

Brake Dynamometer Development: Unveiling Precision and Performance
(Technical Report)

Navigating the Road Ahead: Ethical Considerations in Autonomous Vehicle Development
(STS Research 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

In an era characterized by a continuous drive for innovation, the automotive industry finds itself at a crossroads, facing a complex moral dilemma. It must strike a balance between pushing the boundaries of technological progress and ensuring safety. In 1966, with the formation of the National Highway Traffic and Safety Administration (NHTSA), the automotive industry took an important step toward enhancing regulations and prioritizing consumer safety, a milestone well-documented by scholars like Mashaw (2017). However, as the industry continues to witness rapid technological advancements, it finds itself in a challenging predicament. The NHTSA, responsible for ensuring road safety, is striving to keep pace with influential corporations as modern automotive technologies advance at an unprecedented rate. This dynamic creates an intriguing problem, leaving gaps in safety enforcement within the industry. As automakers pursue more advanced features, autonomous capabilities, and energy-efficient designs, they face many ethical considerations that demand careful navigation.

A notable observation in the evolving automotive landscape is that “the car itself will need to detect problems and make decisions in a variety of situations that cannot be specifically predicted by the software manufacturer” (Marchant & Lindor, 2012). Marchant and Lindor highlight the profound shift in the responsibilities of modern vehicles. Traditional automobiles primarily relied on human drivers to make real-time decisions in unpredictable scenarios. However, the emergence of autonomous capabilities and complex software systems has shifted the responsibility to the cars to assess and respond. This transition raises questions about the reliability of such autonomous systems, their decision-making algorithms, and the ethical ramifications of accidents involving self-driving cars. These new technologies can cause human

consequences. Society will struggle with the questions: where is the personal responsibility and who is at fault?

The implication of this transformation is twofold. On one hand, it heralds a promising era of enhanced safety, with the potential to reduce accidents caused by human error. As the NHTSA grapples with regulating these evolving technologies, the challenge lies in bridging the gap between modernization and safety.

This topic delves into the heart of this intricate challenge, exploring the dilemmas that arise when automakers seek to revolutionize the driving experience. From integrating sophisticated technologies to the complexities of risk assessment explored in the technical report, this subject explores the multifaceted ethical landscape where innovation and human life intersect in automobile safety.

Technical Discussion

The automotive industry is currently undergoing a profound transformation. This shift toward more technologically advanced vehicles has ushered in a new era characterized by simulated destructive testing, a method where virtual models experience extreme conditions, and the use of sophisticated tools for performance evaluation and data collection. The adoption of powerful computer simulations and modeling techniques allows automakers to replicate real-world scenarios, thereby assessing vehicles without extensive physical testing. While this approach reduces costs, it does not account for potential manufacturing errors in design and assembly.

The fast-paced industry raises concerns about ensuring flawless vehicle systems. As software use grows, questions surrounding consumer privacy and data security have emerged.

The data collected from vehicles holds immense potential for improving safety. Correspondingly, the rapid progress of autonomous driving technology has introduced ethical considerations for assigning responsibility in the case of accidents or failures.

Additionally, the Journal of Computing and Information Science Engineering notes that advanced vehicle systems can drastically enhance the occupants' experience (Panchal & Wang, 2023). However, the interaction of these systems with infrastructure, such as roadways, pedestrian crossings, and traffic, plays a pivotal role in regulating safety. This connection is crucial, given the evolving complexity of modern vehicle systems, which hinders safety assessment. The ever-growing intricacies of these systems present a challenge for safety engineers, underscoring the need for stringent safety protocols and guidelines.

The primary dilemma faced by automakers and regulators revolves around the extent to which technological advancements can take precedence over the safety of human lives. Striking a balance between innovation and safety without compromising either becomes a paramount challenge in this evolving landscape. Autonomous vehicles can address several pressing problems in the automotive industry. Jack Stilgoe's observation highlights the persistent issue of human error on the road. Human drivers often become distracted, impaired, fatigued, and drive at excessive speeds, contributing to most accidents (2018). Autonomous vehicles have the potential to mitigate accidents and safeguard human lives. With over a million people losing their lives annually in global road accidents, the prospective public health benefit of reducing human error through autonomous driving technology is enormous.

The legal issue of liability and responsibility will also be tested with the introduction of the autonomous vehicle. Initially, autonomous vehicles promise positive implications. With the commercial availability of autonomous vehicles, concerns about how the law will treat liability

have surged. Volvo's CEO has promised that the company will accept full responsibility whenever one of its cars is autonomous (Brodsky, 2018). Whether or not all the car manufacturers will take the similar position remains to be seen. Nevertheless, this initial commitment to liability assures consumers and regulators of addressing concerns related to accountability in the emerging era of autonomous driving. As automakers like Volvo lead the industry in shouldering the responsibility for autonomous vehicles (as referenced by Brodsky, 2018), the industry's direction becomes more apparent.

Significantly, adopting autonomous vehicles could potentially solve critical problems in the automotive industry. They can reduce accidents caused by human error, potentially saving countless lives and reducing the burden on healthcare systems. Furthermore, they introduce the need for a clear legal framework to address liability issues, establishing a foundation for accountability. As autonomous driving technology progresses, ethical considerations extend to determining responsibility for accidents or failures. Who bears the responsibility when an autonomous vehicle is in an accident: manufacturers, software developers, or vehicle owners? The primary ethical dilemma lies in deciding the extent to which automakers can prioritize technological advancements over the safety of human lives. While innovation can lead to safer vehicles, it can also introduce new risks, such as potential vulnerabilities in autonomous systems or overreliance on driver-assist features. As the industry navigates new technology, autonomous vehicles represent a promising path forward, ushering in a safer and more efficient future of transportation.

