wheel. Some states have legislature on **truck platooning**, or the practice of placing many semi-trucks closely behind each other to minimize wind resistance. Autonomous driving features can be used to maintain this distance safely.

IDEOLOGICAL VIEWPOINTS

Conservative View

*Conservatives often
advocate for
minimal
government
involvement,
favoring industry
self-regulation and
market
competition.*

Conservatives typically approach autonomous vehicles from a perspective of limited government interference and free-market principles. They may argue that excessive regulations hinder innovation and impede the natural progress of technology. Conservatives often advocate for minimal government involvement, favoring industry self-regulation and market competition to drive safety improvements and advancements in autonomous vehicles.

They may be concerned that overregulation could stifle entrepreneurship and slow down the development of new technologies. Additionally, conservatives may prioritize individual freedom and choice, opposing measures that restrict human-driven vehicles in favor of autonomous ones. They may advocate for a flexible and adaptable regulatory framework that allows for experimentation and innovation while ensuring public safety.

Liberal View

Liberals generally tend to support legislation and regulations concerning autonomous vehicles, as they often prioritize safety, environmental concerns, and societal welfare. They frequently see government intervention as necessary to ensure that the

development and deployment of autonomous vehicles align with public interests.

Liberals may advocate for stricter safety standards, including robust testing and certification processes, to prevent accidents and protect passengers, pedestrians, and other drivers on the road. Additionally, liberals may emphasize the potential environmental benefits of autonomous vehicles, such as reduced emissions and improved fuel efficiency, and call for policies that encourage the adoption of these technologies.

AREAS OF DEBATE
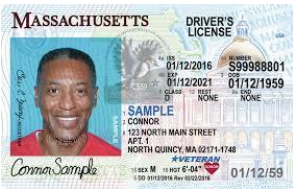
Driver's licenses ensure vehicle operators are properly educated and equipped to deal with the dangers of the road.
MA RMV

Creating legislature for autonomous vehicles requires thinking into the future, and designing systems that will still be useful as technology progresses. Therefore, even if the technology for completely autonomous vehicles does not exist yet, you should prepare for its imminent development.

Assessing the Licensing of AV Driving

The process to acquire legal authorization to drive a vehicle is lengthy, requiring mandatory driving practice and both a written and field examination to be granted a driver's license. It might seem prudent that an AV should need similar qualifications before being allowed on the open road.

It is true that each state has its own process for obtaining a regular driver's license; however, for AVs, this evaluation should likely be much more involved. Should the federal government take control of this evaluation, or leave it to states to regulate? There exists debate on whether or not the evaluation should be done once for each model of vehicle, or once for each car itself. Furthermore, since these AVs are capable of being updated through software over the air, should they be reevaluated for every update? What if that update only modifies features not related to automated driving? Any attempt at creating an autonomous vehicle driving examination should address all of these issues. Congress has a role in deciding the above questions, and as delegates, you all get to address them within committee as well.

Political Perspectives on this Solution

Liberals may support the federal government creating a nationwide driver's test for autonomous vehicles, as they believe in strong government regulation to ensure community safety and protect public welfare. They argue that a uniform standard across all states would establish consistency and address concerns such as liability and cybersecurity.

On the other hand, conservatives may be skeptical of federal intervention, emphasizing states' rights and a more decentralized approach. They may argue that transportation regulations should be left to the states, and that market forces and private sector innovation are more effective in promoting safety and technological advancements.

Creating a Research Committee

It is possible that a definitive answer to some of the questions mentioned above is not yet available. As autonomous vehicles are a relatively new consumer good, careful research on both their safety and effective legislation should be conducted so that Congress can make informed decisions on the matter. This committee could be granted the ability and the funds to perform a number of tasks. First, Congress needs information on how autonomous vehicles perform differently from human drivers, so that it can best understand how AVs will function on the United States' roads, which are designed for human operators. Secondly, Congress should learn how AVs might fail, and what faults they may have so that sensitive tests can be implemented to find these errors before they are given to consumers. Lastly, as a secondary task, information on effective legislation for AVs should be collected and presented to Congress. This can consist of attempts at legislation from other countries, or from local governments where AVs are more prevalent.

Most representatives would support a committee of some sort to gather more information on this issue, but the size and scope of this committee might vary greatly depending on perceived value. Finally, the composition of this committee is very important. Politicians, entrepreneurs, and scientists should all be involved to make sure everyone's needs are met. The composition of such a committee would need to be debated and established by congressmembers within committee and potentially other key stakeholders.

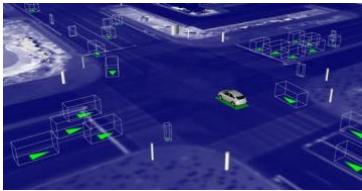### Political Perspectives on this Solution

Liberals and conservatives both would likely support a committee to research the current state and future advancement of autonomous vehicles, although they might disagree on the scope and funding of such a committee. Liberals would be in favor of a broad and powerful research-oriented committee, largely so that decisions can be made based on relevant data and expert input. Conservatives may question the necessity for large government spending on this kind of research; they might also worry that this research could interfere with private company innovation and place unnecessary regulation on it.

