Executive Summary

The modern world relies on the aerospace industry. Essential services including communication, weather tracking, and GPS are only possible with satellites that require rocketry to put into place. Furthermore, Earth is only a tiny fraction of the universe, and space exploration by the aerospace industry is pivotal to improving our understanding of physics, accessing vast materials and energy in space, and discovering if life exists outside of Earth. These functions are all imperative to both society's ability to function currently and to society's improvement and advancement in the future; however, the aerospace industry is flawed, and some of its practices actively contribute to making life worse for some people on Earth. One of these grievances includes the contribution to modern slavery through the unethical collection of resources. Cobalt, an element useful to the aerospace industry, happens to have its largest reserves in the Democratic Republic of Congo (DRC); unfortunately, much of the cobalt extracted from the DRC comes from modern slavery which consists of atrocities such as forced labor, wage theft, violent and sexual crimes, and hazardous working conditions. In order to fully reap the benefits of the aerospace industry, further research and development must be conducted to improve and cheapen the available technology, and the aerospace industries' ties to modern slavery must be severed completely.

To one day contribute to the aerospace industry, the rocketry capstone set out to understand how rockets function and to design a smaller-scale (~2 meter tall) rocket with potential novel features. The goal was to design and construct a rocket that would successfully and safely launch, reach five to ten thousand feet in altitude, deploy a parachute on its way down, and land safely. To accomplish this, the capstone class of about thirty students was divided into

three teams: the aero-structures team, the propulsion team, and the mechatronics team. The aero-structures team was focused mainly on designing the body of the rocket and ensuring optimal aerodynamic properties and structural integrity, the propulsion team focused on designing the motor and propellant for the rocket, and the mechatronics team was tasked with designing the controls and electric systems for the rocket in addition to the parachute deployment and payload. I was a member of the mechatronics team and ended up focusing most of my efforts into developing the payload. We decided on a glider as the payload; this would nominally deploy itself (before the parachute deployed) and glide slowly down while taking footage of its descent. Unfortunately, due to safety policies and logistical red tape, our chances of a real launch (especially with a deployable glider) diminished to near zero. Despite the fact that we will not be allowed to launch, we are continuing to develop our rocket and payload.

My STS research project focused on the supply chains of aerospace entities and how well they prevent the unethical acquisition of materials, specifically cobalt. I found that a few places, including the U.S., Australia, and Great Britain, have laws regarding this topic which typically promote company transparency. However, as stated in the literature these laws are not strong enough to effectively deter modern slavery in supply chains and thus generally do not effectively eliminate the unethical sourcing of materials. Stricter and more thorough legislation and enforcement policies are necessary to prevent unethical sourcing of materials from the national level in the U.S. Next, I investigated a few U.S. based aerospace entities' policies regarding their supply chains, and found that Lockheed Martin had the best policy, SpaceX had the next best policy, and NASA had the worst policy of the three. Despite their relative rankings, ultimately all three of them lacked strong enough policies to truly prevent unethical sourcing of materials.

Hence, at both the company and national level, the unethical acquisition of materials is possible in the United States.

The aerospace industry is an exciting sector in society and holds a lot of promise in improving humanity's future. This past year I've come to understand a great deal of the challenges and potential of smaller-scale rocketry, and I've also explored the nuances of one of the aerospace industry's largest downsides. My rocketry capstone unfortunately fell short of its full potential, but I'd say I still made a great deal of progress and hopefully our class got a good start for the next rocketry capstone. My STS project succeeded; I successfully gauged the protection against the unethical collection of materials at the legal and company level in the U.S. and determined that it was inadequate. Future steps should be taken to audit aerospace entities (and technology entities in general) much more thoroughly to determine how much of their cobalt supply originates from the DRC.