Network Analysis of the Underperformance of Peloton Technology's Platooning System

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

Carolyn Pitorak

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

Bryn E. Seabrook, Department of Engineering and Society

Analysis of the Underperformance of Peloton Technology's Platooning System

Introduction

In 2019 alone, there were 12.15 million vehicles involved in car accidents in the United States (Carlier, 2022). Transportation also accounted for 29%, the largest portion, of the total U.S. GHG emissions in 2021 (EPA, 2021). The high volume of car crashes coupled with the high level of pollution to the environment highlight how the transportation system in the United States is incredibly inefficient and desperately needs to change. While technology is rapidly changing, and car companies are switching to electric and autonomous vehicles, society has yet to deal with some of the problems that create unsafe environments on the roads and ecosystems. Companies who have sought out to achieve these goals fail to reach any solution because the problems are too big or fail because society has not accepted their solutions yet. This has been the case for platooning technology companies in the United States in recent years; while the technology has the opportunity to revolutionize the inefficiency in American transportation, society has yet to incorporate it into modern day transportation systems. Drawing on Actor Network Theory (ANT), I analyze the failure of one of these companies, Peloton Technology. Specifically, I investigate how the interactions among technical and social factors such as the design of the system itself, the perceptions from society, and legality of the system contributed to the technology's underperformance.

Research Question and Methods

Using Actor Network Theory, I address the question "How did socio technical issues technologically, legally, and economically contribute to the failure of Peloton Technology?" I analyze actors under each of these specific lenses, and discuss the aspects of each that led to

Peloton Technology's failure and how they interact with each other. Performing network analysis, peer reviewed articles were accumulated using keywords: "Peloton Technology, Truck Platooning Systems, Public Perception, Legal Implications." Each actor requires more information than what documentary analysis can provide so discourse analysis was used by referencing sources the research articles cited and using key terms in search engines. These sources include, but are not limited to, Peloton Technology's website, opinion pieces on the subject, business reports and analysis, government databases, and safety outlines. Using the sources I am able to discuss how each of these actors transformed Peloton Technology and how they contributed to the decline of the company.

Background

Platooning systems have been researched since the 1980s in order to decrease fuel emissions and increase safety on roadways, but they still have yet to gain popularity in the transportation industry (Bhoopalam, Agatz, Zuidwijk, 2018). These systems work by using advanced sensing and communication between vehicles that are following each other (Puplaka, 2016). The safety among vehicles increases due to the awareness of where each vehicle is located around them, and the fuel emissions decrease because vehicles can drive closer to one another and decrease their drag coefficient.

In the past 30 years, a lot of research has gone into different platooning systems since they can save money on fuel emissions, potentially save money on wages for drivers, and also provide a potentially safer driving system on roadways. Most of these technologies use the same basic structure, using sensors to relay information between vehicle to vehicle communication (V2V) (Shaver and Droege, 2021). The difference between the research done at companies and universities comes in the algorithms they develop that take in sensor data and control the

distance between vehicles. Some of the groups that have ongoing research on this are Peloton Technology, Daimler, Isuzu and Hino, Volvo Trucks, and Partners for Advanced Transportation Technology, PATH (Bhoopalam, Agatz, Zuidwijk, 2018). Each has their own algorithm of allowing the vehicles to platoon, and some groups have even been able to implement their system on public roads in other countries.

The two American groups above, Peloton Technology and PATH, had different approaches to the system. Peloton Technology equipped all of the vehicles with different sensing capabilities like camera, GPS, radar, and LiDAR sensors, and used this in conjunction with a 5.9 GHz Dedicated Short- Range (DSRC) device for reliable V2V. The system used the sensors and the communication between vehicles to maintain a fixed gap, and the platoon also connected to the cloud which allowed for it to operate (Syed and Abadin, 2020). PATH has been researching more efficient algorithms to use in their platooning systems and has conducted highway tests on trucks using Cooperative Adaptive Cruise Control (CACC). They have shown that using their system compared to only Adaptive Cruise Control has been proven to realize faster braking and acceleration responses in the following vehicles and shooter headways. In addition to using the sensors to derive the measurements to the vehicle in front of it, CACC also finds the vehicle before it's acceleration and uses it in a feed-forward loop. This decreases the chances of amplified braking and acceleration which could cause traffic jams in the platoon (Yang, Shladover, Lu, Spring, Nelson, Ramezani, 2018).

