Thesis Project Portfolio

Hypersonic ReEntry Deployable Glider Experiment Critical Design

(Technical Report)

A Comparative Analysis Between Airbus and the Concorde on their Organizational Structure and Success of Products in the Aerospace Market

(STS Research Paper)

An Undergraduate Thesis

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Sociotechnical Synthesis

The focus of my STS research paper was centered around the development of novel technology that occurs in the aerospace industry and analyzing how the management of these projects led to differing results. As for my technical project in my Spacecraft Design course, we worked on developing a design for a low-cost CubeSat that can be sent into orbit and collect data when re-entering the atmosphere in the hypersonic regime. This type of technology and experiment has yet to be done at a cost-effective scale, and demonstrating that university students can accomplish this task sets up a precedent for future work in this type of research. The connection between these projects, then, is the idea of working on creating technologies that are novel for their time and being able to approach the problems with multiple teams of engineers to produce an effective solution and design. The extent of my technical resulted in a prototype and Critical Design Review (CDR) to pass along to the next year's students in the course, and potentially garner interest from the government and defense industry to continue developing these CubeSat models.

Our Hypersonic Re-Entry Glide Experiment (HEDGE) is a proof of concept mission determining the feasibility of using CubeSats as a means of low-cost sustained hypersonic flight. The concept is to deploy as a cube on a commercial launch vehicle and be sent into orbit at second stage separation in a low earth orbit (LEO) where it will slowly lower its altitude and eventually re-enter our atmosphere. At these speeds, when returning to Earth, it will pass through at hypersonic speeds and with sensors onboard collecting temperature and pressure data to allow us to learn more about this regime of flight, which is an expanding area of aerospace. The previous iteration of this course concluded with a preliminary design review (PDR) and through my work, my class developed a full-scale physical and software prototype accompanying a

critical design review (CDR) for the next iteration of the class. Specifically, I am a member of the software and avionics subsystem team, which is 1 of 6 on the project. My team's work has been focused on selecting an onboard computer to go inside the chassis of the CubeSat and then developing a code structure to interface with the sensors and other subsystems to communicate with satellites and onboard power, as well as be able to perform tasks in flight autonomously, since we will not have contact with it while re-entering.

My research paper was a comparison between the Concorde project of the late 20th century and Airbus, a modern aerospace company that has been in place since the late 20th century as well. I selected these two entities since they are both European based projects/companies and have experienced very different results when the final product was put on market. The analysis delved into the project structure and setup of the teams and how this impacted communication, design, and manufacturing of the project and eventually its use by the end-users. What this analysis found was that having an integrated and collaboration focused project structure leads to a better designed and performing final products, following Airbus' approach to these, whereas the Concorde failed in the aspect of having a static and convoluted structure and communication channels between engineering teams, executives, and contractors all working together. While what they were doing was difficult, the lack of effective communication and collaboration led to a worse design and a poor performing product for the Concorde. Airbus continues to strive for and bring in new ways to connect different disciplines in their company and try to have successful products as they continue to be a major part of the aerospace market.

The focus of my time spent in the aerospace engineering major was to analyze systems and components using primarily numerical methods to look at how they perform given certain

conditions. What this research paper and capstone design has allowed me to practice in terms of analysis is stepping back and examining the social impact of engineering. Working on this research which had an emphasis on organizational setup in tandem with working with multiple engineering teams on my capstone taught me a lot more about our interactions between teams as we were all new to this sort of work and needed to design something very complex and unique. Had I worked on the research without having the capstone at the same time, the impact may have been less profound, since these types of projects were more unfamiliar to me up until that point, but having the ability to step back and see the parallels, in my mind, helped contribute to an overall better capstone project. The communication aspect of our work was a major hurdle to get over since each team had other responsibilities and schedules, and learning about what leads to better project results influenced how I approached that. Immediate communication in my team was relatively unaffected since we had the same goals and similar schedules, but between teams it allowed me to make better decisions about approaching others for requirements and deadlines for our work and getting the information we needed throughout the project. I didn't have the appreciation of just how involved these projects can be that I was analyzing for my research until I had gotten into the design phase for my capstone, but having the opportunity at the same time to work on both was impactful in the way that I approached my specific tasks and work with others in the class.