VEHICLE FLEET MANAGEMENT SAFETY METHODS

AN ANALYSIS OF THE NECESSARY FACTORS REQUIRED FOR MAXIMIZING ROAD SAFETY

A Thesis Prospectus
In STS 4500
Presented to
The Faculty of the
School of Engineering and Applied Science
University of Virginia
In Partial Fulfillment of the Requirements for the Degree
Bachelor of Science in Systems Engineering

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October 27, 2023

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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

Road traffic accidents are the leading cause of death by injury and the tenth-leading cause of all deaths globally (Worley, 2006). The volume of fatalities caused by motor vehicle accidents has been consistently increasing year after year despite the rapid advancements in injury prevention and crash mitigation technology (Worley, 2006). Existing safety measures and technologies aim to reduce the likelihood of serious injury during an accident. Although these measures are effective at reducing the likelihood of injury or death during an accident, the most beneficial approach to reducing fatalities associated with motor vehicle accidents is one that is proactive (World Health Organization, 2022). Proactive approaches such as hotspot identification, accident countermeasures, and vehicle fleet monitoring have consistently resulted in a greater reduction in deaths and injuries caused by motor vehicle accidents (Fisa et al., 2022). Increasing the resources available for these approaches will ultimately lead to safer roads.

I suggest the development of a vehicle fleet management system that identifies hot spots associated with accident surrogate measures. This system will also provide information on potential countermeasures that can be implemented at each hotspot. Since this technical project requires the development of a diverse network, constructed of technical, social, conceptual, and other factors, the understanding of successful network creation and implementation is paramount to this project. To examine the mechanisms behind successful network development, I will use the STS framework of actor-network theory to analyze the insufficiencies of the University of Virginia facilities fleet management system. This system monitors facility vehicles and identifies safety measure failures. I will analyze how the interactions among technical and social factors have led to failures throughout the system. For example, interactions between the drivers, the design of the system, and the efforts to reduce location-specific accidents have led to a high level of safety violations.

Not accounting for factors that exist beyond the technical aspects of a system, particularly those that involve a combination of social and technical aspects of a system's network, yields the risk of a system that is incapable of achieving its intended purpose (Callon, 1984). If this were to occur in the development of an accident prevention system, the risk of injuries and fatalities caused by vehicular collisions would increase. Therefore, due to the combination of the technology of vehicles and the communication needed to operate them simultaneously, it is imperative that both the social and technical dimensions of the system be accounted for. In the next section, I describe two research proposals: a technical vehicle safety fleet monitoring system and an STS project that examines the failures of the social and technical interconnections that led to the implementation of an insufficient safety system among UVA facilities' vehicle fleet. As I develop a safety system that accounts for the failures of the existing system employed by UVA facilities, I will draw upon the neglected socio-technical aspects of the implemented systems' network to form a novel network that accounts for those factors. By addressing these factors, the goal of reducing accidents and therefore injuries and fatalities associated with them becomes feasible.

Technical Proposal

The University of Virginia facilities management organization maintains a fleet management system that monitors over 300 vehicles within their organization. This fleet management system tracks driver and vehicle-specific information that includes whether the vehicle was speeding if the driver was wearing a seatbelt, and if the vehicle experienced harsh braking, harsh acceleration, and harsh cornering (Duffy, 2023). The safety system uses a fleet management software called Geotab which tracks the location of each vehicle and the violations of various safety metrics that a driver may have committed. The software relies on devices that are installed in each vehicle that track location, speed, acceleration, and other key safety metrics. The software provides UVA facilities with critical safety information that shapes their future safety strategies. However, the data that is obtained from the safety system lacks precision. The software does not track the exact location of each safety measure violation and instead provides a nearby address. Additionally, the devices in each vehicle are not consistently accurate in determining if a safety violation has occurred. This has resulted in multiple false positives. With inaccurate device thresholds for surrogate safety measures, imprecise locations of safety violations, and the general lack of data regarding safety incidents, the development of an effective safety strategy becomes compromised.

The development of a concrete safety system that uses precise thresholds for surrogate safety measures as well as accurate locations of each safety violation, will ensure a better understanding of the causes of safety infractions. These causes may be dependent on outside factors such as road conditions or road design. Other factors such as traffic volume and speed limits may also contribute to safety violations. Therefore, having an understanding of the exact safety violation location, and the concerns surrounding it, will allow for a better safety strategy. If these factors are not considered, the risk of death or injury caused by unaddressed safety violations expands. This goes against UVA's goal of increasing fleet safety.

The objective of this technical project is to find the best methods that can be implemented into a vehicle fleet safety management system that allows for the greatest potential for safety violation reduction. To accomplish this, a team of researchers at the University of Virginia and Virginia State University will work together to establish thresholds for safety measures, perform an analysis of existing data to examine the causes of safety violations, and implement a comprehensive location tracking system. Using the findings from this research, the team will develop a consequential safety strategy that will reduce the number of safety violations.

