Thesis Project Portfolio

***Corvus:* Urban Air Mobility Solutions for Package Delivery**

(Technical Report)

Accelerating the Transition to Electric Vehicles by Developing Compound Solutions That Consider Multiple Perspectives and Create Synergistic Relationships

(STS Research Paper)

An Undergraduate Thesis

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

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Bachelor of Science, School of Engineering

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Table of Contents

Sociotechnical Synthesis
(Executive Summary)

Accelerating the Adoption of Electric Vehicles and Designing an Electric Drone

Today, humanity is facing a crisis with the production of greenhouse gases (GHG). The increasing trend of GHG is precipitating climate change, which according to experts will have drastic consequences if not acted upon immediately. For the last year, I have worked both on designing a solar car for a university team competition and designing an electrical unmanned-aerial-vehicle (UAV) for my capstone design project. My technical research developed a drone with vertical takeoff and landing (VTOL) capabilities for a NASA challenge competition. My STS research focused on understanding and extrapolating two frameworks —the multi-level perspective and cross-cultural comparisons— to accelerate the transition required by the United States to electric vehicles (EVs) in a timely manner. To help such transition, EVs development (e.g. solar car research) is necessary as it will be shown throughout the STS research paper.

The technical portion of my thesis designed a VTOL UAV. One of the challenging parts about designing a UAV was that most of the technology is quite new, and there is not enough background theory to explain how it functions. Aspects like the transition between VTOL and cruise were simplified to accommodate for such complexity. Other challenges our team found will be explained in the technical portion. The UAV design consisted of three stages. For the first stage, inspired by NASA, our team decided to use a tilt-wing configuration to address the mission requirements —climbing rate, range, safety, efficiency, among others. For the second stage, with a variety of software and research, our team designed the size, component distribution, propellers, loading mechanisms, battery systems, stability, and safety mechanisms of the drone. This second stage was intertwined with the third stage, in which our team refined the UAV design by a feedback-loop process to accommodate for all the varying parameters.

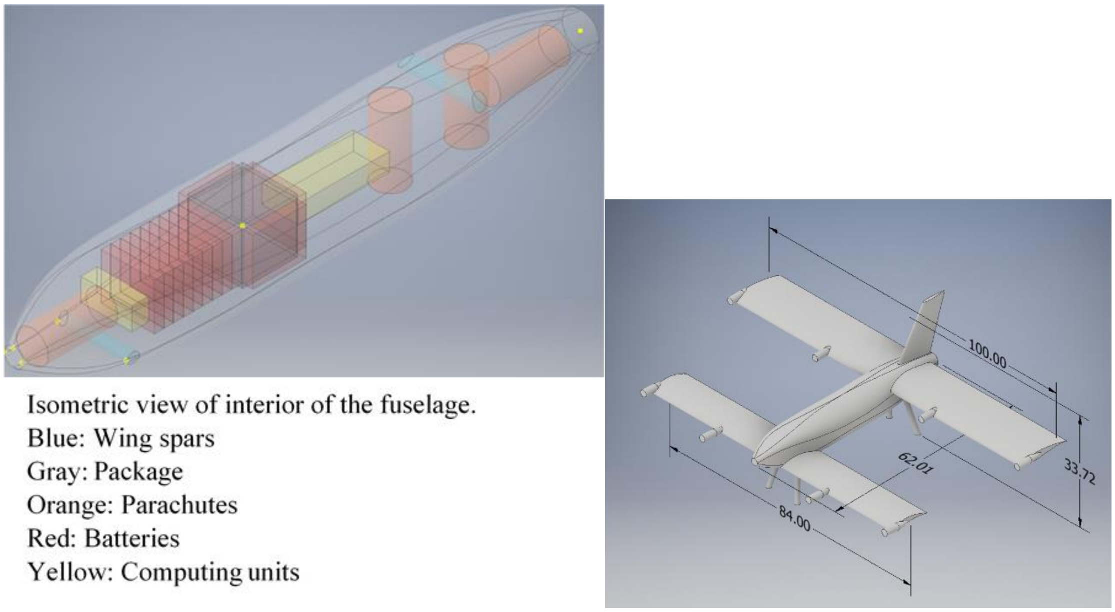

Figure 1: UAV Design Illustration (Created by authors of the technical portion)

In my STS research, I decided to look into something that I am passionate about—the planet’s response to climate change. Most people are aware of the consequences of climate change; however, with my STS research, I wanted to focus on what could bring about a faster shift to cleaner energy in the U.S., particularly the transportation sector, which accounts for a 23% share of global energy-related GHG emissions (IEA, 2017, n.p.) The multilevel perspective and cross-cultural comparisons were the two frameworks that attracted my attention to tackle this issue. With the multilevel perspective framework, I analyzed the interactions between the three levels (socio-technical landscape, socio-technical regime, and niche) in the adoption of electric vehicles in a particular society. Likewise, with the cross-cultural comparisons’ framework, I analyzed the demographic and educational factors that succeeded in other countries, and then I extrapolated some of that analysis into the American context. It seems as though a good understanding of sustainable transitions and the public’s level of education is essential to succeed in quickly implementing electric vehicles.

My STS and technical projects, although not entirely related, taught me the value of rigorous consideration of the role that organizational and cultural factors play in the success (or lack of success) of a technical artifact. For the technical project, the UAV had a set of requirements in which noise and public safety were of paramount importance. This project exposed me to the ethical and technical tradeoffs that a technical artifact can have. For instance, including a parachute on the UAV disadvantageously increased the weight by 20 percent; however, because it was the safest option, our team decided to implement it. For my STS project, I learned that fighting climate change in the transportation sector is not only about developing better electric vehicles, but it also consists of understanding the driving factors of society and what precipitates change at both the human and organizational level. Unquestionably, society and technology are intrinsically connected, but attempting to understand their complex interactions is what produces the best approach to a solution.