

How Companies Promise That Autonomous Vehicles Are the Future of Driving

An STS Research Paper
presented to the faculty of the
School of Engineering and Applied Science
University of Virginia

by

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March 17, 2023

On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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Preface

What are the sociotechnical implications of machine learning (ML)? ML has major implications in many fields, including e-commerce and transportation.

For the capstone paper, the writer of this paper did a proposal, which explores how tech companies use promises about ML, 5G, and other state-of-the-art technology to revive the optimism for autonomous vehicles. To pursue the paper's goal, the writer plans to research, read, and gather information from credible media sources and articles to highlight the reasons for the lack of trust in ML, its inherent danger, and the transformation it seeks to bring to e-commerce and transportation. In regard to the anticipated results, the research will help tech companies to streamline their production schedule, improve their apps, and ensure their apps and AVs are ready for e-commerce. Also, the anticipated results will give a new meaning for how a driver is defined, enable engineers to learn new vehicle behavior to improve safety, highlight the ethical use of consumer data, and lay the foundation for policy-making to integrate AVs into Americans' traditional modes of transportation and e-commerce. The capstone paper was very successful since the paper gave a detailed analysis and reached its goal.

Since 2018, as optimism about the near-term possibilities of so-called "autonomous vehicles" (AVs) has waned, how have tech companies used promises about state-of-the-art technology to revive the optimism? Tech companies and automakers invoke machine learning (ML), 5G, lidar, and other state-of-the-art technology in an effort to sustain optimism about connected and automated vehicles. According to some companies, ML may finally make autonomous vehicles practical. Participants include automakers such as Honda and Tesla, tech companies such as Waymo and Aurora, and trade associations such as the Autonomous Vehicle

Industry Association (AVIA), Partners for Automated Vehicle Education (PAVE), and the Coalition for Safe Autonomous Vehicles and Electrification (SAVE Coalition).

Promoters of so-called “autonomous vehicles” (AVs) have promised consumers for decades that these vehicles would come soon, but the promises have not been kept. For instance, even after \$100 billion in investment, fully automated vehicle services remain rare and unprofitable (Chafkin, 2022). So, consumers have gotten skeptical. Since 2018, as optimism about the near-term possibilities of AVs has waned, tech companies used promises about ML, 5G, and other state-of-the-art technology to revive the optimism. The participants who work to sustain the optimism include automakers such as Honda and Tesla, tech companies such as Waymo and Aurora, and trade associations such as the Autonomous Vehicle Industry Association (AVIA), Partners for Automated Vehicle Education (PAVE), and the Coalition for Safe Autonomous Vehicles and Electrification (SAVE Coalition). To sustain credibility despite broken promises, companies involved in developing and promoting AVs invoke the latest technology, promising audiences that what was impossible before is finally possible now. They mischaracterize skepticism as fear, and frame their task as “educating” an uninformed public.

Review of Research

Stilgoe (2020) examines the broken promises that tech companies and automakers have made for AVs. Stilgoe found out that a Tesla electric car crashed in Florida, and its occupant driver passenger died (n.d.). Also, an Uber in Phoenix, Arizona ran over a woman who was crossing the road with with her bicycle. Stilgoe found out that a Tesla electric car crashed in Florida, and its occupant driver passenger died (n.d.). Also, an Uber in Phoenix, Arizona ran over a woman who was crossing the road with with her bicycle.

He considers the fatalities that automated vehicles have caused, both to drivers and to pedestrians, despite the promises of safety that the responsible companies, Tesla and Uber, made. This paper also fits into the scholarship journal (Issues in science and technology by Jack Stilgoe) since Stilgoe's research also discusses how promises have not been kept for the hyped autonomous vehicles, and how the vehicles may not be safe. The writer's work confirms Jack Stilgoe's findings. He found that there are one million deaths per year even with the technology for autonomous vehicles (Stilgoe, 2020). The writer states that promoters of autonomous vehicles have not kept their promise for consumers who wanted fully working autonomous vehicles.

In regard to theoretical tools that are of value to my work, Missy Cummings found that autonomous vehicle perception system's (sensors that can see the surroundings) inability to function is why self-driving car companies have not kept promises about autonomous vehicles (Stilgoe, 2020). Her team's tests of Tesla's sensors is also valuable to the writer's paper since it uses another source of information (experiments) to further explain why optimism about the near-term possibilities of so-called "autonomous vehicles" (AVs) has waned in order to support the writer's paper.