Peloton Technology was established in 2011, and aimed to develop a vehicle platooning system that increased safety and fuel efficiency (Peloton Technology, 2020). It was the first non-research company to test a system like this on public roads in America and to offer their system for sale to truck fleets (Syedand Abadin, 2020). Despite the positive effects that their

research found, the company did not take off as much as expected, and ceased operations in 2021 (Gehm, 2022).

STS Framework

To analyze the failure of Peloton Technology, I use the Actor Network Theory (ANT) framework. The theory allows the reader to understand the technological aspects of the case, the societal aspects, and how they influence each other. To do this it focuses on "science and technology in the making" as opposed to the already existent science and technology (Latour, 1987). ANT uses a network of actors that come together in order to accomplish a certain goal. There is a network builder who is the creator of the overall goal and recruits the actors into the network. The recruits all align their specific goals to the ones of the network, in order to help achieve the sought out goal. These actors do not need to be people, they can be technical, social, natural, economic, and conceptual (Cressman, 2009).

Actor Network Theory is commonly associated with three main writers: Michel Callon, Bruno Latour and John Law (Cressman, 2009). It has been written about and analyzed for the past 30 years, and because of its longevity there are many critiques and criticisms of it despite its usefulness. The name itself causes confusion, how can something be an actor and a network at the same time? Calhoun defends that the actor or network can be "refined and transformed" depending on the perspective one looks at it with, so the actor can be both simultaneously (1987). ANT also allows anything to be an actor as long as it fits into the network, human, non-human, and even abstract thoughts can be included into it. This creates much confusion over where the line is drawn for actors, but Latour reasons that "an actant can literally be anything provided it is granted to be the source of action," (1996). Although there is confusion in the

definition being vague, it also allows for the wide range of usability of the framework. Another critique to the framework is that it is used the same way on a micro network as it would on a macro network. The main authors of ANT recognize that the societal and technological concepts differ on the two levels, but it uses generalized language to support both levels of networks so that frameworks do not need to be changed depending on size (Cressman, 2009).

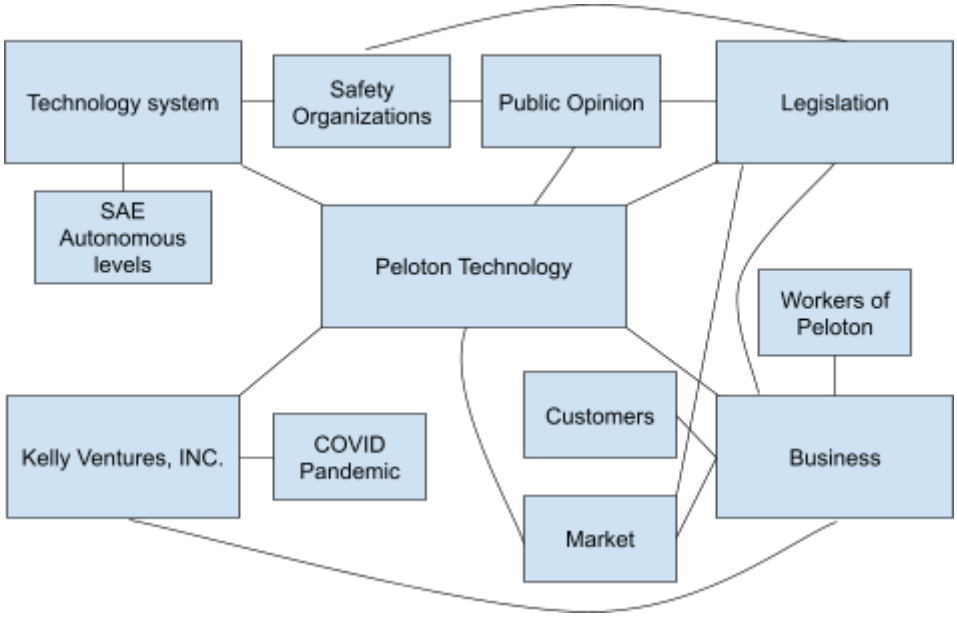

Figure 1: Actor Network of Peloton Technology's Decline (Pitorak, 2024)

In context to the failure of Peloton Technology, Peloton Technology was the network builder and there were also many economical, legal, and technological actors. In figure 1, the actors are presented, and the connections covered in this paper are represented by the lines connecting the boxes. In the context of this paper, the "goal" of the network builder was the underperformance of Peloton Technology. Obviously this was not the intended goal of the company, but it is the impact caused by actors which is being analyzed in the paper. Each actor contributed to the overall decline of the company and also interacted with each other to inevitably cause the company to go out of business. Previous research has understood the

impacts of these actors alone on Peloton technology, but there is a gap of research that has not analyzed them together along with their interactions using ANT.

