

**Private Influence Over Public Security: Privatization, Regulation, and National Security
in the Aerospace Industry**

A Research Paper submitted to the Department of Engineering and Society
Presented to the Faculty of the School of Engineering and Applied Science
University of Virginia • Charlottesville, Virginia

In Partial Fulfillment of the Requirements for the Degree
Bachelor of Science, School of Engineering

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Spring 2024

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

Beyond the atmosphere lies a region where satellites and spacecraft occupy a low-earth orbit (LEO). Once the sole dominion of governments and their space agencies, the nature of this space has undergone a profound transformation in recent decades. The aerospace industry, comprising a diverse spectrum of technologies ranging from weather satellites to space launch vehicles, has evolved into a multifaceted environment intertwined with economic, political, and strategic interests. At the heart of this transformation lies the increasing involvement of the private sector, a trend that has reshaped the dynamics of space exploration and exploitation.

Since the signing of the Commercial Space Launch Act by President Ronald Reagan in 1984 (H.R.3942), private entities have steadily asserted their presence in the aerospace domain, challenging the traditional monopoly of government agencies such as NASA. This shift has brought an era of unprecedented innovation, commercialization, and diversification to the industry, marking a departure from its military-centric history. Current observations and literature paint a picture of a booming industry in flux, where private companies play a pivotal role in driving technological advancements and shaping the future of space activities. With the deployment of satellite constellations for global communication networks such as SpaceX's Starlink to the emergence of space tourism ventures (Chang, 2015), the commercialization of space has unlocked new frontiers. These opportunities, however financially stimulating or technically advantageous they may be, have been raising complex questions about governance and regulation. Within the sea of entrepreneurial vigor, cost-cutting efficiencies, and technological progress lies growing concerns surrounding the implications of private sector dominance on national security. As space becomes increasingly crowded with diverse actors and payloads, policymakers and analysts grapple with the challenge of safeguarding strategic

interests while sustaining a \$418 billion industry now responsible for nearly 2% of the country's GDP (AIA, 2021). The temptations of capitalism to stimulate expansion for internal and international competition, political gain, market growth, and technological prowess encourage further under-regulated growth. This contrasts the hesitance present in protecting critical assets like GPS and communications, controlling information sensitive to commercial and military space activity, and taking necessary precautions in considering international threats.

This paper conducts a thorough exploration into the interconnectedness of privatization, regulation, and national security within the aerospace industry. Drawing upon Langdon Winner's theory of technological politics, I critically examine the evolving landscape of space governance and the associated risks and vulnerabilities posed by escalating commercial involvement. By analyzing key legislative milestones, industry developments, and policy debates, this study aims to reveal general regulatory oversights that have come about through the rapid and vast expansion of industry actors. Analysis will prove how the space industry has been shaped by interplay between technological advancement, civilian capability, national security, and public and private interests. Through a comprehensive review of primary and secondary sources including government reports, academic studies, and industry analyses, this paper will identify the mechanisms through which private sector involvement has influenced regulatory frameworks and governance structures. By identifying stakeholders and assessing the impact of technological advancements on power dynamics and decision-making processes, it will provide insights into the broader socio-political implications of aerospace privatization. Ultimately, this paper contends that the resulting paradigm shift from increased reliance on the private sector within the aerospace industry has profound ramifications for national security. This work seeks

to inform policy discourse and stimulate further research into the intersection of technology, politics, and society in the space age.

Literature review

What influence has the aerospace industry's increasing reliance on the private sector exerted on developing regulations and governance? Understanding these shifts and their implications for regulatory frameworks and governance structures is imperative for comprehending the contemporary aerospace landscape. Through systematic analysis of pertinent literature, I seek to discern key trends, challenges, and opportunities within the privatization and regulation of aerospace activities.