Flashy Technology for Autonomous Vehicles

First, one way tech companies sustain credibility despite broken promises, is to promote new technologies for their autonomous vehicles. For example, Aurora has Aurora Driver which is a self-driving system with hardware and software for their autonomous vehicles. The hardware in the Aurora Driver has sensors to help the AVs interact with their environment and a computer which is compact, durable, has high-speed processing, and can handle extreme temperatures (n.d.). The Aurora Driver's software has perception and mapping technology to help the vehicle

understand its environment. Waymo is another tech company that promote new technologies for their autonomous vehicles in order to sustain credibility despite broken promises. Waymo's AVs use technology such as cameras, radar, and sensors for navigation (Wayland, 2022). The new technology for autonomous vehicles can improve driving and therefore restore consumers' trust in autonomous vehicles despite broken promises.

Next, to sustain credibility despite broken promises, tech companies make news articles to inform the community about their plans for autonomous vehicles. For instance, the SAVE Coalition made a news article to inform the public about their future plans for autonomous vehicles. Matthew Lipka, Head of Policy at Nuro, states that the state of California had support from Nuro, environmental advocates and other AV companies in order to pass a law that requires all autonomous vehicles to be electric by 2030 (Lipka, 2022). Nuro workers are designing battery-electric autonomous vehicles and prioritizing renewable energy in order to reduce CO2 emissions. Nuro also joined other companies to found the SAVE Coalition, which works to have AVs run on electric energy. The SAVE Coalition's news article will not only inform the public, but also restore consumers' trust in AVs because of the lower CO2 emissions from the AVs.

Third, to sustain credibility despite broken promises, tech companies work with international policymakers and industry organizations. For instance, AVIA works with international policymakers and industry organizations to make sure laws allow the full commercial deployment of Level 4 autonomous vehicles and allow for market access with healthy market competition. AVIA also supports international safety metrics and performance requirements for autonomous vehicles when AVIA works with international policy makers (n.d.). Working with international policymakers and industry organizations will not only help AVIA accomplish their goal to increase road safety in autonomous vehicles with the laws and safety

metrics, but also will boost the economy with the healthy market competition and thus increase consumers' trust in autonomous vehicles.

Fourth, to sustain credibility despite broken promises, tech companies such as General Motors (GM) are developing AV technology with a focus on safety and making investments. In 2016, GM acquired Cruise which became GM's majority-owned autonomous startup. After the acquisition, Cruise made its core AV technology with a focus on safety (n.d.). As a result of their focus on safety, in June 2021, Cruise was the first company to get a permit from the California Public Utilities Commission (CPUC) to give passenger test rides in its AVs without a trained test driver in the vehicle. Also, GM invested \$300 million in Momenta to quicken the development of self-driving technologies for future GM vehicles in China which is the world's largest automotive market.

Fifth, to sustain credibility despite broken promises, tech companies such as Ford claim that AVs can help workers who manage and are employed on large worksites. Ford teams up with DP World London Gateway to show how autonomous delivery could benefit large worksites such as ports. This is a part of Ford's Self-Driving Research Program, which aims to help businesses understand how autonomous vehicles could benefit their operations (Mathew, 2021). Richard Balch, director of Autonomous Vehicles and Mobility, Ford of Europe states that Ford continues to work with customers to learn how autonomous vehicles can help their businesses and it is exciting to see the impact this can have in many places. Ford has also teamed up with Argo AI to test self-driving technology in the U.S. Ford plans to invest around \$7 billion in AVs until year 2025.

Sixth, to sustain credibility despite broken promises, tech companies such as BMW make partnerships. BMW and Mercedes-manufacturer Daimler formed a partnership to work together on autonomous vehicles (Reid, 2019). Around 1,200 technicians from BMW and Daimler will make self-driving technology in a bid. The engineers will work on driver assistance systems and automated driving on both highways and parking. The firms say the technology will be specified to SAE level 4. SAE (Society of Automotive Engineers) levels determine the automation capabilities of vehicles and range from zero to five. Level 4 vehicles can intervene if a system failure occurs. Even though a driver has access to a manual override, the car can perform all functions itself. BMW and Daimler plan to have the technology installed in cars for the general public by 2024. Additionally, BMW and Daimler teamed up with nine other firms to publish a white paper on driverless technology, called “Safety First for Automated Driving.” The report plans to draft worldwide industry standards for tackling the risks of self-driving vehicles. The firms’ authors and expert will present the paper’s principles and findings at auto industry and technology conferences. The paper’s main goal is to make a situation where an autonomously-driven vehicle is proven to be safer than one involving full human control. Audi, Baidu, Continental, Fiat Chrysler, Here Technologies, Infineon, Intel, Volkswagen and Aptiv were other participants for the document.