Based on Actor Network Theory, I am able to identify the actors that contributed to the failure of Peloton Technology and how they interact with each other. This analytical perspective can help the future of platooning system companies and enhance the transportation inefficiency facing the United States currently.

Results and Discussion

Overall, it was found that Peloton Technology ceased operations because of a legal dispute with Kelly Ventures, INC., but the company was already on the decline before the legal troubles. The technological actor, the technology of the company itself, was not at the production level it needed to be for the company to be successful in the long term. The economical actors, the workers of Peloton Technology, the market for platooning technologies, their customers, the economics of the business, and the court case, all contributed to the final stage of failure of Peloton Technology when they could no longer function as a business model. The legal actors, legislation itself, public perception, and safety, also affected Peloton Technology and any other company in the near future by limiting the profitability of a company specifically focused on platooning systems.

Economical

Peloton Technology ceased operations in 2021, pending a legal battle with actor Kelly Venture, INC. (Gehm, 2022). The legal battle was prompted by the 2020 COVID pandemic, but Peloton Technology's failure can not solely be attributed to the interaction among actors during

the pandemic and legal struggle. The company was already declining in funds at the beginning of 2020, and the pandemic only intensified the decline of the company (*Peloton Technology vs. Kelly Ventures INC.*, 2020). In this section of the paper, I discuss the economic actors of the failure of Peloton Technology and how they transformed each other and the company.

A Spherical Insights & Consulting report published that "The Global Truck Platooning Market Size is anticipated to exceed USD 2887.80 Million by 2033, growing at a CAGR of 43.28% from 2023 to 2033" (*Global truck platooning market size, share, forecast to 2033,* 2024). The market shows great potential for platooning systems and the report even found that the "North America Market is expected to grow fastest during the forecast period" (*Global truck platooning market size, share, forecast to 2033,* 2024). The company was also receiving ample funding from industry leaders, as one of their blog posts highlights that they received "$60M to fuel commercial truck industry collaboration on the road to automation." (Chhabra, 2017). The economics of the company had great potential in the market and in investments, but failed just a couple years after they received the funding. While this demonstrates there is an increasing market for platooning systems, it also shows that there must have been other actors within Peloton Technology that caused the decline.

Peloton Technology functioned as a business by charging a per-mile fee when trucks using their system were in platoon in addition to the one time payment for the installation of the hardware required for the system (Puplaka, 2016). Although the costs of these services and installations were not available to the public, European commercial platooning companies are 10,000 pounds (around $12,500) per truck. (Slowik & Sharpe, 2018). The customers would also have to endure other costs related to the new technology such as training drivers and additional service and annual costs (Puplaka, 2016). With the novelty of the technology, the pricing and

additional costs associated with Peloton Technology's system may not have been justifiable to potential customers. The International Council on Clean Transportation found that "fuel savings from truck platooning is significant, estimated at $3,000 to $11,000 per truck annually." (Slowik & Sharpe, 2018). While the potential savings using platooning systems seem promising, the lack of confidence in a pricing for the new technology may have deterred companies from purchasing Peloton Technology's system.

One major actor of Peloton Technology is the workers of the company. The company was led by a executive team: Steve Boyd - founder and CEO, Dave Lyons- founder and advisor, Mark Luckevich- vice president of production programs, Becky Wu- vice president of finance and corporate controller, Amanda Anderson- external affairs manager, Richard Pallo- product design & user experience lead (*Who we are - peloton technology: Truck Platooning & Automation*, 2020) This group of leaders have an admirable resume, bringing very impressive degrees and industry knowledge to the company. Right before the legal debacle there were around 36 total workers at the company, 80% of the team working on research of the platooning system and the other 20% working on the scheduling and performance of their systems (*Peloton Technology vs. Kelly Ventures INC.*, 2020). The company had to start furloughing employees at the beginning of 2020 because of the financial situation of the company, and this only increased as the pandemic hit and the legal dispute started (*Peloton Technology vs. Kelly Ventures INC.*, 2020). The conditions the employees of the Peloton Technology were put under were similar to many other startups in the Tech center, but this led to job insecurity and may have created a suboptimal work culture. The workers of Peloton technology inevitably affect the future of the company, and so with a suboptimal work environment the workers may have not been able to produce their best work and led to the decline of the company.

