The Implications of Cruise Self-Driving Cars on San Francisco

A Research Paper submitted to the Department of Engineering and Society

Presented to the Faculty of the School of Engineering and Applied Science

University of Virginia · Charlottesville, Virginia

In partial Fulfillment of the Requirements for the Degree

Bachelor of Science, School of Engineering

Riley Tufts

Spring 2024

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

Advisor

Joshua Earle, Department of Engineering and Society

Introduction

Autonomous vehicles (AVs) are gaining traction in today's society, with more and more manufacturers developing autonomous technology. In 2022, driver-assistance systems and other forms of autonomous technology generated between $40 billion to $55 billion in revenue, with an expected uptick to $300 billion to $400 billion in revenue by 2035 (McKinsey & Company, 2023). In order for this technology to continue to grow, consumers and manufacturers alike must understand the influence AV technology has on roads, passengers, and other drivers, for example, when in use. Studying the impact of autonomous vehicles on their surroundings can enable manufacturers and policymakers to create safer systems, which in turn enhance public trust in the technology. This can help to create a better future living with autonomous vehicles.

Understanding autonomous vehicles means understanding the extent of autonomy that is currently achievable with today's technology. Specifically, six levels of autonomy measure and categorize AV technology. This ranges from level 0, which describes technology with no driving automation present, up to level 5, describing full automation of the vehicle with no need for human interaction (Gordon, 2020). Vehicles commonly feature lower levels of autonomy, namely levels 0 through 3, as demonstrated by technologies such as cruise control and automatic braking. However, many manufacturers and developing systems currently focus on levels 4 and 5, as these levels of autonomy are less common in modern vehicles. Because level 4 and 5 technology is primarily in the developmental stage, more research is needed to regulate these levels of autonomy and understand the current level of safety achievable within them. This research can also reveal whether higher levels of autonomy will ever be safe enough to fully implement into society.

One example of a company focusing its efforts on the development of level 4 technology is Cruise, an autonomous vehicle company owned by General Motors. In June 2021, the California Public Utilities Commission approved Cruise vehicles to be a part of a pilot program in which companies could test autonomous vehicles with a safety driver on public streets (California Public Utilities Commission, 2021). Cruise was the first autonomous vehicle company to be approved to take part in this program, establishing them as a leading company in the AV industry.

After their introduction into the public streets of San Francisco in 2021, Cruise vehicles were occasionally involved in disruptive incidents on the roadways, such as passenger accidents and traffic disturbances. Ultimately, Cruise could not successfully operate its autonomous rideshare vehicles in San Francisco. This is due to the lack of transparency within the company as well as a failure by Cruise to address issues with the technology promptly and effectively. As a result, authorities revoked Cruise's privileges of operating passenger vehicles in the San Francisco area, and Cruise's former CEO, Kyle Vogt, resigned.

To determine if the benefits outweigh the costs of implementing autonomous vehicles into society, I conducted research examining this specific case study: the impact of Cruise self-driving rideshare vehicles on the San Francisco community. Examining this specific scenario with autonomous vehicles as the focal point may guide the future development of this technology to be safer and more regulated, or help decide whether this technology is safe enough to use at all. I chose this specific case to determine the source of adverse effects present and to conclude how to minimize the negative consequences imposed on society by autonomous vehicles.

In the subsequent sections of this paper, I explain my usage of the Actor-Network Theory framework to analyze this case study, focusing on the construction of the network surrounding the Cruise autonomous rideshare vehicles. I discuss the permitting process Cruise went through to be allowed to operate, Cruise's current safety protocols, and how the public interacted with these vehicles in San Francisco. Finally, I present the reasons for failure of this network and describe how the case study ends with the suspension of Cruise vehicles in San Francisco.

Conceptual Framework and Methods

Actor-Network Theory

My analysis of Cruise's autonomous rideshare vehicles in San Francisco draws on Actor-Network Theory (ANT), which focuses on the analysis of networks including both human and non-human actors. ANT emphasizes the breakdown of sociotechnical networks into associations. Sociotechnical networks, also known as heterogeneous networks, describe the web of relationships between both human and non-human actors (Cressman, 2009, pg. 4). Using this framework, both social and technical actors are equally regarded, as each actor influences the others through associations. Associations are the connections between heterogeneous actors, and studying the strength of these associations between actors is the essence of Actor-Network Theory.

