Program Management on the Hypersonic ReEntry Deployable Glide Body Experiment (HEDGE)

A Study of Prime Defense Contractor Consolidation since the 1990s and its Effects

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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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Introduction

United States prime defense contractors are an integral part of the military-industrial complex and ensuring the safety of Americans as well as our foreign allies and interests. These are corporations tasked with delivering mission-ready capability to the warfighter on the front line, our first defense against interference from our nation's enemies. However, as Donald Gribbin and his colleagues established, defense firms saw a large decline in R&D intensity and innovation after 1993 (Gribbin et al., 2012).

Before the 1990s, though, things were completely different. Primes engaged in a competitive market, vying for government contracts. Innovation and ingenuity were paramount. According to Jonathan Chang and Meghna Chakrabarti, this all changed when, "a secret dinner at the Pentagon kicked off a massive consolidation in the defense industry"(Chang & Chakrabarti, 2023). Since then, the amount of primes has decreased drastically. Instead of a competitive market with a wide range of players, there exists one where each large defense contract is bid on by only a few, or one, large entities. Karam Kang and Robert Miller found that, in 2015, 44 percent of the procurement budget for the federal government was spent on contracts with only one bid. Additionally, Kang and Miller found that the government did not pursue open competition in more than two-thirds of contracts (Kang & Miller, 2022). Chris Strohm showed that this number was below half between 1998 and 2004 (Strohm, 2004). I will be investigating the following in relation: How did this mass consolidation come about? What impacts has this process had on the military-industrial complex of today?

For my technical project, I am the CFO of the Hypersonic ReEntry Deployable Glider Experiment (HEDGE), on the program management team. This experiment is intended to prove that cubesats, small and relatively cheap satellites, are able to collect useful temperature data during a hypersonic reentry similar to that of a hypersonic boost-glide missile. As CFO and Outreach Officer, I will be tasked with managing the budget of our experiment, securing funding from the Department of Defense or elsewhere, and managing communications between our team and outside organizations.

Our class is then acting similarly to a prime contractor in the sense of being responsible for delivering a unique capability to the government. In their report to congress, Corinne Kramer and her colleagues stated that a full test of a hypersonic missile costs tens of millions of dollars, with the glide body itself accounting for $38.5 million (Kramer et al., 2023, Table C-1). Therefore, a small group of undergraduate students getting meaningful data in the hypersonic regime for only tens of thousands of dollars would be impressive and useful for future testing.

In this paper I will first elaborate on HEDGE, my role in the project, and future plans. Then, I will switch my focus to elaborate on my research methodology and framework moving forward concerning the consolidation of primes and its effects. Lastly, I will list some key texts that will be useful to my final research paper.

Technical Project

Introduction and Significance

The fiscal year 2023 DoD budget request lists hypersonics as a defense-specific critical technology; technologies that require prioritized research, experimentation, and prototyping to ensure homeland defense and project power to our adversaries (Office of The Under Secretary of

Defense (Comptroller), 2022). Kelly Sayler recognizes that global relations continue to deteriorate, and the threat of a larger conflict becomes ever more probable, the United States Government (USG) recognizes the national security implications in our lack of technological maturation in the field of hypersonics, and the threats these weapons pose to the US homeland (Sayler, 2023). As Sayler and collaborators argue, "[t]he maneuverability and low flight altitude of hypersonic weapons could challenge existing detection and defense systems" (Sayler et al., 2020). Hypersonic missiles have become a serious national security concern in the past decade due to China's hypersonics weapons program testing, and the operationalization of these missile systems by Russia in their war with Ukraine.

Unlike Intercontinental Ballistic Missiles (ICBMs), hypersonic missiles travel through the atmosphere rather than a suborbital flight. This allows for near real-time navigation and control of the missile while also hindering early missile warning defenses. Understanding the behavior of materials traveling at hypersonic speeds is crucial in order to successfully develop and field a weapons system that can deter our adversaries. A major issue the USG has in developing these systems is the length of time a major acquisition program takes; the typical timeline takes roughly 10 to 20 years to operationalize. Figure 1 illustrates the bulk of the DoD's acquisition process for major acquisition programs, which has many bureaucratic "go/no-go" decision points that can often add months to years to the expected program delivery timeline.

