Thesis Project Portfolio

Hypersonic ReEntry Deployable Glider Experiment (HEDGE)

(Technical Report)

The Impact of Cost Plus and Industry Consolidation on the US Defense Sector

(STS Research Paper)

An Undergraduate Thesis

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Introduction

Both the STS and technical portions of this paper concern the US defense industry, an area that is responsible for much of the research taking place in the Aerospace field. The Hypersonic Reentry Deployable Glider Experiment (HEDGE) is an attempt to develop an improved method for collecting hypersonic data. The STS portion investigates the impact of cost plus and industry consolidation on innovation in the US defense sector.

Developing hypersonic vehicles (a vehicle able to travel more than 5 times the speed of sound) is an area of primary interest to the US government and the defense sector. However, despite its importance, military and intelligence analysts widely believe that the US has fallen behind both China and Russia in developing hypersonic technology. As such, the technical portion of this paper is directly pertinent to the STS aspect that addresses how the current structure of the US defense industry may be hindering innovation. Hypersonics is not only an area of technical research within the defense sector but serves as an example of slow development progress in a modern defense project.

Why is hypersonic technology so important? Primarily because hypersonic weapons are so difficult to defend against. If an aircraft or missile is traveling fast enough, it becomes almost impossible to shoot down and it's time to impact significantly reduces an adversary's ability to react. Hypersonic weapons are also increasingly effective if an adversary does not possess them

since an intercepting missile needs to travel faster than whatever weapon it is intended to shoot down. For this reason, the US and geopolitical rivals are investing billions to make missiles and aircraft fly ever faster.

Technical Project Summary

The technical portion of this paper concerns the development of HEDGE, which can be used to collect hypersonic data in a more cost-effective manner than the current status quo. HEDGE is a cube sat (a small satellite, that can be as small as 10x10x10 cm) that will be launched into orbit aboard a rocket and will reenter the earth at hypersonic speeds. During reentry, the HEDGE vehicle will collect temperature and pressure data and transmit this data with an antenna to the iridium satellite constellation until the vehicle's eventual burnup upon reentry. This concept can then be used to collect data on different materials in a hypersonic environment The current projected cost of the program is $55,800, far below the >$1 million price tag associated with most hypersonic experiments today (Tegler, 2020).

STS Project Summary

The STS portion of this paper investigates the impact of cost plus and industry consolidation on the development of technology in the defense space. These are factors that are uniquely prevalent in defense and may be at least partially responsible for a slowdown in the development of new technology following the cold war. The reduced pace in developing new technologies is an issue that is increasingly highlighted by members of the DOD, former executives in the defense space and investors. For this reason, the STS portion of this paper should be pertinent to the conversation around how defense procurement should work moving forward. The Actor-Network STS framework is employed to show how the interactions between

players in the defense industry contribute to the outcomes we see today regarding the development of new technology.

Concluding Remarks

There are several benefits that came from working on both the technical and STS portion of this paper simultaneously. The first and simplest is simply that working on a hypersonic project demonstrated how unbelievably difficult some of the problems being tackled in the defense space are to solve. Within the thermal group on HEDGE, predicting the time until the space craft burns up is a problem that is near impossible to solve until a physical prototype is launched. There are simply too many changing variables to produce an accurate model. There are a myriad of other problems like this encountered by both the thermal and all the other subsystem teams involved in the development of HEDGE. At the same time, it is also apparent how little progress has been made in this domain over the past 4 decades. Many papers we used to inform are thinking came from the 60s or 70s and studies with relevant data are often few and far between. Contrast this to a field like software engineering where so much progress has been made in just the last 10 years and it paints a quite stark picture. This supports the view put forth in the STS portion of the paper. Finally, I think working on HEDGE and a defense focused paper at the same time helped with idea generation. In class we have had defense professionals speak to us and their comments often pointed me in the right direction for research. For this, I owe all those who spoke in class a thank you.

References

Tegler, E. (2020, June 24). *To develop hypersonic weapons, the U.S. has to build some fiendishly complicated wind tunnels*. Forbes. Retrieved October 26, 2022, from https://www.forbes.com/sites/erictegler/2020/06/19/to-develop-hypersonic-weapons-the-us-has-to-build-some-fiendishly-complicated-wind-tunnels/?sh=71a536d2237e