One concept that allows for the use of ANT in most systems is the use of "black-boxes". "Black-boxes" describe when a system is observed only for its influence on external factors, rather than focusing on its internal workings and functionality. Therefore, "black-boxing" helps to simplify complexities within larger systems. All things can be considered both an actor and a network depending on perspective: technology can be an actor in a larger network while also being an entire network of its own, housing connections and relationships between internal actors (Cressman, 2009, pg. 7). To analyze one network, actors in that network must be simplified, as their internal workings do not have a great impact on the associations made between actors of the larger network. Punctualization describes this “black-boxing” of complex networks as a single node, or actor, for their analysis in a larger network (Cressman, 2009, pg. 7). However, whenever a “black-box” is created of a complex network through punctualization, it creates a situation in which aspects within the “black-box” seek to be made known in the context of the larger network being observed (Cressman, 2009, pg. 7). This can cause some internal workings of the black-boxed actor to influence the larger network being observed.

Within a heterogeneous network, social and non-social actors influence each other through translation and delegation. Translation is the act of relating things in a network that were previously unrelated to each other, bridging the gap between actors (Cressman, 2009, pg. 9). Through the creation of networks, translation between actors is seen primarily through delegation. Delegation is the two-sided relationship between human and non-human actors, specifically looking into how one impacts the other. For example, technologies are delegated work from humans, while technologies influence the behavior of humans, displaying how delegation goes both ways (Cressman, 2009, pg. 10). Because of this relationship, ANT helps to analyze these reciprocal associations within networks to understand why the network formed the way it is.

While analyzing a network of actors and their individual associations within the network is essential to ANT, it is not enough to merely describe the connection between actors and the delegation between them. Observers consider associations within a network for their strengths and weaknesses, as failed or unsuccessful relationships between actors can and will cause a network to break down. In the case of a broken network, these associations are crucial in understanding where an actor in the network failed to some degree. Additionally, known broken connections can influence actors in other networks to correct relationships with each other to ensure the success of their network. ANT provides the basis of this analysis, allowing for the failure of one network to be learned and adapted to ensure the success of other sociotechnical networks being created every day.

Methods

I conducted a literature review and a brief case study. For the literature review, I reviewed scholarly articles regarding the developmental factors of autonomous vehicle technology, such as the internal ethical decision-making, external regulation and management, and their perceived safety in the eyes of the public. To obtain information about the specifics of Cruise as a company and the complications with their self-driving rideshare vehicles, I reviewed news articles reporting on incidents and updates within the company as well as specific statements made by Cruise representatives. I conducted this research to gain insight into the specific situation Cruise is facing with their premiering technology, and how this can relate universally to the introduction of autonomous vehicles such as these into different parts of society. Additionally, information I learned from this research helped me to construct the network specific to this case study and analyze the associations between all actors in the specified network, presented in the paper below.

Literature Review

In the development of all autonomous systems, thought is put into how technology will respond in different scenarios. Autonomous algorithms consider ethical choices regarding the safety of passengers and pedestrians. In the chapter titled “Machine Ethics and Automated

Vehicles” from *Road Vehicle Automation*, Noah J. Goodall explores the ethical decision-making autonomous vehicles are programmed with in situations where a crash or collision is unavoidable. Goodall responds to criticism of machine ethics research while highlighting that programmable ethics in autonomous vehicles are unavoidable and necessary. However, this leads to many questions of how humans weigh risk in driving scenarios and how to implement this into the technology as ethical decision-making. Goodall discusses the importance of research in the moral behavior of technologies, whether this be through machine learning algorithms or scenario-based predetermined actions (Goodall, 2014). This concept applies to autonomous vehicles specifically, as the development of this technology is flawed and crashes will continue to happen.

In addition to discussions of ethical decision-making processes in AVs, another important factor in the development of autonomous vehicles is the safety and regulation of this technology. In the podcast titled *Creating an Autonomous Driving Ecosystem*, the host Carlos González has a conversation with Kevin Vincent, the director of the Center of Connected and Autonomous Automotive Research at Coventry University, in regards to the infrastructure needed to allow the safe and smooth operation of autonomous vehicles in society. Vincent touches on the main focus of developing AV technologies in the UK, which is the safety net built around autonomous vehicles, or the infrastructure in cities. For safe operation of these vehicles, it is important to develop many levels of communication technology alongside AV development; this way, AVs can be more effectively monitored and aware of their surroundings. This is important for the safety of their passengers (González, 2022). Safety of autonomous vehicles is not only dependent on how the vehicles are developed, but also on how they are managed and regulated externally.

