

Analyzing Case Studies of Transitioning from Human-Driving to Self-Driving Vehicles
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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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Current Impressions of Autonomous Vehicles

As of 2021, even the most advanced autonomous vehicles (will abbreviated as AV's in this paper) require some form of human interaction to compensate any amount of unreliability as well as fear that autonomous features may fail. Nearly three in four Americans remain uncomfortable with the idea of self-driving cars according to an AAA survey conducted in 2019. However, the same survey suggested that "Americans are willing to take baby steps" in slowly adapting and familiarizing themselves with autonomous technology and capabilities. In addition, it is stated that it would be extremely beneficial for AV manufacturers to let consumers acquire hands-on exposure to the technology in low-risk environments, as well as acquire education on autonomy, in an effort to eliminate the mistrusting stigma against AV's (Mohn, 2019). Holding onto that endeavor, there may be a substantial level of optimism for AV developers successfully globalizing their innovations, given that there will be multiple challenges and hurdles for manufacturers to transcend.

Ultimately, the purpose of this research paper is to gain an intimate understanding of what it is that hinders AV acceptance – how consumers view the technology, and how those views affect AV development. In the case study items that will follow, we will be looking through various viewpoints of autonomous vehicles through different lenses. These include opinions from a judiciary, news articles, a research institution, and lastly, from an engineer who works directly with transportation engineering. Each item contains either a promotion or discouragement of AV's. These case studies will be conducted holistically with the Social Construction of Technology (SCOT) theory serving as the main framework of the analysis,

assisted by the idea of paradigm shifts. SCOT explains how social factors and forces shape technological development (Infonautics, 2021). Ethical frameworks may also be implemented to further prove, through the lens of STS (Science, Technology and Society), how stakeholders' viewpoints affect AV development as well as manufacturers' decision-making. The main two applicable ethical frameworks in this paper are Consequentialist and Duty. For a party to have a Consequentialist point of view, they are motivated by the possible results their actions could bring. For a party to have a Duty ethical framework, they would have to be motivated by their ascribed jobs and responsibilities. Utilizing all of these tools allow thorough STS analysis for each case study.

German Court Ruling

Recently, in 2020, an article was released informing readers that a Munich judge ruled that Tesla, the most well-known leading manufacturer and developer of AV's as of today, may not use misleading terms such as "full potential" and "autopilot inclusive" in German advertising. The Munich court claimed that the advertisement's exaggerated vocabulary would convince viewers that the vehicle is able to operate without any human intervention, and may go as far to imply that AV's were legal on German roads at the time (Beresford, 2020).

Comments and critiques of the article were generally consistent, agreeing with the Munich judge that it is irresponsible to execute that marketing tactic taking the form of false advertisement. Even before the ruling, Tesla has been hit with similar criticism from other authoritative figures (i.e. NTSB) for Tesla's hyperbolic vocabulary. Since this backlash, Tesla has informed customers that its technology does not have fully autonomous capabilities, with Chief Executive Officer Elon Musk stating "the electric car manufacturer was close to making

its cars capable of automated driving without any need for driver input,” which is equivalent to Level 5 autonomy according to the Society of Automotive Engineers (Reuters Staff, 2020).

It is within this event that showcases turbulency and conflict of a paradigm shift. In this case, the shift is going from the idea that the ideal vehicles on any given road will go from being human-driven to self-driven. Because of these opposing viewpoints, manufacturers and developers are faced with the pressure in challenging and advocating for their ideal future normal of there being only AV's on roads. The final verdict of the Munich Judge showcases a prime example of that adversity, regressing Tesla's progress.