Seventh, to sustain credibility despite broken promises, tech companies like Zoox use groundbreaking technology for their autonomous vehicles. Zoox engineers use unique sensor architecture for their vehicles which has cameras, lidars, and radars combined in order to see surroundings. The sensor placement in the autonomous vehicles provides a 360-Degree Field of View. The autonomous vehicles can see over 150m away in all directions and around corners. As a result, Zoox vehicles can safely see what is coming before it is close to the vehicle (n.d.). Zoox

vehicles have a compute system and redundant backups, which house proprietary software. This allows the vehicles to make quick decisions to drive safely. Zoox vehicles have a geometric and semantic map to drive in predefined areas. The advanced perception software in Zoox vehicles helps to categorize pedestrians, vehicles, and other road users. The prediction system in Zoox vehicles has machine learning to predict what people and vehicles will do later on. Zoox vehicles have a proprietary planning system, which puts all collected data together to help the autonomous vehicles drive efficiently.

Eighth, to sustain credibility despite broken promises, tech companies such as Cruise use autonomous vehicles for delivery. When there was COVID-19 and increased food insecurity in San Francisco, Cruise used its autonomous vehicles to help society by delivering food. In early 2020, Cruise made two long-term partnerships with the San Francisco-Marin Food Bank and SF New Deal, to deliver meals to residents, while also helping restaurants (Lenaghan, 2022). As a result, Cruise's AVs delivered more than two million meals to residents most in need in San Francisco, as part of their social impact program, Cruise for Good. Also, San Francisco Business Times gave Cruise the 2022 "Beyond the Check" Award in the Community Impact category because of Cruise's collaboration between numerous people, teams, and organizations. Since Cruise helped people throughout the delivery with autonomous vehicles, residents are more likely to regain trust in tech companies despite broken promises.

Ninth, to sustain credibility despite broken promises, tech companies such as Intel work with other companies. Intel works with Beep, which is another tech company. Beep's goal is to make transportation easier to access such as reducing the distance between someone's front door and the closest bus stop with their autonomous vehicles. Beep's app gives autonomous vehicle schedules and provides scheduled pickups in specific locations. Intel Core i7 processors make

Beep vehicles more efficient (n.d.). The Intel Core i7 processors combine Beep's AI sensor technology and help control the autonomous vehicles while ensuring safety. Intel tech enhances Beep's services by processing numerous amounts of data that help their vehicles to perform autonomously.

Tenth, to sustain credibility despite broken promises, tech companies like Velodyne work with Not-for-profit organizations. Velodyne has joined a Not-for-profit organization named Intelligent Transportation Society of America (ITS America) in order to promote autonomous vehicles. ITS America members make autonomous vehicles technology and smart city solutions, improving mobility and sustainability to help society. Velodyne uses lidar sensors to measure and watch conditions in areas such as pedestrian safety, vehicle traffic, and parking space management (Shivangi, 2020). The sensors will gather traffic data about users including vehicles, pedestrians and bicyclists, while not showing people's facial characteristics and maintaining anonymity. ITS America president and CEO Shailen Bhatt quoted: "Velodyne has demonstrated a strong commitment and great skills in advancing public knowledge about lidar and how autonomous technology can greatly improve transportation. We welcome their contributions in helping ITS America promote intelligent transportation technologies." When people learn more about lidar and how autonomous technology can greatly improve transportation, it will help people to trust in tech companies again despite broken promises.

Eleventh, to sustain credibility despite broken promises, tech companies such as Mobileye make their own unique advanced technology for their autonomous vehicles. Mobileye made its own advanced technology for autonomous vehicles such as Mobileye SuperVision which is an eyes-on, hands-off technology, Mobileye Drive robotaxi solution and Mobileye Chauffeur consumer AV offering. Mobileye made other groundbreaking technologies such as

REM crowdsourced mapping, True Redundancy sensing, and Responsibility Sensitive Safety (RSS). These technologies had success for nearly two decades in camera-based safety and driver-assist systems and are installed in more than 135 million vehicles globally (Hyde, 2023). Due to Mobileye employees' hard work in developing technology for autonomous vehicles, Guidehouse Insights and ABI Research, which are leading research groups, recognized Mobileye as the leader in the development of autonomous vehicle technology. Mobileye got the top spot in rankings within frameworks that assessed numerous companies both quantitatively and qualitatively across a wide range of criteria including technology, innovation, strategy, implementation, customer bases, etc.