A final important factor in the development of autonomous vehicles is the perception of the public, or the user groups that will be most affected and influenced by the technology. In *Psychological factors affecting potential users' intention to use autonomous vehicles*, Tianyang Huang developed a model of autonomous vehicle technology acceptance based on assumptions surrounding perceived trust, enjoyment, and value of autonomous vehicle users. This model was then tested by having 232 participants engage in a questionnaire, whose results showed that a user's intention to use AV technology was mostly affected by attitude, perceived trust, perceived enjoyment, and perceived usefulness. This information can be important to developers of autonomous vehicle technology to help predict how to engage the community to trust and find use in AVs (Huang, 2023). Public perception of autonomous vehicles is crucial in the success of commercial AVs.

Case Study Analysis

Network Construction

The network involving the use and eventual suspension of Cruise self-driving rideshare vehicles in San Francisco is constructed below. The actors included in this network are the public, the California Public Utilities Commission (CPUC), Cruise LLC through CEO Kyle Vogt, and the self-driving vehicles, which I refer to as robotaxis or autonomous rideshare vehicles. I consider the public as a collection of actor subsets, the subsets being users or passengers of the robotaxis, pedestrians, and other drivers on the road who are not using autonomous vehicle technology. In the following analysis, I describe an idealized network to show how strong associations between actors in this network are essential in the successful integration of Cruise vehicles into San Francisco. Then, I reevaluate this idealized network to observe weak associations between actors and reveal breaks in the network.

For simplification of analysis, I use punctualization to analyze both the robotaxis and Cruise LLC in this network. While acknowledging that they are networks of actors themselves that must run smoothly together to successfully operate, I black-box both for my analysis. The internal workings of autonomous vehicle technology, including the ethics of this technology, will affect the association between this actor and the public actors. Additionally, Cruise as a company will be black-boxed to focus on Kyle Vogt, Cruise's CEO at the time of implementation of robotaxis into San Francisco as well as when the CPUC revoked Cruise's operating license. Kyle Vogt is the obligatory passage point in this network, as defined by Michel Callon in *Some Elements of a Sociology of Translation: Domestication of the Scallops and the Fishermen of St Brieuc Bay* (Callon, 1984). All other actors interact with Vogt in such a way that the network would collapse without his role as CEO of Cruise.

Furthermore, I include the California Public Utilities Commission as an actor in this network and exclude the California Department of Motor Vehicles (DMV). Although both have had meaningful interactions with Cruise and the deployment of their autonomous vehicles, the permits issued by the CPUC are required specifically for autonomous passenger vehicles, while permits from the DMV are required for all AVs wanting to operate on public roads (California Public Utilities Commission, 2021). Because the other actors in the described network are public actors, I focus my analysis on the sector of the California state government that handles operations with the population, allowing these autonomous vehicles to become operable rideshare vehicles.

Figure 1 shows an idealized actor-network surrounding the recent incidents with Cruise's robotaxis and the San Francisco community.

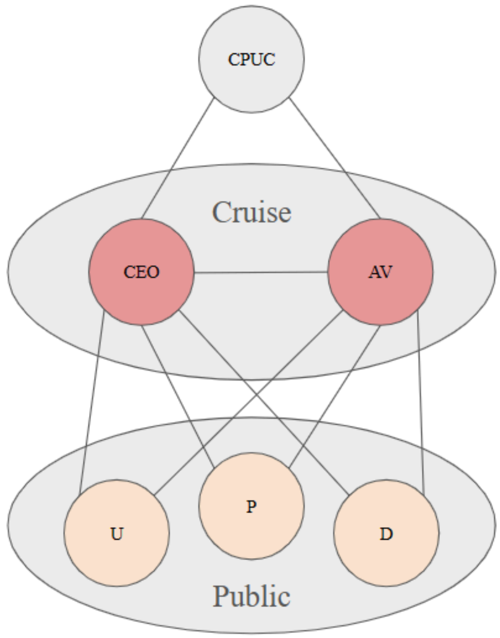

Fig. 1: Idealized network for the successful integration of Cruise rideshare vehicles into the San Francisco area

The actors in the above network are users (U), pedestrians (P), other drivers (D), Cruise CEO Kyle Vogt (CEO), rideshare vehicles (AV), and the California Public Utilities Commission (CPUC). The actors in red directly relate to Cruise LLC, and the actors in orange represent members of the public.

