Thesis Portfolio

Project Kestrel

(Technical Report)

The Future of Flight On-Demand

(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

Alfredo Basile

Fall, 2021

Department of Mechanical and Aerospace Engineering

Table of Contents

Sociotechnical Synthesis

Introduction

My technical and STS work have been centered about the technologies that will be changing the aerospace industry in the near future. My technical research is a conceptual design of a light attack aircraft in response to the AIAA (American Institute of Aeronautics and Astronautics) competition held last spring. The STS research is not connected with light attack aircraft specifically, but the technologies that were considered by our team for the design of our aircraft are related. In the case of our design, the major design choice to achieve the competition requirements, was a fixed wing aircraft that had vertical lift capabilities via a tilt-wing that would allow for short field and vertical take-off and landing. The other possible design choices included electric or hybrid electric power, and automation. Our team did not use the other design choices, but their consideration during our preliminary discussions shows that these are the design considerations that are prevalent within the aerospace community. The combination of these technologies in aviation will change the way we transport both people and products move through the air and my STS research aims to answer how this will impact the future.

STS Research

My STS research is to look at how electrification, vertical lift and automation will facilitate on-demand air mobility (ODAM), a field that covers both drone delivery and air taxis. Both applications will rely heavily on advancing all three technologies, with electrification being the largest milestone to cross before real world applications can expand outside of short-range urban and regional flights. My research focuses on the different components of the aircraft and how their development and advancement have their own consequences as well as its own independent drivers that demonstrate the technology's further advancement regardless of its use

in ODAM. Then putting all the parts back together to see what the whole effect of ODAM will be in urban environments.

Technical Research

For my technical research, my team and I developed a conceptual design for a light attack aircraft we dubbed the kestrel. The design process and analysis spanned two semesters and was by far the most beneficial and practical experience I had at UVA. Prof. Quinlan was not only a former UVA student, but also still worked at NASA while teaching us, which gave us additional opportunities to showcase our work to other NASA employees as well as other advisors that provided input back when Prof. Quinlan was a student. Our design was inherently risky considering that one of the goals was to design an aircraft that would be inexpensive, and our configuration consisted of a twin turbine tilt-wing. The risk may have cost us the AIAA competition win, but we all worked hard to prove our concept was sound and it was enough to earn best design in the class.

Conclusion

Both experiences with the STS research and technical paper were beneficial. However, the experience of designing an aircraft with the same team for a year, gave me the feeling of actually doing engineering rather than just learning about it. I hope in the future more emphasis will be on the practical tools that industry uses so that there is less of a learning curve needed to do real word engineering.