Through a Duty ethical framework point of view, the Munich Court upheld their responsibility in successfully protecting German citizens from, what they considered, false advertisement. On the other hand, Tesla possessed a Consequentialist framework, in which they justified their exaggerated vocabulary as a means to promote their vision. Within Tesla's vision are AV's that are capable of more efficient, smarter and safer decision-making than human drivers. There is irony in that these opposing ethical framework viewpoints have the common mission to keep consumers safe, however – the Judge keeping German citizens safe from a misunderstanding that could lead to potential accidents, and Tesla aiming to develop technology that could prevent those accidents. It is because of this trend of criticizing AV's for not yet being fully autonomous that adds more cautiousness to developers' actions – leading into the SCOT theory, which holds that the progress of technology is influenced by society and its views on the subject. If Tesla's advertisements were never criticized, there would be less concern for the manufacturer's promotion of their technology, allowing them to reach more consumers around the globe. This would cause an even further chain reaction because having a larger and more diversified consumer demographic would increase the chances of more

thorough development and innovations of their AV technology. A globalized technology implies that it is positively biased by everyday people. Tesla will aim to perfect self-driving aspects, as well as to implement features that can essentially get the trust of the driver and passengers – emphasizing to those riding that the manufacturer’s car is reliable, safe, and more intelligent than what a human driver can offer. There is plenty of conversation of how technology affects advertising, but rarely is the converse, advertising affecting technology, discussed. This case is one of numerous examples where a simple public relations mistake may cause a manufacturer to redirect the way they promote their technology.

Uber Self-Driving Car Fatal Crash

Arguably the most notorious AV-related accident happened in 2018 in Tempe, Arizona, where a test-run of one of Uber’s self-driving cars ended up costing the life of a crossing pedestrian. The test driver, according to dashcam footage, was shown to have spent 36% of the drive on her cellular device. The vehicle’s computers detected the victim 5.6 seconds before impact, but it did not correctly identify her as a crossing pedestrian, but as a bicycle since the pedestrian was pulling one by her side. Conversely, it was stated that the victim was crossing the road unsafely, with toxicology reports suggesting she consumed drugs that may impair judgement (Lee, 2019). In Figure 1 is an illustration of the incident, where each concentric yellow ring marks distance in meters, the purple area and green line projects the car’s intended path after detection, and the orange line marks the initial travel before detection.

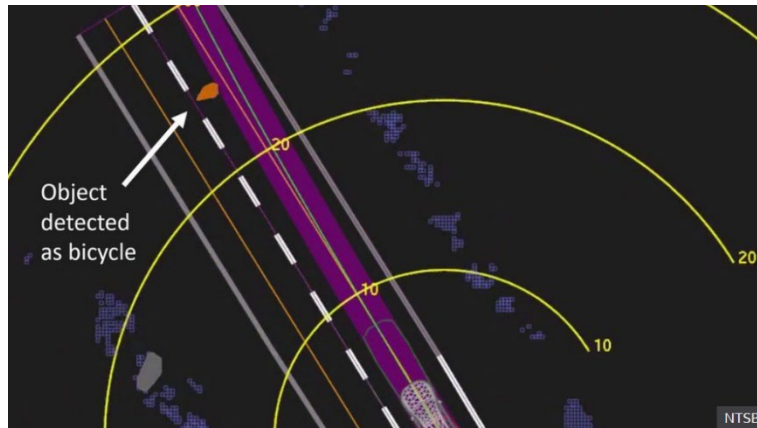


Figure 1. NTSB mapping of the incident (Lee, 2019).

Naturally, there is intense debate on who is to be held accountable. One interpretation is that Uber attempted to offset accountability onto the test driver by mandating that the human safety backup be attentive the whole drive. However, the NTSB has rebutted that Uber has had a history of “inadequate safety culture,” which the institution can then infer that Uber placed a human safety backup for the sole purpose of performing demonstrative action. Resulting from the incident, Uber was suspended from conducting any self-driving programs. Uber has also increased its transparency to the NTSB by allowing accessibility to information about their technology as well as developments since then. The NTSB also pushed for more regulation of AV manufacturers as well as a more thorough analysis and strict review of the technology before it can be tested on public roads.

Like the case with the Munich court on Tesla, the impact of NTSB’s criticism on Uber further encourages the development of AV’s to be detrimental and unsafe to the public eye. Even though there are far fewer AV-related accidents compared to human-driving accidents, the public tends to focus on and only remember the cons of autonomy over its pros. This behavior is reflected in the AAA’s aforementioned survey.