In order to properly test the robotaxis before their deployment for public use, Cruise must apply for testing permits from the CPUC. The CPUC must grant these permits to regulate the development of the robotaxis along with all other autonomous vehicles being developed and tested in California. Once testing is complete and Cruise has the correct permits from the CPUC, the autonomous rideshare vehicles interact the most with members of the public. The AVs must foremost have an emphasis on safety, following the rules of the road with other drivers, stopping for pedestrians, and successfully transporting passengers from one location to another. Cruise then issues statements to the public about developments in their technology or regarding the public concern about the safety of the vehicles. This creates a network composed of human and non-human actors; their successful interaction with each other leads to a successful deployment of Cruise robotaxis in San Francisco.

However, by further examining the details of this specific case study, I show the relative strength of these associations and conclude the reason for the failure of Cruise robotaxis in the San Francisco area.

Cruise Permitting Process

Autonomous vehicles must go through certain steps to ensure the technology is safe and well-tested before being deployed into society. In California, a company must go through the DMV to get a permit to operate on public roads, first testing with a driver, then testing without a driver, and finally, the deployment of the vehicles. The DMV issued Cruise all three permits, allowing for the deployment of their AVs onto public roads. To be a passenger vehicle, companies must get a Charter-Party Carrier (TCP) permit from the CPUC. Cruise also held three TCP permits through the CPUC: a Drivered Deployment permit, a Driverless Pilot permit, and a Driverless Deployment permit (California Public Utilities Commission). Cruise was the first company to receive a Driverless Autonomous Vehicle Passenger Service Deployment permit from the CPUC on June 2, 2022, which regulated the deployment conditions of these vehicles, including the approval of a Passenger Safety Plan submitted by Cruise. This allowed these vehicles to fully operate on public roads and transport passengers (California Public Utilities Commission, 2022). The safety concerns of the public, regulating bodies, and companies involved influence this process of obtaining permits to operate autonomous vehicles publicly as passenger vehicles. Therefore, the association between Cruise and the CPUC is strong as Cruise went through all the correct channels to be authorized to operate.

Cruise Safety Protocols

The Vice President of Product at Cruise, Oliver Cameron, discusses the importance of safety and how autonomous vehicles can create a safer way of traveling, especially at night. Driving at night is statistically more dangerous than driving during the day, because of many factors such as visibility, driving tired, and intoxication (Cameron, 2022). Most of these factors develop out of human fallibility, and the use of autonomous vehicle technology creates a safer transportation option. This shows the business model of Cruise: developing technology intending to create as safe of an environment as possible.

Public Interaction

By September 2022, Cruise had deployed a little fewer than 100 vehicles as a fared rideshare service in the San Francisco area, and members of the public could use these vehicles similarly to how one would use Uber or Lyft (McFarland, 2022). However, while Kyle Vogt and Cruise as a company had intentions of expanding their fleet and extending their reach outside of San Francisco, issues with the already deployed vehicles became a growing concern. The network, as depicted above in Figure 1, breaks down when the rideshare vehicles interact with the public, as the most significant association in this network is the connection between the vehicles and the public actors. This is because the public actors are most affected when this technology malfunctions. Additionally, as Oliver Cameron states, Cruise prioritizes the safety of the public in the development of their vehicles, showing the importance of the association between the vehicles and public actors (Cameron, 2022).

Traffic disruptions caused by Cruise robotaxis affect other drivers on the road. CNN reported that there were incidents of Cruise vehicles stopping unexpectedly in roadways, sometimes alone while other times in groups (McFarland, 2022). These incidents caused traffic jams, blocking of high-traffic roadways, and increased congestion. From June 2022 to August 2023, the number of unplanned stops made by Cruise vehicles totaled around 600 (Roeloffs, 2023). These unexpected events caused major disruptions, specifically to the other drivers on the roads. This is the association between the autonomous rideshare vehicles and other drivers on the roads of San Francisco, shown to be weak.