The aerospace industry first truly boomed through wartime efforts directly in the World Wars, and indirectly throughout the Cold War period. (FAA, 2022) Surveillance crafts, high powered rocketry designed for nuclear warheads, and remote sensing satellites characterized this time period. At this time, the industry was composed mainly from the two superpowers, the United States and the Soviet Union. Though commercial aircraft grew conservatively, private space developments had yet to yield much. During this time, civilians did not have access to the information or technology necessary to produce space-faring expeditions, regulating orbital activities and data to government agencies alone. This was the case for many decades, leading to the creation of recognizable developments such as the F-22, B2 bomber, remote imaging technology, and GPS. Aerospace's rich military background isn't unique among various American industries. However, the incredible extent of its development, the distinctive impact space technology offers, and the consequential technological prowess grant the industry a highly notable level of both caution and influence.

In recent history, the aerospace industry has experienced a rapid and massive-scale unparalleled growth in transition towards reliance on the private sector. This transition has been themed by a shift from centralized government control to commercial enterprises. A landscape once occupied by only the world's largest two governments has substituted an array of private companies in a vast and evolving work environment. The space sector, in particular, has emerged as a lucrative arena, with revenues exceeding \$300 billion annually, predominantly driven by satellite technology and telecommunications services (Space Foundation, 2018). This burgeoning private sector involvement, however, has raised concerns regarding its implications for national security and regulatory oversight. Private sector engagement in aerospace activities has introduced a plethora of challenges, particularly with incentives differing from past federal motives. Private companies often prioritize profitability, leading to potential secrecy surrounding research efforts and competitive advantages. The introduction of profit-based enterprises has overturned the foundation and infrastructure laid by military history, altering the way incentives and progress are determined. Moreover, the inherent dangers of space activities, coupled with the lack of clear property rights in orbit, pose significant challenges including abundant orbital debris carrying collision risks. In 2023, Corrado wrote "The lack of orbital property rights due to the Outer Space Treaty will lead to costly misallocation of orbital space and overproduction of orbital debris and collision risk" (Corrado, et. al., 2023).

Furthermore, the increasing involvement of private entities in space launches and operations has prompted discussions surrounding national security implications. Space enterprises are known to be some of the largest, most expensive operations in the world, which can make them difficult to regulate. Controlling sensitive information, ensuring security protocols are followed, and even work-from-home initiatives have raised red flags for national

security. At full scale across thousands of companies today, these minor vulnerabilities create mass uncertainty. The industry's exposure is difficult to understate, with additional factors including out-sourcing for parts and third-party specialists. Experts highlight the emergence of new actors and a broader diversity of payloads, which could potentially alter the dynamics of national space programs, military procurement patterns, and informational supply chains (Popp, 2018). While scholars and policymakers alike have acknowledged the need for increased security measures given the substantial rise in both number and variety of space actors, there remains a gap in adequately addressing the comprehensive security risks posed by this evolving landscape (Hertzfeld, 2016).

My analysis of the influence of the private sector on developing regulations and governance in the aerospace industry draws on Langdon Winner's theory of technological politics. Winner's theory emphasizes the interplay between technology and politics, highlighting how specific technological designs can establish authority and shape decision-making processes. Examining the socio-political implications of technological developments allows for an exploration into the nuances of power structures, accountability mechanisms, and decision-making processes within the aerospace industry. Winner stresses recognizing political dimensions of technology, and the technology inherent to them. By applying this framework, we aim to identify key stakeholders in the American aerospace establishment and analyze the systemic features perpetuating risk and vulnerability within the sector. Though analyzing the ways in which private companies influence decision-making processes and resource allocation, I aim to uncover the underlying power dynamics and their implications for regulatory practices. Furthermore, the framework will help shed light on how technological designs shape the distribution of authority and accountability within the aerospace sector. Langdon Winner writes,

“The atom bomb is an inherently political artifact. As long as it exists at all, its lethal properties demand that it be controlled by a centralized, rigidly hierarchical, chain of command closed to all influences that might make its workings unpredictable.” (Winner, 1980). As large scale engineering enterprises require the coordination of so many individuals, social hierarchies are uniquely inherent to these technologies. For companies like Lockheed Martin, artifacts such as their F-22 fleet can be likened to the atomic bomb in terms of the grave responsibility they carry. Ultimately, this contributes to a deeper understanding of the socio-political dimensions of aerospace governance.

