

CECIL, 1U Amateur Radio CubeSat
(Technical Report)

Ethics of Boeing in the Design of the 737 MAX
(STS Research Paper)

An Undergraduate Thesis Portfolio

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Bachelor of Science in Aerospace Engineering

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My STS research project and technical work are connected through lessons on risk management. Both projects are connected to failures which may have been prevented through better use of risk management and mitigation. My technical project places an emphasis on minimizing risk as a means to ensure mission success and prove UVA is capable of managing complex student engineering projects. My STS projects investigates a major failure resulting in loss of life and investigates how risk mitigation applies to engineering practice in an ethical sense. Both projects display the diversity of acceptable risk in engineering projects and the drivers used to access that risk.

My technical work focused designing a 1U cubesat which was capable of reliably communicating with the UVA ground station using amateur radio frequencies and transmitting pictures taken of the Earth. Cubesats are a class of small satellites with standardized dimensions. Using these standards, companies have created easily integrated off the shelf components. These components allow for a cubesat mission to function on a lower budget and shorter timeline than a traditional satellite project. My capstone team focused around the use of amateur radio frequencies in our design to eliminate complex licensing issues and too allow collaboration with the amateur radio community. This will demonstrate the ability of UVA engineering to run complex student led projects.

My STS research paper focused on the design decisions made by Boeing in the creation of the 737 Max aircraft. The 737 Max is an updated version of Boeing's popular 737 aircraft series and was involved in two deadly crashes in October 2018 and March 2019. Both crashes were the result of the uncommanded activation of a software system which was meant to prevent a dangerous stall conditions while in flight. After an AOA sensor began giving incorrect readings,

the system caused the aircraft repeated enter dives which pilots were unable to counter. My STS paper was focused on determining if Boeing acted ethically in this aircraft design. To accomplish this, I used the virtue ethics framework which focuses on the character of an actor to determine if they acted morally. By calling on a list of virtues created by Michael Pritchard, I make the argument that Boeing acted immorally in their design. This is because they failed to adhere to several virtue developed by virtue including a failure to keep the big picture in perspective, a failure to thoroughly document, and lack of commitment to quality.

I believe that working both problems concurrently helped me gain a better understanding of risk in engineering projects. My STS project shows that When engineers are not cautious enough in their design and don't focus on mitigating risk, the results can be catastrophic. However, being too conservative with risk can massively increase the project cost and timeline. In my technical project an acceptable risk could be much higher than that of Boeing. An Engineer needs to decide the on the proper level of risk somewhere between the extremes for a project to succeed.