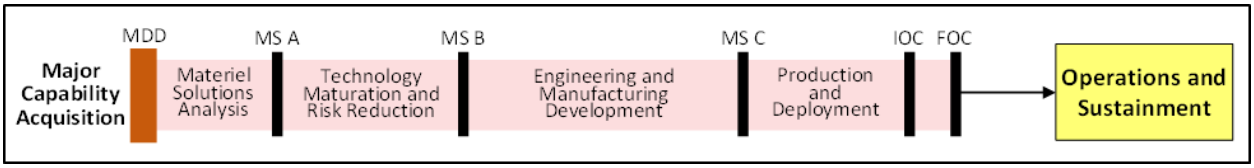

Figure 1. DoD Acquisition Process for Major Acquisition Programs (Department of Defense, 2020)

Since our nation's adversaries have a significant lead in the development of this technology, it is imperative that the USG places significant importance on development of these weapons systems. Unlike our adversaries, most US hypersonic weapons programs are not designed to include nuclear payloads. This poses an additional challenge to the acquisition life cycle since it is more technically challenging to develop as the weapons system needs to be highly accurate in targeting (Sayler, 2023). This can be enabled through research grants, which ultimately helps speed-up the acquisition lifecycle of a program. A more accepted research and development technique is to test technologies through the use of CubeSats. The Hypersonic Reentry Deployable Glider Experiment (HEDGE) program will help bridge some of the gap related to hypersonic glide research and development.

Objective of Research

There are three primary mission objectives for HEDGE: demonstrate the feasibility utilizing low-cost CubeSat technology for defense research and development, where HEDGE supports hypersonic glide research; demonstrate low-cost material screening methodology for hypersonic flight conditions; demonstrate that undergraduate university students can contribute to national security research and development goals, in which HEDGE is a low-cost, accessible hypersonic glide experiment.

The goal with HEDGE is studying the effects of hypersonic reentry through the atmosphere, and as the Project Management Team, our job is to make sure it happens by helping organize the other functional teams to ensure program timelines are being met. Unlike most CubeSats, HEDGE requires an atmospheric reentry to conduct its mission, and thus it will be launched into very Low Earth Orbit (LEO), below 200 km in altitude, so that it reenters the atmosphere soon after launch. The goal of this experiment is to transmit crucial scientific data

back for analysis on conditions HEDGE experienced as it reentered the atmosphere at hypersonic speed.

Program management is an essential component to ensuring that our hypersonic capabilities are ready as soon as possible to ensure the safety of Americans and the United States' interests around the world. One of the most important responsibilities of program managers is to keep projects on schedule and on budget. According to a Congressional Budget Office report, in addition to the $8 billion spent since 2019 on hypersonic missile development, the DoD is requesting $13 billion over the next five years for developing hypersonic weapons programs with an additional $2 billion for actually procuring missiles (Kramer et al., 2023). Adherence to schedule is not only necessary to keep up with our adversaries, but also to keep costs down. Walt Majerkowicz and Stephen Shinn state that it is commonly accepted in the field of program management that cost overruns are directly tied to delays in schedule (Majerowicz & Shinn, 2016).

Given HEDGE's end goal to test conditions around hypersonic reentry via CubeSat technology at low cost , it is essential that we, as a program management team, monitor the budget to ensure we extract the maximum utility for each dollar spent and keep the class on-schedule to keep costs down and prove to our sponsor(s) that relatively cheap, hypersonic flight is possible with our methods.

Methods

Program Management is a team of individuals that oversee a program in alignment with design objectives to ensure the success of the developmental process. Program management is essential for the balance of the sub-groups of a project. Each specialized group is only inclined to

communicate with the people on their direct team. Without proper communication between the distinct groups, the timeline of a project can be strained. Program management can foster positive communication between the sub-groups. However, time is not the only effect of a lack of communication; materials and money can be wasted. Hence, Program management seeks to optimize resources, time, and labor. Additionally, teams may spend time on concepts that don't align with the agreed design objectives. Through Program Management, the sub-groups can be guided to only focus on relevant tasks and avoid non-essential undertakings.

