Safe and Sustainable Fleet Management with Data Analytics and Reinforcement Training
(Technical Paper)

The Social Construction of Electric Vehicles in Work Fleets
(STS Paper)

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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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Introduction

The University of Virginia's Facilities Management (FM) fleet consists of over 260 vehicles, and is one of just six universities in the country to be designated a "fully sustainable fleet" by the National Association of Fleet Administrators ("Sustainable Fleets," 2021). Each vehicle within the University (UVA) fleet has a data collection software installed that measures a wide array of statistics on the driving habits of that vehicle. This technical project aims to use said data in order to create relevant training resources for various shops within the fleet, tailored to their specific functionalities and needs. By analyzing the frequency and methodology of the training throughout the course of the project's lifespan, an appropriate actionable training plan can be permanently implemented into FM, ensuring the continued sustainability and safety of the fleet.

In addition to training drivers to be more environmentally conscious, FM recently introduced ten hybrid and electric vehicles (EVs) into the fleet to replace older gasoline-powered vehicles (Centofante, 2021). UVA is not alone in this concept, however, as other organizations around the world have begun to implement electric vehicles into their work fleets. Despite being outperformed by traditional vehicles in aspects such as mileage, infrastructure, and general reliability (Lemme et al., 2019), corporate and government fleets alike continue to increase their electric vehicle roster. This STS research paper aims to analyze if the rise in popularity of electric vehicles within work fleets can be attributed to social construction, and uses the SCOT (social construction of technology) framework to accomplish this, which theorizes that the creation of different technologies relies solely on the needs and wants of society. The paper will specifically focus on fleets, both corporate and governmental, keeping in line with the central subject of the technical project.

Technical Topic: Safe and Sustainable Fleet Management

The University of Virginia's Facilities Management (FM) team is responsible "for the planning, construction, renovation, maintenance and repair of the University's buildings and facilities; and the provision of utilities, grounds care, custodial, trash collection, recycling and other services" ("By the Numbers," 2021). The FM fleet consists of 265 vehicles in total, ranging from vans to pick-ups to dump trucks. Each vehicle within the fleet currently has a Geotab telematic sensor installed, which collects data on their driving history. The statistics provided from Geotab are extremely advanced, displaying updated information on mileage, idling time, engine life, and much more. Last year, a team of UVA engineers used these statistics to analyze driving behaviors throughout the fleet and provided training based on the results in order to improve safety and sustainability, two of FM's core initiatives. They determined that the "mindful driving" training conducted was statistically significant in five metrics (idling time, seat belt usage, speeding, hard acceleration, and hard breaking) when compared to the control group that did not receive training (Gresham et al., 2021). All of these categories except "idling" influence safety, while all but "seat belt usage" affect sustainability.

The goal of this proposed project is to build off of last year's capstone project, ensuring the most relevant and effective training program is conducted within the FM fleet. The previous project conducted two weeks of virtual training, and analyzed the results of the metrics before and after this time period, comparing to a control group that did not receive training. The current research team initially wanted to focus on personalized driver feedback to improve upon this concept, but FM would not allow their employees to be individually and anonymously tracked. Due to this concern, the group shifted its plan towards focusing on various shops throughout the

fleet, which each consist of different types of vehicles and typically have the same group of employees driving them.

The research team will compare shops that are similar in nature (same vehicles, same tasks, etc.) in order to determine which training methods are most effective. The length of training effects will be looked at, analyzing how long drivers maintain safe and sustainable driving habits following their training. Similarly, reinforcement training will be tested, in order to see the effects of multiple trainings on driving habits over a longer period of time. Methodologies and incentives will also be a point of study, in order to see which types of trainings are most effective (only giving drivers feedback scorecards, compared to adding an in-person conversation with these, compared to these items plus a positive incentive).

The metrics of performance will be the same five metrics analyzed in last year's project, and these will be recorded throughout the training processes to identify any changes in behavior. Driving speed and idling have proven to be the most important categories when it comes to sustainability (Huang et al., 2018), while seatbelt usage and hard braking are the two biggest safety factors. The statistics of these metrics will be recorded when comparing the different lengths of training effects and levels of reinforcement in order to determine which methods are the most effective overall. Ultimately, the final deliverable will be a more developed and relevant training plan for FM to use through the future to continue to ensure safe and sustainable driving habits among their employees, as well as a technical report describing the project and results.

