

Thesis Project Portfolio

Battery Management System Design for Electric Vehicle Racing

(Technical Report)

Examining the Effect of Motorsports and Various Sociotechnical Factors on Electric

Vehicle Development

(STS Research Paper)

An Undergraduate Thesis

Presented to the Faculty of the School of Engineering and Applied Science

University of Virginia • Charlottesville, Virginia

In Fulfillment of the Requirements for the Degree

Bachelor of Science, School of Engineering

Silas Schroer

Spring, 2024

Department of Electrical Engineering

Table of Contents

Sociotechnical Synthesis

Battery Management System Design for Electric Vehicle Racing

**Examining the Effect of Motorsports and Various Sociotechnical Factors on Electric Vehicle
Development**

Thesis Prospectus

Sociotechnical Synthesis

The global transition to Electric Vehicles (EVs) and reducing the market share of Internal Combustion Engine (ICE) Vehicles is a pivotal part of the global sustainability movement. This paper explores the historical evolution of EV technology focusing on the interplay of societal needs, technological development, and environmental perspectives. This paper explores the historical story of EVs, beginning with their invention by Thomas Parker in 1884 and the following centuries of competition with ICE vehicles. This evolution fits well within Hughes's established framework for the development of large technical systems. Significant achievements and setbacks along this path have shaped contemporary perceptions of electric mobility and EV technology.

Ideas of momentum, inertia, and reverse salients such as insufficient infrastructure have defined the evolution of this technological system as well as the current EV renaissance. This paper analyzes how modern variables relating to momentum and seamless web will contribute to the future success of EVs in the research and consumer markets. At its current momentum stage, the trajectory EVs is defined by public policy and societal support, which is causing pressure to expand the role of electric mobility in our society.

At the center of this discussion is an analysis of the role of motorsports as a catalyst for technology and societal adoption of EVs. Motorsports, specifically EV racing, has emerged as a prominent arena in which competition and sustainability has fostered accelerated development of progressive automotive technology. The sphere of motorsports serves as a practical platform for testing and refining experimental technologies. These advancements then propagate into the consumer market and address reverse salients, uplifting the production EV sector. The publicized nature of racing captures attention and stimulates public discussion that contributes to broader adoption and acceptance of electric mobility. EV motorsports is also playing a role in inspiring the

next generation of engineers and helping define the future workforce in a way that can support the transition. Competitive student motorsports programs such as FSAE serve as a source of specialized engineering knowledge and emphasize the importance of continuous learning and practical innovation.

This narrative presents complexities however, and paradoxes associated with rapid prototyping and event logistics present a counter argument to the broader impact of EV racing. In addition, the production of components such as batteries that are vital to the success of EVs are inherently unsustainable, and waste in manufacturing needs to be addressed. This paper argues that the significance of reducing the ICE vehicle market and creating a sustainable automotive fleet is far greater than that of the environmental impact associated with EV production. In addition, the positive societal and technological impact of EV motorsport programs outweigh the short-term environmental burden created by the industry.

The evolution of EVs as a large technical system has culminated in widespread commercialization in the 21st century, and EVs have become a cornerstone of the global shift towards environmental sustainability. The future role of EVs within this transition will be uplifted by motorsports programs, and defined by public policy, societal perception, and continuous technological innovation.

Acknowledgements

I would like to acknowledge the contributions and achievements of my technical capstone partners: John Link, Gabriel Binning, and Asad Shamsiev, as well as my teammates on the Virginia Motorsports FSAE team. In addition, I thank my technical advisors Dudley White and Adam Barnes, as well as my STS advisors Richard Jacques and Gerard Fitzgerald.