The goal of program management is to improve the organizational process through communication, guidance, and optimization. Program management focuses on the holistic view of a project to examine questions such as "What is the impact of this design?" and "How will this alter existing operational systems?" There is an emphasis on not only the subsystems and how everything fits together but also how the design will be implemented by society and industry standards.

The Program Management Team for HEDGE is broken into four roles: Program Manager, Deputy Program Manager, Chief Compliance Officer (CCO), and Chief Finance Officer (CFO). The Program Manager and Deputy Program Manager ensure the project follows the specified design objectives throughout the developmental process. The CCO assists the subgroups in following industry standard practices, and the CFO affirms the optimization of resources throughout the project. This leadership team will use an Open Source Project Management Software, Open Project, to monitor progress and assign tasks to the specific subgroups, in addition to bi-weekly meetings via Zoom.

Using these tools we will prepare materials for a Technical Interchange Meeting (TIM) at the end of the Fall semester. We will then further our work into the Spring semester continuing

to ensure efficient communication across groups, keeping the project on schedule and budget, and keeping a record of tasks across the class. This will lead up to the completion of a System Integration Review (SIR) at the end of the Spring semester. The completion of this meeting will demonstrate that the HEDGE project is ready for assembly.

Conclusion

As the Program Management team for HEDGE, we are working this year to ensure that HEDGE is a success, by each completing our individual roles. This helps the project stay on track, and ensures that the other teams are able to successfully accomplish their duties. When our CubeSat is launched and released into the upper atmosphere at a speed of over Mach 5, assuming HEDGE is successful, we will gain a better understanding of hypersonic travel and how materials respond under that stress. This is crucial information to help our military stay competitive with other global superpowers so we are less vulnerable to attacks. Nothing is more important than safety, and without missions such as this being performed to gather the data to allow the creation of the most advanced technology and weaponry in the world, the United States would not be able to remain safe.

STS Project

Alex Mintz defines the Military-Industrial Complex as, “a coalition of powerful groups and bodies that share economic, institutional, or political interests in intensifying defense expenditure” (Mintz, 1985, Page 624). Heidi Peters states in her congressional report that the government itself does very little in the realm of new weapon or technology development. The actual engineering work (design, testing, fabrication, etc.) is outsourced to contractors, while government employees are responsible for overseeing the work of these contractors. Prime

contractors work directly with the government and are responsible for the delivery of the technology as a whole, while also potentially managing other contractors. These sub-contractors design or fabricate specific parts of a technology. In her report, Peters discusses when this shift occurred, “Following the conclusion of the Cold War, the U.S. military—in line with a government-wide trend—embraced outsourcing, increasing reliance on contractors instead of using military servicemembers or government civilians” (Peters, 2023). Since this entire system is funded by the government, and therefore taxpayers, there is a responsibility to use money effectively and to the general benefit of the American people.

The fact that, “since the 1990s, the defense sector has consolidated…from 51 to 5 aerospace and defense contractors” complicates this responsibility (“State-of-Competition-Within-the-Defense-Industrial-Base,” 2022, Page 1). Perhaps this consolidation and decline of competition has made the acquisitions process more, or less, efficient. My research will focus on the following questions associated with this mass consolidation in the defense industry: How and why did this consolidation come about? What, if any, effect(s) has this had on the military-industrial complex of today?

Social Groups

As with any other huge system, a huge number of different people and groups played a role in these events and are impacted to this day. The most obvious would be any employees that lost their jobs in this paradigm-shifting sequence of events. It is possible that the owners and higher-ups at these major defense firms neglected to fairly represent the interests of their own employees when cutting these deals. Perhaps executives did this to make more money for themselves, regardless of the impact it may have on their many employees. However, it is also

possible that the changing landscape in the defense industry necessitated these mergers while executives were left unable to save everyone.

The government, including politicians, bureaucrats, and leaders of the armed services played a role in the conditions that facilitated, or encouraged, these mergers. The government, "had made very clear what they could afford and they were going to pay for companies that had one third of all factories and inefficiencies to go with that" (Chang & Chakrabarti, 2023). While all of these people have a responsibility to the American people at the end of the day, it would not be the first time that personal or institutional forces led to decision-making that was out-of-line with the interests of citizens at large.

