Thesis Project Portfolio

Cecil, 1U Amateur Radio CubeSat

(Technical Report)

CubeSats and the Standardization of the Space Industry

(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

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Sociotechnical Synthesis

The technical thesis is on a capstone project done through MAE 4700: Spacecraft Design II. The project was to develop a 1U Amateur Radio CubeSat called CECIL. The satellite design incorporated an experimental radio transceiver that will receive commands for the satellite and transmit images taken by the onboard camera. The primary objective of this space mission was to build and operate a satellite system that is able to reliably communicate with the UVA ground station and facilitate communication between amateur ground stations around the world. The project was to be accomplished at a low cost and with low risk of failure. To allow for data sharing and collaboration, the satellite was designed to function within the bounds of an amateur radio license. The final result of the capstone was a post-PDR all-encompassing design document that goes over the technology investigation required for the project, and then describes in detail the mission architecture, including mission requirements and constraints. This document also provides an in-depth look at each of the spacecraft subsystems and outlines the planned future activities, along with a specific timeline and budget to complete this project.

The STS thesis is a discussion of CubeSats and their role in bringing the space industry closer to standardization. Using the social construction of technology as a framework, it starts by identifying the relevant social groups involved in the standardization of the space industry. The motivations of the relevant social groups and their stances on standardization are discussed. The thesis then inspects CubeSats as a technology and investigates the advantages and disadvantages compared to traditional satellites. Next, the thesis analyzes the arguments that relevant social groups have for and against standardization in the space industry and the reasons for their viewpoints. The economic factors and technical merits of standardization are the focus of this section. It also goes in-depth into how CubeSats are instrumental to the standardization of parts

in the space industry. Finally, thesis attempts to draw comparisons between the space industry and other industries revolutionized by standardized parts in order to draw parallels between them. The effects standardization had on price, accessibility, and innovation in other industries and how standardization may affect the future of the space industry is the primary focus of this part of the thesis.

The topic of the STS thesis came from work that was done on the technical thesis. It was decided that CECIL, the 1U Amateur Radio CubeSat, was to use off-the-shelf components instead of designing custom parts in order to stay within budget and ensure reliability of the satellite. After learning that most satellites are mostly composed of unique parts the question of how standardization could affect the space industry as a whole was born. Combining the question of how standardization would affect the space industry and the growing popularity CubeSats, a highly standardized class of satellites, led to the main topic of the STS thesis. Since the space industry was increasing their usage of CubeSats, the question became more about how CubeSats could bring widespread standardization into the space industry and the effects that resulting standardization might have.