Peloton Technology filed a civil case of business tort/ unfair business practice against Kelly Venture INC., et al. on 5/28/2020. They claimed that they "experienced substantially suppressed revenue and business development activities," and so it "could not afford to pay the full deferred rent for the La Avenida offices until the Covid-19 crises eased and funding sources were recovered" (*Peloton Technology vs. Kelly Ventures INC.*, 2020). While they cited the Santa Clara County Urgency Ordinance NS-9.287 saying they could not be evicted by Kelly Ventures, Inc. at the time, the ordinance did not actually apply to Peloton Technology because they terminated the lease and not Kelly Ventures, Inc. Since the evidence supported that Kelly Ventures Inc. did not practice unfair business, they then totaled the amount of money lost because of rent, damages to the space, legal payments, among other things and declared that Peloton Technology owed them that amount. Peloton Technology complied with the settlement and paid $362,217.51 to Kelly Ventures Inc. (*Peloton Technology vs. Kelly Ventures INC.*, 2020)

On top of the lack of funds and customers that the pandemic had caused them, the legal case against Kelly Ventures Inc. concluded Peloton Technology's business. They cited in the legal documents several emails and statements that proved the company was already close to bankruptcy before March of 2020 when pandemic shut downs first occurred (*Peloton Technology vs. Kelly Ventures INC.*, 2020). The legal funds and settlement costs associated with the case, sufficiently cleared out any of the money that could have been used to revamp the company. This was the tipping point for the company, the point of no return, and in early 2021 they ceased operations.

While Kelly Venture Inc. acted as the main actor that gave the final push Peloton Technology to their decline as a business, the other actors also contributed to the legal debacle. The potential customers of the company were not convinced enough from the performance of

their system, and thus decreased the potential revenue for the company. A lack of revenue caused the company to be unable to pay the rent for their offices and start the legal case. The workers of Peloton Technology as an actor also interacted with both of the other actors by shaping how the company ran. With a different team culture or different management, the company could have responded to the customers and the legal case in a more successful way. Overall, all of these actors and their interactions with one another effectively led to the failure of Peloton Technology.

Technological

While the legal battles between Peloton Technology and Kelly Venture, INC. inevitably caused Peloton Technology to cease operations, the company was not financially sound before the pandemic and legal dispute. The technology of Peloton Technology was very new and had many promising goals of increasing fuel efficiency. However, the technology may not have been what the truck companies were looking to buy. In this section, I discuss the impact the technology of Peloton Technology had on the decline of the company.

The technology of Peloton Technology was innovative and new to the commercial world. Rod Mclane, the vice president of marketing at Peloton Technology, described the technology, "The following truck is being governed by the Peloton Technology's system, managing the speed and most importantly, the breaking of the second truck."(Kingston, 2019). Mclan also described the success of testing with their systems, saying "It's been on the roads for the whole second half of 2018. These pilot programs are effectively hauling freight using the technology with these customers."(Kingston, 2019). In another interview Peloton said "Several U.S.-based Fortune 500 trucking fleets have already agreed to install the platooning system on a trial basis within the next year." (*Peloton lands $60m in funding for Automated Vehicle Tech*, 2019). Despite being so

new, the company was able to successfully implement their technology with various truck companies.