Lastly, if this mass consolidation created unideal conditions in the military-industrial complex and, thus, an unoptimized military, then our servicemen and women, as well as Americans overall, are ultimately less safe than is possible. It is possible that greed and/or faulty thinking at the highest levels of government and industry are responsible for the endangerment of all those not in positions of immense power.

Methods, Frameworks, and Timeline

Due to the nature of my research topic inherently involving the investigation of an entire system and its actions and influence, I will be utilizing the Actor-Network Theory framework. Actor-Network Theory, pioneered by Bruno Latour, Michel Callon, and John Law. E.J. Roe, places an emphasis on the connections between parts of a system, "through conceiving materially heterogeneous associations between human and nonhuman entities to produce a network constituted through the links rather than the nodes of its making" (Roe, 2009). This seems like a good fit since I will be studying organizations, the people that make them up, and their influence on each other as well as the technologies that they create.

I will conduct my research using a historical and public policy investigation, case study, and potentially interviews. Essentially, I will study a plethora of primary sources from the 1990's, other works of synthesis surrounding defense contractor consolidation, documents pertaining to the development of Lockheed Martin as we know it today, and, if possible, sit down with someone involved in the government acquisitions space between the 1990's and now.

To answer my research questions, I will first examine the nature of, "The Last Supper," the meeting that seems to have jumpstarted this period of rapid consolidation in the defense industry. This involves published interviews with people in attendance or with knowledge of the event, and papers, articles, and/or memos from the time. I will then consult any additional papers necessary to fully grasp what led this to occur in the first place. Then, I will turn my attention to the how. I will look for interviews, financial or court documents, and other case studies to determine what companies merged and when. Lastly, after I feel I understand both what led to this mass consolidation and the mechanisms by which it occurred, I will use recent papers and government reviews to examine the effects on price and innovation. I plan to have most of my initial research surrounding the "why" and "how" of this contractor unification finished in preparation for a potential interview over winter break. I will then move on to focus specifically on Lockheed Martin's path, before training my attention on effects and impacts.

Key Texts

[1] Callon, M. (1999). Actor-network theory—The market test. The Sociological Review, 47(S1), 181–195. https://doi.org/10.1111/j.1467-954X.1999.tb03488.x

In this paper, Callon addresses possible issues with ANT as it is applied to the market. He argues that ANT allows for an explanation of markets, with calculating agents, through

disentanglement, framing, internalization, and externalization. Essentially, for market agents to be calculating, they must separate relationships between goods and other parts of the system that they will take into account, and those that they will ignore. This paper offers me useful tools as I move forward, using ANT to analyze the military-industrial complex, a market in and of itself.

[2] Chang, J., & Chakrabarti, M. (2023, March 1). *"The last supper": How a 1993 Pentagon dinner reshaped the defense industry*. https://www.wbur.org/onpoint/2023/03/01/the-last-supper-how-a-1993-pentagon-dinner-reshaped-the-defense-industry

This is an interview with Norman Augustine, the former CEO of the Martin Marietta Corporation and Lockheed Martin after the merger between Lockheed and Martin. Augustine attended "The Last Supper" where the speech given by Deputy Secretary of Defense William Perry kicked off the consolidation wave in the defense space. He even coined the phrase "The Last Supper" and sat directly next to Perry during the dinner. This is a first-hand account of what happened at the dinner, and what followed among CEO's in the industry and the government.

[3] Hooke, R. (n.d.). The Defense Industry in the 21st Century. PriceWaterhouseCoopers. https://www.pwc.pl/en/publikacje/defence_industry_ads.pdf

This piece dives into the economic conditions that contributed to contractor consolidation in the 1990's and early 2000's and has useful graphics that depict the companies that came together to eventually create industry giants like Lockheed Martin and Northrop Grumman. This piece will be useful to me both in studying the formation of Lockheed Martin as it is today, and the conditions that predated "The Last Supper".

[4] Carril, R., & Duggan, M. (2020). The impact of industry consolidation on government procurement: Evidence from Department of Defense contracting. *Journal of Public Economics*, *184*, 104141. https://doi.org/10.1016/j.jpubeco.2020.104141

This piece studies the effects of industry consolidation on the acquisitions process. It concludes that consolidation has led to a decrease in competition, but an increase in overall efficiency. This is counter to other sources I have come across and it will be important for me to see how these sources compare.

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