The team will utilize prior research and perform comprehensive data analysis. The team will also develop a geographical map of all safety violations that go beyond locating an address for the safety violations. This information will be used to determine the best safety strategy for each location and will advance an effective and proactive safety approach.

STS Proposal

As the population of the world continues to grow and the modernization of transportation increases around the world, the number of cars on the road also increases. With more cars on the road, the number of motor vehicle accidents has also been steadily increasing (Christy Bieber, 2023). Many safety organizations aim to prevent injury from accidents through the development of technology specific to the design of vehicles and safety systems within them. However, other safety organizations, such as the Federal Motor Carrier Safety Administration seek to employ a more proactive approach that utilizes vehicle fleet tracking, accident location tracking, and location-specific analysis (FMCSA, 2023). The University of Virginia currently uses a fleet management system to track its vehicles and promote safer driving practices. However, the existing system fails to take into account the various quantitative and qualitative methods that are needed to ensure that the system performs as intended. The system fails to take into account driver experience, minimum safety thresholds, the effectiveness of safety procedures, and the locations of potential accidents or “hot spots”. This has resulted in several safety violations. Considering how human factors such as driver experience, speed limits, and the driver’s perception of the road all contribute to the possibility of a safety violation, these factors should not go unobserved (Christy Bieber, 2023).

It is important to answer the question of how the current system fails and what factors the system does not account for. Prior research has shown that the use of safety surrogate measures is an effective method of tracking vehicle and driver safety (Lu et al., 2021). However, this research fails to account for other factors that influence safety. These factors include other motorists, cyclists, and pedestrians. Because these approaches fail to account for contributing factors, they fail to provide the most adequate safety strategy.

My analysis of this case provides a greater understanding of the social factors that affect the safety of UVA facility drivers. The development of complex roads throughout Universities, where large bodies of students often cross, leads to incidents in which safety violations occur (Lindenwood University, 2016). To answer the original question of how the current system fails and what factors are not accounted for, I will draw upon the science, technology, and society (STS) concept of actor-‑network theory, which analyzes the power dynamics among human and non-‑human actors associated together in a network designed to accomplish a particular goal (Cressman, 2009). Additionally, I will analyze the network builders, which are actors that actively contribute to network construction, to further develop an understanding of this case. Specifically, I will use Michel Callon's concept of translation, which describes the process of network formation, to examine the roles that key human and non-‑human actors played in the failure of the UVA facilities fleet management network to form successfully (Callon, 1984). Michel Callon's concept of translation relates nonhuman factors within a network as being able to enroll others in the exact way humans do. Within the confines of this case, there exists a multitude of nonhuman factors that are not accounted for by UVA facilities.

These factors include the density of bus routes, ongoing construction, and the design of a particular road, such as the intersection of Jefferson Park Avenue and West Main Street. This intersection has a high volume of both vehicular and foot traffic which has led to the detection of five safety violations within thirty days (Duffy, 2023).

In terms of human actors, many drivers are not trained with the most recent safety protocols. These drivers tend to have a greater number of safety violations (Christy Bieber, 2023). Other human actors, such as University students, are known to jaywalk (Zheng, 2014). Therefore, UVA facilities management must maintain an understanding of the human and nonhuman factors that affect their driver network. The problem cannot be constrained to just the driver. To support this assertion, I will analyze evidence from accident statistics such as those provided by the Forbes crash statistics article authored by Christy Bieber, as well as prior safety studies and articles.

Conclusion

The pressing issue of increasing road traffic accidents and related fatalities necessitates a proactive approach to address this critical socio-technical challenge. While existing safety technologies focus on mitigating injury during accidents, it is evident that an effective solution must encompass a broader perspective. This proposal suggests the development of a vehicle fleet management system, emphasizing hotspot identification, accident countermeasures, and rigorous safety data analysis. By bridging technical and social factors, the aim is to create a dynamic network that can address the root causes of safety violations.

Simultaneously, the STS project offers a critical lens to understand the inadequacies of the current safety system at UVA facilities. Drawing from actor-network theory, it highlights the interconnectedness of human and non-human factors influencing safety. Factors such as road design, driver training, and pedestrian behavior significantly impact safety outcomes, but often remain unaccounted for in existing safety strategies.

Ultimately, the integration of these findings aims to contribute to a holistic and efficient approach to accident prevention, reducing injuries and fatalities caused by motor vehicle accidents. Embracing the complexity of sociotechnical systems, this proposal seeks to create safer roads, drivers, and pedestrians by addressing the multifaceted nature of the challenge at hand.

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