The path to my final essay was a somewhat meandering one. The aerospace honors program is very broad: the essay could have been on anything aerospace-related at all. I've always been interested in space operations and mission planning (more so than the technical aspects of these things) and so my original focus was going to be reusability of space systems (both in material aspects and with respect to keeping capabilities current). While doing this research, I found that many barriers to keeping space systems in good condition and upgrades with the latest technologies lay in the fact that they had to be launched into space in the first place! Keeping something in orbit is easy (relatively) but getting it there requires hardening your satellite to forces that it will only experience once in its operational life (and not while it's doing its job). Therefore, I started considering how launch itself could be eliminated while still placing systems in space. Although there are many fascinating ideas about this out there, the most feasible solution I uncovered was the space elevator.

Space elevators are an interesting field where, though there is much well-developed science and rigorous mathematical analysis, there is also a large amount of "pseudoscience".

I began in the aerospace library in Glenn L. Martin, which although small was a treasure trove of information about my original query of reusability – mostly browsing. However, most of my research was conducted online via the WorldCat system. I started broad, just querying "space elevator physics" which resulted in an excellent background paper from a WPI professor that referenced many other sources which turned out to be hugely useful. From reading through these and developing my abstract at the same time, I was able to narrow down more specific ideas of what areas I would need to do more specific research in and so adjust my queries accordingly. One example of this is the space elevator "crawler" – the actual elevator part of the space elevator! It never crossed my mind that this would be exponentially more complicated than a normal elevator counterweight system until the WPI report mentioned the changing effect of gravity as you move further away from the earth's crust while also accounting for centrifugal acceleration.

While in the planning process (around the abstract), talking to my professor, I mentioned that I was interested in space elevators. He agreed that the concept was interesting but warned me to be cautious in source selection due to the large amount of misinformation and fallacy present in the field, particularly on the internet. Admittedly, many of the sources I had gathered to that point had been … dubious, especially when I turned a more critical eye to them.

This meant I had to apply more rigorous source selection, including background research into the authors of any papers I found. For example, an organization called the International Space Elevator Consortium has published a huge, 300+ page report detailing various aspects of their concept of a space elevator, from the relevant physics to 90 pages on the cable crawler. This report was published but seemingly not peer reviewed. However, the lead author, Dr Peter Swan, had a PhD in Mechanical Engineering from UCLA and had co-authored (with 41 other experts) a report published by the International Academy of Astronautics, a prestigious organization with widespread expert membership. I used that report instead, which had an unimpeachable background. My overall criteria were similar to any other research program: the reliability of the source, the education of the author and if it was peer reviewed or not were all key factors. I did choose to use some websites for basic information, such as the Falcon-9 specifications, because I believe SpaceX to be a reliable company and source and such data could not be found anywhere else. Such decisions were made based on the importance of the

information being retrieved to the overall picture. The less important the information, the looser the source requirements.

Looking back, I would have begun my research looking at a more focused topic. Writing a technical paper on an area as broad as “reusability” is nigh on impossible. I should have begun someplace more concrete and specific, such as a reusability of a particular satellite system. This will help me further down the road as, although I didn’t notice at the time, PhD theses are in very specific areas, such as ferromagnetic fluids in helicopter seat dampeners. Finally, I would have spent more time doing background research before diving right in. A thorough understanding of the surrounding material of a topic (such as the physics of centrifugal motion, gravitation and material strength heuristics) would have saved a lot of time and effort backtracking to learn about those things.

In terms of improving the library, I would have been much more effective if all the works were clearly labelled with “keywords” similar to how items are marketed on the internet. For example, a certain volume of a journal could have a piece of paper on the cover proclaiming “space shuttle maintenance, ion jet propulsion, material properties of nanotubes…” and so forth.

Overall this paper was the most comprehensive report I have ever written and I learned many lessons from its production.