Thesis Project Portfolio

Hybrid-Electric Regional Turboprop Final Design Report

(Technical Report)

Social and Environmental Impacts of Commercial Aviation

(STS Research Paper)

An Undergraduate Thesis

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Bachelor of Science, School of Engineering

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Sociotechnical Synthesis

Introduction

The overarching theme of my STS research and technical capstone is environmentally responsible aviation. My STS research focused on analyzing the environmental impact of aviation and potential policy solutions through the lens of Actor-Network Theory (ANT). Through my technical capstone project, I worked on a team developing a conceptual design for a hybrid-electric turboprop with the goal of exploring ways to reduce emissions from short-haul commercial flights.

Project Summaries

As an aerospace engineer, I think it is important to understand and consider how to mitigate the negative consequences of the aerospace industry. Climate change is the defining challenge for my generation, and the aviation industry plays a significant role in the perpetuation of this crisis. I utilized ANT to understand how the industry is structured and how it interacts with society with a focus on decision making relevant to its environmental impact. Specifically, I looked at the roles of aircraft manufacturers, airlines, governments, and the general public. With an understanding of the incentives and preferences of each stakeholder, I was able to discuss ethical responsibility as well as potential policy solutions. Ultimately, despite having an ethical responsibility to not harm society, aircraft manufacturers and airlines are private companies that prioritize returns to investors. Therefore, I conclude that governments must enact policies that force the aerospace industry to internalize their social and environmental costs. Overall, my STS research paper describes the importance of considering and mitigating the environmental impacts of aviation going forward.

My capstone project is a response to the American Institute of Aeronautics and Astronautics (AIAA) design competition request for proposal (RFP). The competition requires my team to develop a conceptual design for a 50-seat regional turboprop with a hybrid electric propulsion architecture. To accomplish this, we researched state of the art technologies and conducted trade studies to optimize our design for the figures of merit defined by the RFP. The figures of merit are a reduction in block fuel burn (fuel used from takeoff to landing) of at least 20% for a 500 nmi mission as well as a reduction in CO_2, NOx, and soot emissions relative to a conventional, state of the art aircraft. Over the past year, we have worked on this and are at the final stages of our conceptual development.

Conclusion

Working on my STS research paper and technical capstone project, I gained a lot of insights into the importance, challenges, and potential of environmentally responsible aviation. Given the technical, political, and financial challenges, it will be difficult to implement the changes necessary to make the industry environmentally friendly. As an engineer, it is important to consider the wider societal impact of your work as well as the constraints placed on it. By working on these two projects concurrently, I have developed an appreciation for the sociotechnical considerations of my work.

Finally, I would like to acknowledge my STS professor, Richard Jacques, my capstone advisor, Jesse Quinlan, as well as my capstone teammates, James Caputo, Darius Espinoza, Jannik Gräbner, Ryan Grant, Eun Park, Kangyi Peng, Alex Poley, and Alex Wang.