Twelfth, to sustain credibility despite broken promises, tech companies such as Nuro designed their own type of autonomous vehicle. Nuro made a second-generation vehicle called R2. R2 is designed to carry packages instead of people. Consumer products, groceries, and hot food from local stores and restaurants are examples of packages R2 can deliver (Ferguson, 2020). R2 has specially designed size, weight, pedestrian-protecting front end, operating speed, electric propulsion, and cautious driving habits to perform efficiently. Since Nuro wanted to design a new class of vehicle, R2 is not only driver-less, but also passenger-less. Nuro's engineers believed that their unique type of vehicle has the potential to be safer than passenger vehicles since Nuro's vehicles are more nimble, narrower, and better able to prioritize the well-being of other road users. Nuro's workers also believed that their type of vehicle would allow them to reduce vehicle cost, improve the customer experience, and accelerate autonomous technology deployment by solving problems through both hardware and software development. R2 has zero emission propulsion, a durable custom vehicle body that can handle inclement

weather, temperature control to help keep food fresh, a battery that allows all day operation, an updated sensor array, and more cargo space than Nuro's previous R1 vehicle.

Thirteenth, to sustain credibility despite broken promises, tech companies such as Bosch design new advanced technology for autonomous vehicles. Bosch has three key requirements when they design their autonomous vehicles: The car must capture its surroundings ("sense"), process the collected information and plan a driving strategy ("think"), and implement it reliably and safely ("act"). Safety is Bosch's primary focus. Andreas Schulz, Project Director Chassis Systems Control, stated: "We no longer need lane markings to keep self-driving cars safely on the road." Bosch has made a wide range of different sensors and networked services, which enables automated vehicles to perceive their surroundings without lane markings.

High-performance vehicle computers help the autonomous vehicles' brain to operate. The vehicle must calculate the best driving strategy from a wide host of data captured by the environment sensors and networked services such as digital high-resolution maps, while simultaneously making reliable predictions for anticipatory driving. Bosch teams up with another company named Volkswagen subsidiary CARIAD to address the challenge (Bosch Global, 2023). Bosch and Volkswagen subsidiary CARIAD are working on hands-free systems that allow drivers to take their hands off the steering wheel in specific situations.

Also, Bosch acquired Five, which is Europe's leading start-up for automated driving. With the Five platform, Bosch can analyze real-world data from a group of test vehicles, make a wide variety of test scenarios, and design a simulation environment that has quick evaluation and validation of system behavior. Bosch also acquired Atlatec, an innovative manufacturer of high-resolution 3D maps for autonomous vehicles in order to have high-resolution digital maps for vehicle safety. Bosch invests three billion euros annually in automotive software expertise. In

regard to (“act”), the vehicle computer sends signals to the various parts of the vehicle through cables to have them execute the driving strategy. This allows the vehicle to know where it is at all times, be fully aware of its surroundings, and thus allows it to initiate lane changes on its own. Bosch also uses redundant systems to ensure the highest degree of safety. For instance, if the electronics malfunction, a second, independent circuit can take over immediately so that the vehicle can continue to operate.

Fourteenth, to sustain credibility despite broken promises, tech companies such as Continental AG are developing driver assistance systems for autonomous vehicles. Frank Petznick, head of the Advanced Driver Assistance Systems business unit at Continental quotes: “The high level of confidence in driver assistance systems indicates that, as these become more widespread, confidence in automated driving will grow automatically.” As a result, Continental AG is doing extensive testing in real-life traffic conditions in order to understand how people interact with the systems (Parvanta, 2022). The testing will give important findings that can be integrated into the further development of the driver assistance systems. An example of the driver assistance system is a turn assist system, which is a safety-related function and is in demand. A right-turn assist system specifically protect cyclists and pedestrians from turning vehicles on the road.

Finally, to sustain credibility despite broken promises, tech companies such as ZF design level2+ systems for their autonomous vehicles. Christophe Marnat, Executive Vice President of ZF's Electronics and Advanced Driver Assist Systems Division stated: "At ZF we believe that Level2+ systems that meet advanced safety test protocols and help relieve the stress on the driving task will be the primary driver for light vehicles in the near future." ZF's level2+ systems includes the following functions: adaptive cruise control, traffic sign recognition, lane change

and lane keeping assist, and highway and traffic jam assist (Neemann, 2022). The functions allow the driver to briefly take his hands off the wheel and feet off the pedal in specific situations, but the driver will always remain responsible. The cost-effective coASSIST, coDRIVE, and the coPILOT are ZF's three different Level2+ systems.

Conclusion

To conclude, the writer learned that tech companies use numerous strategies to revive the optimism about autonomous vehicles despite broken promises. This paper's lesson applies to companies in all job sectors. This paper teaches that promises should be kept, and it is important that companies in all job sectors produce high quality and reliable goods and services in order to boost the economy and help society. In regard to further work needed, tech companies need to continue to develop AVs so that they are more affordable, safer, user-friendly, and more reliable.

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