These unexpected stops made by Cruise robotaxis not only affected other drivers on the road but also those who used the rideshare vehicles. The main functionality of Cruise's autonomous vehicles is to transport passengers from one location to another safely and efficiently. When vehicles are stopped without cause or reason, Cruise does not achieve its goal of functionality. Passengers in these vehicles were not being taken to their destinations because of the malfunctioning of the vehicles. Because of this, the public trust in the vehicles decreased, and the association between the autonomous rideshare vehicles and their passengers weakened.

The last public actor is pedestrians, which include members of the community who are not a part of the user group of the robotaxis. Because of a lack of public trust in the vehicles, protest groups frequently messed with the technology by placing traffic cones on the hood of the cars, temporarily disabling the vehicles (Roeloffs, 2023). One group performing this activity is an anonymous activist group called Safe Street Rebel, who have stated their goal of protesting the introduction of emerging technology such as this in San Francisco (Kerr, 2023). This is one example of the lack of public trust in Cruise's vehicles. The most notable incident involving Cruise vehicles occurred on October 2, 2023, in which a driver's vehicle struck a pedestrian and pushed them into the path of a Cruise autonomous vehicle, which then dragged the pedestrian for 20 feet before coming to a stop (Domonoske, 2024). This crash, along with other incidents involving Cruise vehicles, led to an investigation into the safety and operating procedures surrounding the driverless vehicles.

Failure of Cruise

NPR reported that Cruise "failed to adequately inform regulators of the self-driving vehicle's full role in the incident," and suggests the reason for Cruise's shortcomings in their promises of safety involved "poor leadership, mistakes in judgment, lack of coordination, an 'us versus them' mentality with regulators, and a fundamental misapprehension of Cruise's obligations of accountability and transparency to the government and to the public," as the law firm Quinn Emanuel Urquhart & Sullivan, hired to investigate, wrote (Domonoske, 2024). This rift caused by the incidents involving pedestrians and Cruise vehicles shows a lack of trust from the public and a lack of transparency from Cruise, breaking the association between the actors.

In the wake of safety incidents revolving around a particular company, it is important to consider the people in decision-making positions within the organization. Kyle Vogt is the co-founder and former CEO of Cruise LLC. Vogt founded the company back in 2013 and served as President, CEO, and Chief Technology Officer of Cruise until November of 2023 (Pinto, 2023). In 2016, Vogt sold 80% of the company, allowing for the growth of the once small startup (Isidore, 2023).

Following the incidents involving Cruise vehicles, Vogt resigned as CEO of the company, saying he "take[s] responsibility for the situation Cruise is in today," and Cruise as a company needs "to double down on safety, transparency, and community engagement," (Bensinger, 2023). Additionally, sources reported that Vogt believed improvements needed to be made in Cruise's approach to working with the public, the press, and regulators (Bensinger, 2023). Made apparent from these statements made to the public, Vogt believed there was a lack of communication between Cruise and the members of the community that these vehicles serviced, including drivers, pedestrians, and passengers. This illustrates a vulnerability in the network between Vogt and members of the public, as Cruise was possibly not fully transparent with the public during the peak of its operation. This weakens all the associations between Vogt and the public: users of the robotaxis, other drivers, and pedestrians. Viewing Vogt as the obligatory passage point of this network, his resignation ultimately confirms the downfall of Cruise's autonomous vehicle fleet in San Francisco, showing that the idealized network is far from that of reality.

As of February 5, 2024, Cruise holds an Autonomous Vehicle Testing Permit (with a driver) through the California DMV, meaning that they may test on public roads in the state of California with a safety driver behind the wheel (California DMV). However, the CPUC suspended the TCP permits once held by Cruise, preventing Cruise vehicles from being allowed to transport passengers. This is a big step back from where Cruise was in their deployment of rideshare vehicles in early- to mid-2023.

Because of the reasons described above, the actor-network describing the impacts of Cruise self-driving rideshare vehicles on the San Francisco community is far from ideal, as shown directly by the suspension of Cruise's permits to publicly operate. Below is a depiction of the realistic network based on the strength of the associations between actors, as outlined in the above analysis. My analysis corrects the idealized network presented in Figure 1, resulting in the realistic network in Figure 2.