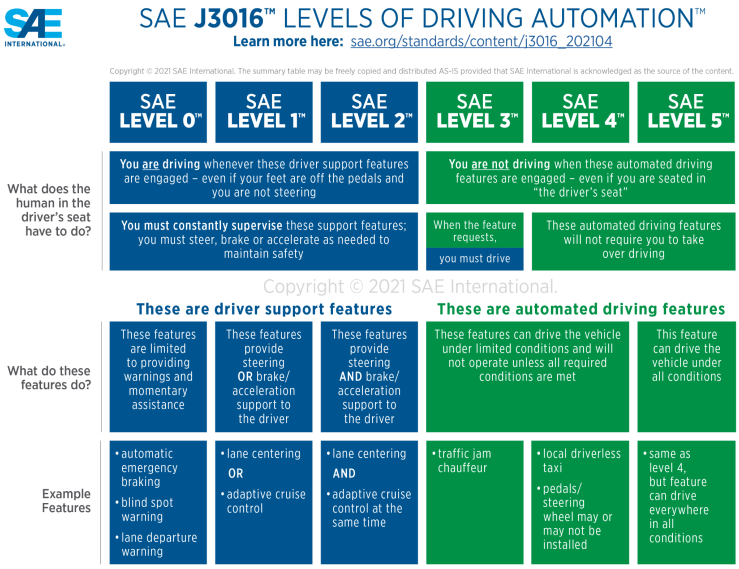

Figure 2: SAE Levels of Driving Automation (SAE International, 2024)

SAE defined different levels of automation as seen in Figure 2. Using these definitions, Peloton Technology's system would be in SAE Level 1 since there is still a driver, but there are features that provide braking support to the driver. The company has claimed that they have developed "a Level 4 automated platooning system, but keeps the driver in charge." (Kucinski, 2019). But keeping the driver in control maintains a level of autonomy of less than 2. The systems that Peloton Technology was selling to their customers were level 1, and so the driver had to be ready to take over the system at any time. While the systems created did show potential in fuel savings because of the decrease in aerodynamic drag, the savings did not fully justify the new technology. A research article states, "For trucking, automation levels 1, 2, and 3, a human operator is still required to be present in the vehicle, and so the potential savings will be greatly reduced, providing less savings to cover the costs required to implement the technology." (Jaller, Otero-Palencia, & D'Agostino, 2022). With the new technology rapidly changing and getting

better year by year, many truck companies are waiting for a level 4 or 5 automation level instead of investing in new technology right now. The failure to reach driverless autonomy level 4 or 5 decreased the amount of customers Peloton Technology was able to reach, and thus led to the decline of the company.

Concerns over the safety and lack of information on the technology Peloton technology used also contributed to the decline of the company. A research paper found, "Research investigating the potential adoption of platooning technology found that fleets want proof that the technology works and the ability to pilot and test the technology before investing" (Slowik & Sharpe, 2018). Peloton technology also worked closely with Auburn University in researching and testing its technology. One report published by Auburn reads, "In the near term, platooning technology is more likely to be adopted within fleets, rather than across fleets, until trust, assurance, and interoperability is established among fleet operators" (Auburn University, 2017). The National Academies of Sciences, Engineering, and Medicine supports this research expressing that there is a "need for additional testing to validate the safety potential both of the system itself and more holistically across all highway transportation under all road conditions and environments" (National Academies of Sciences, Engineering, and Medicine, 2017). The numerous reports all point in the same direction, that platooning systems like Peloton Technology need more research on the safety implications before they are introduced widely onto the roads of America. The lack of research was a large factor in the decision for truck companies to use Peloton technology's system. The newness and concerns over safety inevitably decreased the amount of potential customers for Peloton Technology and led to its decline.

Overall, the connected actors that make up Peloton Technology's system were not sufficient enough to make the company successful. The technology itself was very new and was

successfully implemented on many customers that Pelton did have. However, despite being new and unique technology, it did not fulfill the needs of some truck companies who were looking for fully autonomous options. The SAE levels of automation as an actor really transformed the successfulness of the actor of the technology itself, by diminishing the level of autonomy the system had. Safety organizations as an actor also contributed to the lack of support for the technology because of the wariness around the new technology. When it comes to any technology that fits under the SAE levels of automation, there is a high level of testing and safety considerations to take into account. The safety actor really limited the amount of customers Pelton Technology could have had, and thus led to its decline.

Legal

The legislation of platooning systems also did not help Peloton Technology's case. The legislation shapes what type of technology can be used, and the legislation itself is shaped by the public's perception of platooning and safety associations.