STS Topic: The Social Construction of Electric Vehicles in Modern Work Fleets

While electric cars currently only make up 3% of worldwide car sales, they are predicted to overtake traditional gas-powered vehicles and make up 58% of all vehicle sales by the year 2040 (Kopestinsky, 2021). This increase in interest is not just among the general public, but among corporations and government organizations as well. New York City announced an ambitious plan to invest in electric vehicle (EV) replacements throughout their fleet, in addition to the infrastructure that goes along with this ("Climate Week," 2021). The interest is not limited to America either; the U.K.'s largest delivery service, Hermes, has ordered hundreds of EVs to add to their delivery fleet this year (Baker, 2021). There are many different reasons for why these groups are interested in increasing the amount of EVs within their work fleets, whether it be for environmental, safety, or noise reasons. However, electric vehicles do not yet compare to traditional cars in terms of mileage, infrastructure, and general reliability (Lemme et al., 2019).

Despite being outperformed in all of these practical fields, EVs are quickly growing among organizations' fleets, in both the private and public sectors. Electrical vehicles typically offer less range than internal combustion engine vehicles (ICEV), but Amazon has ordered 100,000 electric delivery vans from EV producer Rivian to replace a large amount of their fleet (Domonoske, 2021). The infrastructure is also much less developed, with far fewer charging stations available when compared to traditional gas stations, yet New York City is putting $75 million towards creating this infrastructure to support a new network of electric transportation ("Climate Week," 2021). These investments pose the questions of why this increased interest in electric vehicles is happening in these sectors, and if the desire for an electric fleet has been socially constructed.

The social construction of technology, or SCOT, is the theory that humans and society shape technology, rather than the other way around. This framework consists of various components, one of which is relevant social groups. In this case, the relevant groups include vehicle fleets (both commercial and public), as well as EV manufacturers and the general public. Another important component of SCOT is the "wider sociocultural and political milieu in which artifact development takes place" (Klein & Kleinman, 2002). The implementation of electric vehicles in fleets around the world is an example of the wider context of the technology. By looking at these components and discussing how the growth of EVs among fleets stems from a societal interest—primarily the desire to be environmentally conscious—it can be argued that the electric work vehicle is a social construction.

As electric vehicles do not emit greenhouse gases, they are more resource-efficient than ICEVs. They are a crucial step in making transportation more eco-friendly, so analyzing the root of their demand is extremely important in looking at the future of their relevance. If it is found that the desire comes solely from public sentiment for the environment, can they remain relevant in the future? Do companies genuinely care about "going green," or do they show interest in EVs in order to maintain a positive image? Exploring these questions and concepts will ultimately prove beneficial when discussing the future of vehicle-manufacturing.

Research Question & Methodology

Research Question: How can the increased interest in electric vehicles among work fleets, both corporate (as seen in delivery service fleets such as Amazon) and governmental (demonstrated by New York City), be attributed to socially constructed desires?

To answer this question, the "social construction of technology" (SCOT) framework will be used. In addition to Klein and Kleinman's original paper introducing the theory, multiple

journal articles giving examples of SCOT within other aspects of technology, including one about delivery vehicles (El Madja, 2021), and one about the social construction of automobiles (Kline, 1996), will be used as supportive evidence. As electric vehicles have only been a phenomenon in the past decade or so, many articles regarding the technology being used are more recent. To provide scope of their wide-ranging popularity, articles and journal entries range from focusing on EVs within America as well as internationally (such as the Association of Southeast Asian Nations' interest in expanded EV infrastructure), also looking at both commercial and public fleets (Li, 2019). More technical articles explaining the pros and cons of electric vehicles compared to traditional internal combustion engines will be used to support the argument that the desire for EVs within fleets is socially constructed, as many of these readings cite traditional vehicles being superior in many aspects that fleets typically desire (financially, range, power) (Lemme et al., 2019). These sources have been and will be found primarily through UVA's online library database, as well as Google Scholar. By demonstrating the worldwide interest in this technology as well as discussing the drawbacks of electric vehicles, the main research question will be thoroughly examined and answered.

Conclusion

The technical project aims to ultimately improve the safety and sustainability of UVA's Facilities Management Fleet by creating relevant training plans for the various shops and vehicle groups within the organization. By analyzing the data collected from the vehicles, and experimenting with the frequency and types of training administered across the different test groups, it is anticipated that specific training methods will be permanently implemented into the fleet. A technical report will also be written, explaining the project's methodologies and final results.

The STS research paper aims to analyze if the desire for electric vehicles within work fleets is socially constructed, meaning that society has shaped the reason for their existence and persistence. It is anticipated that a general conclusion to this research question will be found, which can be used to discuss how to maintain EV relevance in fleets throughout the future. Electric vehicles and environmentally conscious driving habits are both important in the goal of making fleets more sustainable, and both proposed projects aim to accomplish this goal.

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