STS Discussion

The primary objective of this discussion is to enhance automobile safety by examining the ethical considerations. This research aims to shed light on how automakers can develop safer vehicle systems and encourage critical examination by automakers and policymakers. It provides insights to create more effective regulations and standards. Informed consumers can drive market forces toward prioritizing safety, ethical design, and responsible innovation.

The automotive industry stands at a pivotal juncture, grappling with the moral predicament of harmonizing innovation and safety. However, the relentless march of technology has ushered in a paradigm shift, where advancements in autonomous capabilities, energy-efficient designs, and complex AI-driven systems have given rise to a complex web of analysis. Jack Stilgoe's assertion that "technologies distribute risks and benefits unevenly; they create winners and losers" (55) forms a cornerstone for examining the societal impact of innovation in the automotive industry. While autonomous vehicles and advanced safety features promise safety and convenience, they generate questions about accessibility and potential disparities. The benefits of these technologies are pricey and may favor those already well-off. Implications here revolve around equitable access, affordability, and the necessity of regulatory measures to ensure that the benefits are democratized rather than concentrated among a select few.

Correspondingly, the heightened competition in the automotive sector fuels market interest and presents a crucial challenge: ensuring comprehensive safety validation amidst accelerated development (Ling & Wang, 2004). As consumers demand innovative features faster, automakers are racing to launch cutting-edge products. As would be expected, rushing products to market too quickly can result in problems. This fast-paced environment is demonstrated by a tragic incident involving an Uber vehicle operating in Autopilot mode. Unfortunately, a

pedestrian was hit and killed while crossing the street at night. The vehicle's radar detected the woman, first identifying her as an unknown object, then as a vehicle, and finally as a bicycle. This inaccurate radar detection ultimately resulted in her death (Johnson, 2020). Indeed, this tragic event demonstrates the imperative need for comprehensive safety assessment, even amid accelerated development cycles. The incident highlights the potential risk of compromising safety standards in the fervor to launch technologically advanced products rapidly. The pressure to keep up with consumer demands must not undermine the essential duty of care - and the need for safeguarding lives on the road. Real-world incidents such as this underscore the complexities of achieving a harmonious balance between innovation and safety.

Integrating AI into automobiles introduces uncertainty and unpredictable risks. As significant AI-driven technologies like image recognition algorithms play a pivotal role, variations in their outputs in different environments present a safety issue. The onus lies with manufacturers to ensure that AI algorithms do not introduce unforeseeable safety risks and vulnerabilities (Xie, 2020). Moreover, the industry integrating automotive systems with the internet and wireless interfaces exposes vehicles to cyber threats. The potential for cyber attacks to cause systemic failures, harm, injury, and damage underscores the critical role of cybersecurity in modern vehicles (Watney & Draffin, 2017). Implications of software vulnerabilities center on the urgent need for robust cybersecurity measures to safeguard the integrity of automotive systems. Innovation, while ushering in vehicle enhancements, simultaneously raises complex challenges, notably in individual privacy. As vehicles become more connected, addressing these risks becomes increasingly paramount.

The concept of the "trolley" problem manifesting in autonomous vehicles, where accident avoidance systems must make ethical decisions, unveils the profound implications of innovation

in safety. Designers of these systems must write ethical decision-making algorithms (Johnson, 2020). The significance lies in defining and standardizing ethical guidelines for these decisions, striking a balance between minimizing harm and ethical responsibility. These complexities underscore the critical need for comprehensive ethical guidelines, robust regulation, and equitable distribution of benefits. Ultimately, ensuring that innovation in the automotive industry continues to enhance safety without leaving any behind.

Methods

This study used a systematic literature review to achieve the research aims and objectives. Specifically, this issue explores the ethical aspects of self-driving cars, simulation testing, and advanced safety tools. Data collection included searching academic databases and journals, using precise keywords, and setting clear inclusion criteria for articles published in the same period. The results are analyzed to form a comprehensive narrative highlighting trends, gaps, and insights into ethical challenges. These investigations provide an up-to-date perspective on the intersection of innovation, safety, and ethics in the automotive industry, benefiting stakeholders, policymakers, and automakers as they navigate evolving automotive technologies.

Conclusion

Ultimately, the automotive industry's transition to simulated destructive testing and the advancement of sophisticated performance assessment tools embodies a pragmatic approach to confront the intricate ethical dilemmas inherent in the nexus of vehicle safety and innovation. The journey to strike the proper equilibrium calls for a perpetually evolving ethical dialogue, diligent risk evaluation, and an unwavering dedication to upholding the most stringent safety

benchmarks. As we have explored in this discourse, the pursuit of innovation, notably in autonomous vehicles, entails inherent risks and necessitates comprehensive ethical scrutiny, fulsome engineering testing, proactive regulatory measures, and a commitment to liability protocols.

Amidst these complexities, the industry grapples with the need for robust safety protocols, the preservation of privacy and data security, and the ongoing mitigation of human errors on the road. Thus, the future of the automotive sector is intrinsically tied to the continuous process of introspection.

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