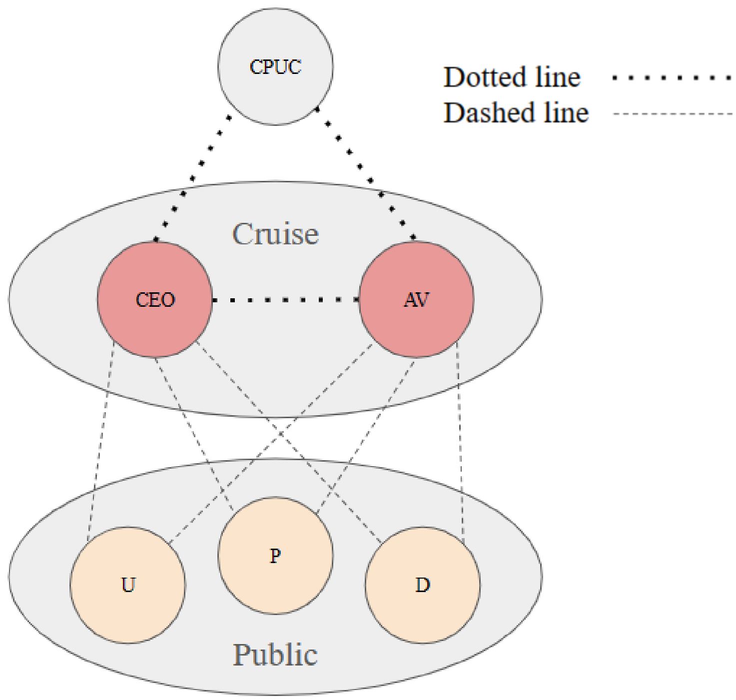

Fig. 2: Realistic network for the failed integration of Cruise rideshare vehicles into the San Francisco area

The actors in the above network are users (U), pedestrians (P), other drivers (D), Cruise CEO Kyle Vogt (CEO), rideshare vehicles (AV), and the California Public Utilities Commission (CPUC). The actors in red directly relate to Cruise LLC, and the actors in orange represent members of the public. The dashed lines represent weakened connections between actors within the network, and dotted lines represent broken associations.

By examining the specific case study of Cruise's autonomous vehicle deployment in San Francisco and the setbacks the company faced, I have shown how the idealized network of actors is not similar to the network in reality. To ensure the success of a network like this, transparent communication between actors needs to be present, as well as mutual understanding between actors. The best interests of the public must be at the center of AV development, as shown by the break in association between Kyle Vogt and the public actors.

Conclusion

Kyle Vogt, the former CEO of Cruise, had a goal of successfully integrating the autonomous rideshare vehicles developed by Cruise into society. Ultimately, through the lack of communication with the public and poor response to accidents involving these vehicles, the connection between Vogt, the public actors, and the CPUC, grew weak, leading to failures in gathering allies towards this goal of successful integration of AVs.

While we cannot predict the future, examining reasons for the failure of a network as presented above can lead to learning from mistakes, hopefully improving the process in the future for other developers. While this technology continues to be developed, companies must transparently express the safety and functionality of these vehicles to ensure their success, and they must take immediate action in the event of the unsafe malfunctioning of these autonomous systems, which was not handled properly in the case of Cruise. Learning from the mistakes made in this case study, autonomous vehicles may see more success in their deployment to society in the future.

Bibliography

Autonomous Vehicle Program Permits Issued. (n.d.). Retrieved February 12, 2024, from https://www.cpuc.ca.gov/regulatory-services/licensing/transportation-licensing-and-analysis-branch/autonomous-vehicle-programs/autonomous-vehicle-program-permits-issued

Autonomous Vehicle Testing Permit Holders. (n.d.). California DMV. Retrieved February 12, 2024, from https://www.dmv.ca.gov/portal/vehicle-industry-services/autonomous-vehicles/autonomous-vehicle-testing-permit-holders/

Bensinger, G., Jin, H., & Bensinger, G. (2023, November 19). Exclusive: GM's Cruise CEO offers apology, will allow share sales. *Reuters*. https://www.reuters.com/business/autos-transportation/gms-cruise-ceo-offers-apology-will-allow-share-sales-email-2023-11-19/

