Thesis Project Portfolio

Student Researched and Developed High Power Rocket

(Technical Report)

Engineering Ethics and the Ubiquity of Undergraduate Defense Funding: A Conflict of Interest

(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

Aaron Edgar Osborne

Spring, 2024

Department of Mechanical and Aerospace Engineering

Table of Contents

Executive Summary

Capstone projects have long been used by undergraduate engineering programs to propel students into the working world. I was the Project Manager for my Spacecraft Design Capstone. Our goal was to design, prototype, fabricate, and ultimately launch a rocket to deploy a glider payload while adhering to the criteria of our launch site. In my STS research paper, I explore the deep connection between private security contractors and undergraduate engineering programs. The implications this relationship has on the careers students pursue is clear, and in my paper, I highlight the conflict of intertest present in teaching engineering ethics while accepting millions in funding from these bodies. Through my technical research, I have experienced firsthand both how the capstone project can push students towards certain careers and how the capstone serves as a simulacrum of the working world. In the capstone class, engineers can express their career interests and learn what it means to work in a large group with a long-term common goal.

My technical research outlines the many difficulties that arise while leading a two-semester-long capstone project. During the capstone, our design requirements changed no less than three times, and my research describes how to best cope with these issues. We were able to design and build a rocket to reach a 4,000-foot altitude despite these changes, and successfully demonstrated our planned separation events. I also managed our $9,000 budget to source parts and complete fabrication. Because we hoped future students would iterate and improve upon our design, we held documentation paramount. During the design phase, each iteration of our rocket was stored in OpenRocket simulations, CAD models, and in our Design Reviews.

Ultimately, we were unable to launch our rocket because of the number of changes we were forced to make. We had to change our launch site—each with its own launch criteria—many times due to issues with the course format. For example, we were unable to launch at the

Spaceport America's IREC, the original site chosen by the class professors, because the UVA Rocketry club already was attending the event. Regardless, in the process of fabricating this rocket, I discovered how to best organize teams, assign tasks, complete relevant documentation, and present our results.

In my STS research, I explored the problem of both accepting funding from the Department of Defense and private security contractors despite student protest, and simultaneously teaching ABET-required engineering ethics courses. I explored this issue through a virtue ethics framework, which highlighted the conflict-of-interest inherently caused by this disregard for student interest. This issue has rippling effects: the lives and careers of many undergraduate engineers are dictated by the parasitic relationship I discuss in my research.

The influence these contractors have on engineering programs far exceeded even my own expectations. I discovered cases of contractors like Raytheon assisting colleges in reformatting their course requirements to fulfill ABET criteria. Cases like this make the influence of the military industrial complex inescapable for students, and as such, these colleges clearly violate their onus to put the students' education first. Instead, what has evolved has been a quiet perversion of both engineering education and contractor recruiting; the two bodies now rely upon one another to an inseparable extent. This very existence of this relationship violates the exact principles ABET requires, and yet these colleges refuse to hear the voices of their students.

Students thrive in an environment in which they can express their own interests in extremely technical projects of their own choosing. In my Spacecraft Design Capstone, we, as a student body, were able to design a rocket outside of any direct influence from contractors or the DOD. This is what engineering education must refocus on: the interest of its students, rather than defense dollars or military research projects given to their professors.