With the use of autonomous vehicles on the rise, society has gone back and forth over the pros and cons of wide spread implementations of them. The people hesitant to implement this technology cite high levels of concerns about interacting with the vehicles themselves, and said they did not think they could have the safety or security levels similar to a human driver (Schoettle & Sivak, 2014). While Peloton Technology's system is not autonomous at the moment, it and other platooning systems get lumped into the discussion of fully autonomous vehicles because it has the potential to become fully autonomous. While concerned with the safety and security of the vehicles themself, the majority of respondents to University of Michigan's research had a "positive initial opinion" of autonomous vehicles and had high

expectations about the benefits of them (Schoettle & Sivak, 2014). Overall, the public consensus over most self-driving technology is that it will be very helpful in the future, but there has to be a vast amount of research that goes into safety and security. The ramifications of this opinion can really harm Pelton Technology and other autonomous vehicle companies; it will be hard to implement your technology in a society that does not fully trust your system. It is for this reason that society's perception may have harmed the perception of Peloton Technology's system's safety, and thus led to its downfall.

Public opinion has a lot of sway in what goes into legislation. In the case of autonomous vehicles, it has really emphasized the safety and security aspects of the technology, while also limiting where those companies can successfully have business. In an interview with the VP of marketing for Peloton, McLane says, "there are a little less than 20 states that have changed their laws to allow platooning, so that two vehicles traveling that closely would be legally permissible. Under the old laws, the back vehicle could be cited for following too closely." (Kingston, 2019). McLane highlights a major challenge platooning systems face- certain states have laws that prohibit the technology from being used in a way that would allow for fuel efficiency. As of May 2020, when Peloton Technology was going through their legal debacle, Level 1 platooning was approved in 27 states. However, "the approved states encompassed over 80% of annual U.S. freight traffic." (Bishop, 2020). While limited to just over half of the states in America, the allowed states still give Peloton Technology enough business to work with. It does however limit its reach and potential of the company.

To summarize, public opinion, as an actor, majorly affects how a lot of society makes decisions on autonomous vehicles. Because the majority of research shows that people are wary and not completely certain about safety in autonomous vehicles, it causes there to be more

legislation and safety protocols surrounding it. Viewing the legislation on autonomous vehicles as an actor, it is apparent that legislators listen to public opinion and are hesitant to pass much surrounding the issue. The lack of legislation on the matter directly impacts the potential market and customers for Peloton Technology, and led to its decline.

Limitations

The research done is limited due to the framework used to analyze information; many actors exist in relation to the research question but were not mentioned due to limited space and relevance. In the future, other researchers could find other actors that contributed to the decline of Peloton such as political actors that may have affected the legislation. The research is also limited to one company's experience, specifically an experience when a pandemic hit during the beginning stages of their company. While Peloton Technology can highlight a story of how one truck platooning system was unsuccessful, it does not speak for all of the companies. Since their decline, it would be interesting to research what companies have filled the gap of Peloton Technology. A macro study across multiple companies with platooning systems would confirm the actors that lead to the decline of these companies.

Conclusion

In summary, the decline of Peloton Technology was not attributed to a single cause, but rather stemmed from a combination of the actors and their interactions. The legal battle with Kelly Venture, Inc. ultimately took Peloton Technology out of business, but they were already on the decline beforehand. The level of autonomy of their technologies, the economics of their business strategies, and public perception of AVs were all contributing actors towards the decline

before the pandemic and legal debacle began. Platooning technology can help reduce major inefficiencies in the United States's transportation structure, but the technology has stayed in research labs for the past 20 years. Commercial companies could break the system and allow platooning technologies to be introduced to the public on a large scale. By understanding how one of these companies failed, it allows future businesses to adapt and not face the same fate. It also creates a transportation structure in the United States that can be environmentally friendly and economically better.

Works Cited

Auburn University. (2017). Heavy truck cooperative adaptive cruise control: Evaluation, testing, and stakeholder engagement for near term deployment: Phase two final report.

Bhoopalam, A. K., Agatz, N., & Zuidwijk, R. (2018). Planning of truck platoons: A literature review and directions for future research. Transportation Research Part B: Methodological, 107, 212-228.

Bishop, R. (2020, May 2). *U.S. states are allowing automated follower truck platooning while the Swedes may lead in Europe*. Forbes. https://www.forbes.com/sites/richardbishop1/2020/05/02/us-states-are-allowing-automated-follower-truck-platooning-while-the-swedes-may-lead-in-europe/?sh=7b088e9dd7e8

Callon, Michel. (1987). "Society in the Making: The Study of Technology as a Tool For Sociological Analysis." In Bijker, W., Hughes, T., & Pinch, T. (eds.) The Social Construction of Technological Systems. Cambridge: MIT Press.