As autonomous vehicles are a relatively new consumer good, careful research on their safety should be conducted in order to make informed decisions.

AV manufacturing facilities are often automated themselves, using robot arms to aid assembly.
Tesla Factory

Autonomous vehicles can potentially be training in entirely simulated virtual environments
New York Times

Machine learning *– subfield of artificial intelligence in which machine systems imitate human behavior*

Liability *– the state of being responsible for something, especially by law*

Intervening in Vehicle Development

In order to ensure the safety of the vehicles produced by a multitude of companies, ranging from established to small, the federal government could take on a larger scope of control in the research and development process.

Like most other forms of **machine learning**, AV technology requires a large amount of data and testing to be useful. Especially in large cities in California such as San Francisco, vehicles strapped with sensors and cameras can be seen driving around busy streets and collecting data. These vehicles are not available for purchase to the public, and they do not require the same level of evaluation to be put on the road. The federal government might follow the path of many states, such as California and Nevada, and allow testing of emerging technologies on public roads. Currently, California allows for SAE Level 3 and above testing if the manufacturer applies and ensures that their vehicle has many fail safes to lessen the risk of accidents.

An alternative approach to testing is to train vehicles in simulation. Companies–such as Waabi from Toronto, CA–have developed complex simulations that can be used to train AVs virtually (Ohnsman 2022). There are many potential advantages to this possibility, as it can run at many times the speed of reality and has no safety risks during training.

Lastly, the government could make sure there are sufficient defenses against cyberattacks implemented during the development and construction process. Since a successful malware attack on an AV could potentially harm dozens of people, this is a top priority for protecting the American people. Establishing firm guidelines in vehicle development to ensure protection against this sort of attack could be key.

Political Perspectives on this Solution

Similar to the perspective on the legality of AVs in general, liberals will likely be wary of unsafe vehicles being allowed to be tested on open roads. They are also very wary of data privacy and may support legislation that protects the information of consumers.

Conservatives, on the other hand, may favor a free market and the allowance of companies to progress without intervention from the federal government. However, a unique nuance is that conservatives are very wary of large companies collecting large sources of consumer data and utilizing them.

Establishing Liability

One large issue in AVs is potential confusion on **liability** in the case of an accident. The autonomy of these vehicles exists on a somewhat continuous scale, with grey areas where both the driver

and technology have some control over the vehicle. Therefore, legally, it should be clarified who is liable in the case of an accident. There could be a gradient scale for liability, where human operators could be charge depending on the likelihood of their intervention given time constraints. Strict liability could also be established, whereby AI developers could always be held at fault. While the former case might be extreme, a law school professor at Case Western University recently argued that human drivers should not hold all of the blame in the case of an accident, stating that manufacturers should take some responsibility when their systems fail (McEwen 2023). As AVs improve, their control over vehicles will only increase.

Congress could create a system that will sort out this liability issue before cases potentially start to flood in, especially given the recent boom in technological advancement. This system would rely on a complex set of ethics and legal considerations and may be suitable as another task for any committees formed to address the AV issue.

AVs use computer vision to recognize road markings as lane separations.
CB Insights

Political Perspectives on this Solution

Within the sphere of liability, liberals are likely to place more blame on manufacturers. In their eyes, manufacturers, as the creators of the technology that they are profiting from, should be held responsible for mistakes their technology makes. Liberals might also argue that this sort of liability placement would even incentivize companies to place a larger emphasis on safety and failsafe design than would otherwise be placed given the economic incentives.

Conservatives, however, would be concerned that any sort of stringent liability placed on developers and manufacturers would disincentivize development and stagnate technological growth.

Investing in Infrastructure

It has become relatively clear that the autonomous vehicle sector is a growing potential opportunity for American economic prosperity. Government spending to support the AV industry could make transportation easier for Americans and increase flow of wealth into our nation as foreign companies purchase American-created goods.

Since AVs use visual data to maneuver roads, clearly marked yellow and white lines painted onto the asphalt, as well as road signs, are extremely important for their functionality. Places where these visual markers are in disrepair may be difficult to navigate for AVs. In general, cities or towns with less developed road and vehicle infrastructure might find it difficult to incorporate Avs into their systems.

Additionally, it is likely that most AVs will be electric as opposed to gas-powered vehicles. Thus, they will potentially require specialized charging ports. Notably, these electric vehicles are more

The vision of autonomous vehicles are often paired with a utopian future.

Forbes

energy efficient than vehicles that burn gas individually, and therefore better for the environment. However, they require charging more frequently and usually have lower range than gas vehicles; the infrastructure needed for them is sparse in more rural areas as you move away from city centers. The construction of electric charging stations in more locations would make EVs and more generally AVs more available in rural areas. Congress could pass infrastructure development guidelines and appropriate funding to this extent.

Political Perspectives on this Solution

Liberals would likely support government investment in this sector, as repairing road signs and markings would increase the quality of life for many Americans. Additionally, they would support government spending to combat climate change, of which the creation of more efficient charging stations might aid.

Conservatives may be opposed to this spending, arguing that free market principles will motivate the repair of roads and the creation of charging stations more efficiently than the government can.