This case is congruent with the previous case, where an authoritative figure is present (in this case, NTSB). The authoritative figure, again, possesses the power to determine the final say in what the manufacturer's follow-up actions are after the incident. Doubting Uber's safety practices invokes an unsettling tone on the outlook of their AV development, as well as obliging a more careful use of the manufacturer's resources. This leads to a compelling proposition that the SCOT theory holds true in this case. Uber was, since then, forced by the NTSB to end testing in Arizona, pausing progress and experimentation. On top of the already vast array of regulatory standards that automobiles must meet, it is devastating to not be able to gather information from a significant geographic area. Regulation itself promotes development in certain directions but forecloses development in others (Infonautics, 2021).

Another way that Uber's technological development was shaped is by the NTSB's public mistrust in Uber. After stating that Uber has had a history of "inadequate safety culture," it can be implied that at least a few members of society are convinced to also condemn Uber's actions and Uber as a whole. The attitude that the public has on Uber, and any AV technology, can greatly affect on if it is accepted and correct by society's standards. If the same unfortunate incidents like Uber's were to happen again, there would be a monumental shift in forbidding AV technological development across nations and manufacturers. The public's attention span would only be focused on the lives lost, and not on any AV companies' mission statements, preventing a successful paradigm shift. This idea is further emphasized in the next case study.

Waymo Van Incident

A closely associated incident happened in January of 2020 in the same area of Arizona, where a driver, with intent, suddenly braked in front of a Waymo van, causing a rear-ended collision that injured the Waymo driver. The Arizona Republic reports “...in late 2018 [there are] documented several incidents of people harassing the autonomous vehicles and their drivers by following them, swerving at them, trying to run them off the road and even one man who aimed a gun at one,” (Randazzo, 2020). Despite the controversial actions from the proclaimed instigator, Waymo released a statement giving an impression of understanding and resilience, “Incidents such as this one reinforces the importance of Waymo’s mission: to make it safe for people to get where they’re going and to help save the thousands of lives now lost to traffic crashes caused by humans.” This was stated even in light of a successful attempt in rear-end collision and injuring one of their test drivers.

The cases so far set a doubtful undertone towards AV’s. It is in this incident where the public goes through extreme measures to send a message that they are against autonomous development that are creeping onto their way onto their roads. Despite multiple experiments, test drives, and data suggesting that AV’s can act more safely without human intervention, there seems to be a clear disconnect between results and the public’s understanding. Because of this incident, NTSB further condemned a lack of state and federal regulation of testing on public roads (Randazzo, 2020), but Waymo’s reaction did not lead to a complete stop in its endeavor to further develop their product, unlike Uber. SCOT is present here, as government regulation directly affects AV technological development. It may be that the NTSB did not aim to place accountability onto Alphabet (Waymo’s parent company) because their vehicle at the time of the

incident was manually driven. Thus, the question if Waymo was exercising “inadequate safety culture” is nonviable. For Uber, their vehicle was testing self-driving capabilities.

Tying this incident to the SCOT theory, we can observe a pattern of aggression towards the thought of AV's being the majority on American roads. If the same theme of aggression continues, society will begin to ascribe a first impression of hostility upon noticing an AV, shaping its technological development if the attitude is severe. The mode of transportation would steer away from autonomy to prevent further hostility. Despite Waymo's mission statement clearly focusing on safety and the common good, there is an antagonistic stigma present aiming to dismantle the company's efforts.

Congressional Research Service Report

Unlike the previous cases, the Congressional Research Service report gives an impression leaning towards optimism in the effort to push AV technology onto roads. It states that in 2018, a study by the National Highway Traffic Safety Administration (NHTSA) suggests that 94% of crashes are due to human error (Congressional Research Service, 2020). This gives an interest in Congress to legislate by allowing further testing, proposing newer bills – though they have not been enacted. The report confirms that since the Uber incident of 2018, the pace of AV commercialization has been slowed. A few key disagreements among Congress arose from deliberation – which governing institutions should be responsible for what (ex. traditional vehicle regulation, vehicle safety), the number of AV's allowed to be tested on public highways and the extent in which they are exempt from safety standards, how to address cybersecurity

threats and breaches, and the amount of transparency there is between vehicle operators and data generated by their AV's.