Carlier, M. (2022, January 25). *Road accidents in the United States*. Statista. https://www.statista.com/topics/3708/road-accidents-in-the-us/#topic

Chhabra, N. (2017, April 12). *Peloton technology secures $60m to fuel commercial truck industry collaboration on the road to automation*. Peloton Technology. https://peloton-tech.com/seriesb/

Cressman, D. (2009). A Brief Overview of Actor-Network Theory: Punctualization, Heterogeneous Engineering AND Translation, ATC Lab/Centre for Policy Research on

Science & Technology (CPROST), School of Communication, Simon Fraser University. *Vancouver*

EPA. (2021, August 27). *Fast Facts on Transportation Greenhouse Gas Emissions*. US EPA. https://www.epa.gov/greenvehicles/fast-facts-transportation-greenhouse-gas-emissions

Gehm, R. (2022, August 4). *Platooning still promising for Trucking*. SAE International. https://www.sae.org/news/2022/08/platooning-still-promising-for-trucking

Global truck platooning market size, share, forecast to 2033. Spherical Insights. (2024, February). https://www.sphericalinsights.com/reports/truck-platooning-market

Jaller, M., Otero-Palencia, C., & D'Agostino, M. (2022). Jobs and automated freight transportation: How automation affects the freight industry and what to do about it.

Kingston, J. (2019, March 26). *Freighttech25: Keeping it close at Peloton Technologies with "advanced cruise control."* FreightWaves. https://www.freightwaves.com/news/technology/peloton-technologies-freighttech-25

Kucinski, W. (2019, July 18). *Peloton develops A level 4 automated platooning system, but keeps the driver in charge*. SAE International. https://www.sae.org/news/2019/07/peloton-develops-a-level-4-automated-platooning-system-but-keeps-the-driver-in-charge

Latour, Bruno. (1987). Science in Action: How to Follow Scientists and Engineers Through Society. Cambridge: Harvard University Press.

Latour, B. (1996). “On Actor-Network Theory: A Few Clarifications” Soziale Welt pp.369-381.

National Academies of Sciences, Division on Engineering, Physical Sciences, Computer Science, Telecommunications Board, Committee on Information Technology, & the US Workforce. (2017). Information technology and the US Workforce: Where are we and where do we go from here?. National Academies Press.

Peloton lands $60m in funding for Automated Vehicle Tech. FreightWaves. (2019, March 2). https://www.freightwaves.com/news/peloton-lands-60m-in-funding-for-automated-vehicle-tech

Peloton Technology vs. Kelly Ventures Inc., Santa Clara County Public Records (2020)

Puplaka, Y. (2016). *Implementation of platooning concept from business perspective.* Lund University.

Schoettle, B., & Sivak, M. (2014). A survey of public opinion about autonomous and self-driving vehicles in the US, the UK, and Australia. University of Michigan, Ann Arbor, Transportation Research Institute.

Shaver, G., & Droege, M. (2021). Develop and Deploy a Safe Truck Platoon Testing Protocol for the Purdue ARPA-E Project in Indiana. Indiana Department of Transportation and Purdue University.

Slowik, P., & Sharpe, B. (2018, March). Automation in the Long Haul: Challenges and Opportunities of Autonomous Heavy Duty Trucking in the United States. Washington, DC, USA: ICCT.

Syed, M. H., & Abadin, Z. U. (2020, July). A pattern for autonomous vehicle platoon. *In Proceedings of the European Conference on Pattern Languages of Programs 2020*

(EuroPLoP '20). Association for Computing Machinery, New York, NY, USA, Article 26, 1–7. https://doi.org/10.1145/3424771.3424813

Who we are - peloton technology: Truck Platooning & Automation. Peloton Technology. (2020, November 9). https://peloton-tech.com/who-we-are/

Yang, S., Shladover, S. E., Lu, X. Y., Spring, J., Nelson, D., & Ramezani, H. (2018). *A first investigation of truck drivers' on-the-road experience using cooperative adaptive cruise control.* California PATH Program, Institute of Transportation Studies, University of California, Berkeley.