BUDGETARY CONSIDERATIONS

Autonomous vehicles represent a potentially massive market in the future, so fiscally, legislators working on AVs might be wary of restricting growth in this sector. If American companies continue to innovate in this field, this opens new lanes for revenue through taxation and increased consumer spending. This is also an international market that could result in foreign monetary flow into the United States.

However, instituting a new system to evaluate AVs would require funding. The US Department of Transportation (DOT) has $251 billion in funding, and has already planned to spend about $100 billion, so this is one resource that could be used to fund a new program. Many of the bills proposed above could be considered bipartisan, but the scale of funding dedicated to the ideas is what could be contentious.

AV market size, including predictions for 2023 and 2024.

Seeking Alpha

CONCLUSION

Autonomous vehicles are an exciting new technology that could change the transportation industry for the better. However, government intervention is required to provide a graceful transition from human operation to autonomous driving. Road safety is crucial, and currently there is little government oversight ensuring the competency of these vehicles. Additionally, issues such as liability present complex ethical issues requiring a government body to

dictate responsibility. Nonetheless, many would argue that the freedom of private companies should be preserved to allow for innovative technologies.

As members of the Science, Space, and Technology committee, it is your job to prepare for the future. Innovation can often be unpredictable and unwieldy, but it can also be incredibly useful. A good solution to the above problems will be comprehensive, combining multiple ideas (even and especially from outside this briefing) and addressing many issues related to AVs. Through careful consideration, the US could become a world leader in autonomous driving technologies!

GUIDE TO FURTHER RESEARCH

Updates from individual companies will provide insight on the actual specifications of autonomous driving and detail what actual features are being developed. However, proactivity and preparation are important, so do not limit legislation to only dealing with current problems. Think about what advancements might be on the horizon within this field and feel free to use your creativity!

Economists have a lot of insight on this issue, as the sector is steadily growing and motivated mostly by consumer interest. Journals like the Wall Street Journal and the Economist might have pieces on the subject; other news outlets like the New York Times or other reputable sources might be helpful to keep up with both current and past trends. The most pertinent information will come from technology-forward places like California, where the AV industry is centered. Legislation passed in these areas, as well as report from local news stations, will be helpful.

Feel free and encouraged to also check out Congress.gov to read about past bills in this technology space. You can also look at bills in related fields, such as consumer safety in the automative industry at large.

GLOSSARY

Dilemma – a situation in which a difficult choice has to be made between two or more alternatives, especially equally undesirable ones.

Full Self-Driving (FSD) – features that allow vehicles to operate completely independently of their human passengers

liability – the state of being responsible for something, especially by law

malware – malicious software that allows wrongdoers access to information or even control of technology

SAE level system – a method of classifying autonomous driving features with a number ranging from 0 to 5.

BIBLIOGRAPHY

"Alternative Fuels Data Center: Autonomous Vehicle (AV) Testing and Operation Requirements." *EERE: Alternative Fuels Data Center*, 12 Oct. 2017, afdc.energy.gov/laws/11889#:~:text=AVs%20may%20be%20operated%20on,the%20automated%20driving%20system%20fails.

"Autonomous vehicles and their impact on the economy." *Forbes*, 14 Feb. 2022, www.forbes.com/sites/forbestechcouncil/2022/02/14/autonomous-vehicles-and-their-impact-on-the-economy/?sh=e2674060def4.

Banner, Justin. "Are Autonomous Self-Driving Vehicles Legal in My State?" *MotorTrend*, 6 Jan. 2023, www.motortrend.com/features/state-laws-autonomous-self-driving-driverless-cars-vehicles-legal/.

"Can next generation simulation build a better self driving car?" *Forbes*, 9 Feb. 2022, www.forbes.com/sites/alanohnsman/2022/02/09/can-next-generation-simulation-build-a-better-self-driving-car-this-ai-upstart-thinks-so/?sh=2cebd078108e.

"Cyber Security for Connected and Autonomous Vehicles." *https://cyberstartupobservatory.com/*, cyberstartupobservatory.com/cyber-security-connected-autonomous-vehicles/.

Fortuna, Carolyn. "How Will Autonomous Driving Disrupt Workers?" *CleanTechnica*, 10 Jan. 2022, cleantechnica.com/2022/01/10/how-will-autonomous-driving-disrupt-workers/.

Lowensohn, Josh. "This is Tesla's D: an All-wheel-drive Model S
      with Eyes on the Road." *The Verge*, 10 Oct. 2014,
      www.theverge.com/2014/10/9/6955357/this-is-tesla-s-d-an-
      all-wheel-drive-car-with-eyes-on-the-road.

"Maintaining American Leadership in Artificial
      Intelligence." *GovInfo*, 11 Feb. 2019,
      www.govinfo.gov/content/pkg/DCPD-201900073/pdf/DCPD-
      201900073.pdf.

"Self driving car statistics for 2021| Policy advice." *Policy Advice -
      Make Your Money Move The SMART Way!*, 29 Sept. 2022,
      policyadvice.net/insurance/insights/self-driving-car-statistics/.

13