Naturally, the time needed for the federal government arriving at a solution to regulate AV testing on public roads will, at the very least, hinder the rate of developing the technology even if they fully permit testing without setting any boundaries. In the 115th Congress's deliberation on AV's, there was a bipartisan consensus on its major issues, with the House of Representatives passing the SELF-DRIVE Act without any amendments. The SELF-DRIVE Act serves to ensure the safety of automated vehicles by supporting the testing and deployment of those products, where manufacturers must satisfy given requirements, including passing a safety certification assessment by the Department of Transportation (DOT). Even though a safety certification assessment presents another hurdle, exemplifying a similar case of the SCOT theory, the government is in full support of a paradigm shift encouraging the use of AV's.

Bipartisan consensus on AV issues, backed by data proving the benefits of AV's, presented an important step in their acceptance. The SELF-DRIVE Act not only allows companies to accelerate progress, but it also ensures an attitude of trust between the U.S. Congress and AV manufacturers. In this case, both Congress and AV companies share the same Consequentialist point of view – to maximize safety for consumers as much as possible. Both parties also wish to put the technology in a positive bias. It's also the promising interplay between the two that can set a precedent that can encourage other agencies to do the same, further shaping technological development.

Wharton Podcast with a Transportation Engineer

A podcast based in the Wharton School of the University of Pennsylvania gives viewers and listeners a more omniscient and thorough point of view of AV technology. The guest interviewed is a leading transportation engineering expert, Samuel I. Schwartz, where he discusses, through various perspectives, future predictions and applications of AV technology and how it can positively or negatively affect different aspects of society.

The podcast begins with Schwartz stating that 90% of public transportation in the United States is in a “sorry state,” (Wharton Business Daily, 2019), where the consumer will almost always choose driving themselves as mode of transportation out of convenience. Schwartz then states that with AV technology, public transportation can be made more accessible, more efficient and more convenient. Conversely, AV technology can lead to a significant consumption of electrical resources if it’s proven to be the most convenient mode of transportation. AV technology can also encourage the intrusion of cultural differences of rural areas versus areas with developed infrastructure, since AV’s can assist in the expansion of developed areas. Schwartz then leads a discussion on the purge of transit jobs due to the introduction of AV’s onto public roads. In support for AV’s, AV technology can allow for more efficient and accurate transportation, saving space used on highways for more opportunistic infrastructure. Land use can become more diversified, and it would promote healthier lifestyles as density between infrastructure would be condensed to walking distances as a result of trading transportation space for business real estate.

This conversation showcases that the future of AV’s depend on society’s wants and needs – factors like convenience, efficiency, how it can positively affect their lifestyles, how it can benefit the economy, etc. Schwartz unknowingly gives these examples of SCOT theory, where

the consumer acts as the main dictator on what direction the technology develops. It comes to our understanding that practical AV implementation will start with businesses that can avoid human labor. Schwartz also briefly mentions the era of when human-driving vehicles were overtaking horse-riding as the most common mode of transportation, signifying a paradigm shift analogous to today.

Conclusion

The current state of AV's in 2021 presents an issue requiring additional conversation and education, where society understands the benefits that AV's have, but the current public point of view of the new technology is skeptical. Skepticism is clearly due to uncertainty and unacquaintedness to not being in full control of the mode of transportation, where it motivates a myriad of society's unwelcoming reactions. All of the case studies used were very recent at the time of writing this paper, demonstrating the peak of conflict of interest for AV's.

Social Construction of Technology radiates through this era, as any one incident can be viewed as intolerable, leading to the defamation of any size corporation/manufacturer. On the other hand, as Schwartz mentions, if society can begin to see the practicality of AV's, and how it can cause a domino effect of accommodating numerous aspects to everyday life, overlooking the rare extreme cases of incidents, we will begin to see an exponential development of AV's.

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