Callon, M. (1984). Some Elements of a Sociology of Translation: Domestication of the Scallops and the Fishermen of St Brieuc Bay. *The Sociological Review*, *32*(1_suppl), 196–233. https://doi.org/10.1111/j.1467-954X.1984.tb00113.x

Cameron, O. (2022). *Experience Autonomous Vehicle Safety At Night | Cruise*. Retrieved November 17, 2023, from https://getcruise.com/news/blog/2022/a-safe-way-to-travel-at-night/

CPUC Approves First Driverless Autonomous Vehicle Service Under Pilot Program Designed To Transform State's Transportation System. (2021). Retrieved February 12, 2024, from https://www.cpuc.ca.gov/news-and-updates/all-news/cpuc-approves-first-driverless-autonomous-vehicle-service-under-pilot-program

CPUC Issues First Driverless Autonomous Vehicle Passenger Service Deployment Permit.

(2022, June 2).
https://www.cpuc.ca.gov/news-and-updates/all-news/cpuc-issues-first-driverless-autonomous-vehicle-passenger-service-deployment-permit

Cressman, D. (2009). A Brief Overview of Actor-Network Theory: Punctualization, Heterogeneous Engineering & Translation. *ACT Lab/Centre for Policy Research on Science & Technology (CPROST)*. https://summit.sfu.ca/_flysystem/fedora/sfu_migrate/13593/0901.pdf

Domonoske, C. (2024, January 25). GM's driverless car company Cruise is under investigation by several agencies. *NPR*. https://www.npr.org/2024/01/25/1226953350/gm-driverless-cruise-investigation-federal-agencies

González, C. (2022). *Creating an Autonomous Driving Ecosystem – ASME*. Retrieved November 13, 2023, from https://www.asme.org/topics-resources/content/podcast-creating-an-autonomous-driving-ecosystem

Goodall, N. J. (2014). Machine Ethics and Automated Vehicles. In G. Meyer & S. Beiker (Eds.), *Road Vehicle Automation* (pp. 93–102). Springer International Publishing. https://doi.org/10.1007/978-3-319-05990-7_9

Gordon, R. (2020). *Explained: Levels of autonomy in self-driving cars | MIT CSAIL*. Retrieved October 30, 2023, from https://www.csail.mit.edu/news/explained-levels-autonomy-self-driving-cars

Huang, T. (2023). Psychological factors affecting potential users' intention to use autonomous vehicles. *PLoS ONE*, *17*(3), 1–22. https://doi.org/10.1371/journal.pone.0282915

Isidore, C. (2023, November 20). *Founder and CEO of GM's self-driving car unit resigns in wake of safety problems | CNN Business*. CNN. https://www.cnn.com/2023/11/20/business/gm-self-driving-ceo-resigns/index.html

Kerr, D. (2023, August 26). Armed with traffic cones, protesters are immobilizing driverless cars. *NPR*. https://www.npr.org/2023/08/26/1195695051/driverless-cars-san-francisco-waymo-cruise

McFarland, M. (2022, September 30). *GM's Cruise wants to add 5,000 more robotaxis to American streets. This city warns it could backfire | CNN Business*. CNN. https://www.cnn.com/2022/09/30/business/cruise-gm-san-francisco-self-driving/index.html

Pinto, M. (2023, November 20). *Who is Kyle Vogt? Cruise CEO steps down after suspension of license to operate in California | PINKVILLA*. https://www.pinkvilla.com/trending/world/who-is-kyle-vogt-cruise-ceo-steps-down-after-suspension-of-license-to-operate-in-california-1259783

Roeloffs, M. W. (2023). *Driverless Cars Face Setbacks In San Francisco—Here's What To Know About The City's Problematic Robotaxi Rollout*. Forbes. Retrieved November 13, 2023, from https://www.forbes.com/sites/maryroeloffs/2023/08/21/driverless-cars-face-setbacks-in-san-francisco-heres-what-to-know-about-the-citys-problematic-robotaxi-rollout/

The future of autonomous vehicles (AV) | McKinsey. (2023). Retrieved October 29, 2023, from https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/autonomous-drivings-future-convenient-and-connected