

**Optimization of VDOT Safety Service Patrols to Improve VDOT Response to Incidents**  
(Technical Report)

**Development of Autonomous Vehicle Technology: The Relationship Between Innovation and Legislation**  
(STS Research Paper)

An Undergraduate Thesis

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## Table of Contents

Sociotechnical Synthesis.....	3
Optimization of VDOT Safety Service Patrols to Improve VDOT Response to Incidents .....	5
Development of AV Technology: The Relationship Between Innovation and Legislation.....	11
Introduction.....	12
Innovation and Legislation of AV Technology .....	12
Case Context .....	14
Research Question and Methods.....	17
Results.....	18
Discussion.....	25
Conclusion .....	27
References.....	28
Thesis Prospectus.....	30
Prospectus Body.....	31
References.....	40

## **Sociotechnical Synthesis**

With millions of vehicles on the road each day, traffic delays and interstate congestion result in loss of productivity and millions of dollars each year. A majority of these traffic delays are caused by traffic incidents including crashes and disabled vehicles. These incidents are safety hazards and can lead to secondary crashes. Rapid clearance of these events and scene management during an incident can significantly reduce the impact of congestion. To combat hazardous conditions and decrease congestion related delays, the Virginia Department of Transportation (VDOT) has a fleet of Safety Service Patrols (SSP) that monitor highway conditions and assist emergency responders in scene clearance and traffic management. Managers of the SSP program seek to schedule patrollers in a manner that optimizes their influence on safety and congestion. The technical report proposes a Genetic Algorithm based route scheduling algorithm that assigns SSP routes with the goal of minimizing the total time vehicles are waiting before an SSP vehicle arrives. The algorithm adapts to different incident rates and response times to produce schedules that vary by time-of-day and day-of-week. To examine the performance of the algorithm, optimal schedules were made for I-95 in Virginia. A regression model was also developed to estimate the incident rates using a combination of daily traffic counts and historic rates that accounts for the under-counting of incidents in non-patrolled regions. Another model was used to estimate the SSP response times that resolves the inconsistencies with historical response times for incidents that occurred outside of the patrolled roadways. The results indicate that new route schedules based on the day-of-week could lead to a reduction in total time waiting for SSP assistance by an average of 13%, helping VDOT maintain safety, increase impact, and Keep Virginia Moving.

Although the technical report addresses service patrol routing, the research explores the relationship between innovation and legislation of Autonomous Vehicles (AVs). The AV technology into a complex technological system requires coordination of legislatures and the automotive industry. AV technology ranges from simple driving assist features common in the current automotive market to fully autonomous vehicles. The introduction of the advanced technology and rapid developments into the market is limited to the slower pace of legislation. The importance of its potential integration includes increasing the safety and accessibility of driving. Understanding the timeline of developments to their use in society will help determine when these benefits will be realized. In regard to technology over time, Hughes' technological momentum framework defines the phases of evolution of a technological system. This framework will be used to characterize the current phase of AV technology from the perspective of legislatures and the automotive industry. Content analysis of constructing co-occurrence networks from legislative documents and industry white papers will be used to describe these perspectives by extracting key themes and priorities. The results will reveal the similarities and differences between legislators and the industry opinion on the state of AV technology. The analysis will characterize the views and advise the relationship between the legislative bodies and automotive industry. The evolution of AV technology has the potential to restructure the transportation system in terms of what technology is introduced and how it is implemented. This highlights the significance of the dependence between legislators and the automotive industry as they make critical decisions that drive the evolution of AVs.