Methods

In this study, I employed a comprehensive approach to gather primary and secondary sources, focusing particularly on instances of changing governance and overall system structure within the aerospace industry since the Cold War era. The rationale behind this methodology lies in the need to investigate the evolution of regulations and governance in response to the increasing reliance on the private sector within the aerospace industry. By examining historical developments and contemporary trends, I aimed to uncover the political significance of evolving technologies, corporate dynamics, and their impact on societal behavior.

To gather data, I conducted an extensive review of scholarly articles, governmental reports, policy documents, and legal frameworks related to aerospace privatization and governance. Specifically, I focused on key documents and events such as the Outer Space Treaty of 1966, the Commercial Space Launch Act of 1984, the Journal of Space Law publications from 2009, the Space Commerce Free Enterprise Bill of 2018, the Space Frontier Act (S.919), and other relevant sources including presidential directives, the Commercial Space Launch Competitiveness Act (CSLCA), and International Traffic in Arms Regulations (ITAR).

This approach was chosen because it allows for a systematic exploration of the historical context and contemporary landscape of aerospace governance, providing valuable insights into the dynamics shaping the industry. By analyzing a diverse range of primary and secondary sources, I aimed to develop a comprehensive understanding of the regulatory frameworks, policy initiatives, and institutional arrangements governing the aerospace sector.

Analysis

The history and military origins of American space programs provided a unique catalyst for companies, creating an environment where technological and political influence may be gained. The Cold War era brought heightened tensions between the United States and the Soviet Union, leading to increased focus on space exploration and military preparedness. The Soviet Union's successful launch of Sputnik in 1957 and subsequent achievements in space exploration fueled fears of technological superiority and prompted the United States to accelerate its own space program. In 1967, the Outer Space Treaty (RES 2222, 1966) was signed, becoming the longstanding foundation for international space cooperation, and prohibiting any claims to national sovereignty. The Commercial Space Launch Act of 1984 (H.R.3942, 1984) marked a significant departure from previous policies by encouraging private sector participation in aerospace activities. This legislative shift aimed to harness the innovative capabilities of private industry and promote American commercialization of the space domain. Various pressures led to the creation of the act such as political influence, market stimulation, commercialized financial gains, and residual cold war concerns with ensuing motives to further develop military spacecraft. By allowing private companies to enter the aerospace market, the United States aimed to stimulate economic growth, enhance technological innovation, and reduce the burden on government-funded space programs. The 1970s, 1980s, and 1990s saw the development of

sophisticated military aircraft and space systems, driven by geopolitical tensions and the arms race between superpowers. Regulations grew by attempting to control the export of sensitive technologies and preventing unauthorized access to classified information. One significant regulatory framework established in 1976 was the International Traffic in Arms Regulations (ITAR), implemented by the United States to control the export of defense-related articles and services. ITAR still regulates much of the industry today, though regulations involving national security have only loosened since the cold war. Dual use technologies, a broad category of satellites capable of performing both defense and civilian services, underwent less rigorous regulation. Commercial satellite and communications restrictions were made less strict as well as tensions have since fallen.

More recent decades have seen increasing dominance of the private sector in aerospace, speaking to the remarkable growth and expansion witnessed in the industry. After the Commercial Space Launch Act, FAA commercial licensing facilitated the establishment of space ventures focusing on civilian applications such as telecommunications, Earth observation, and space tourism. Statistics from industry reports and academic studies highlight the exponential increase in the number of aerospace companies and the value of commercial space activities. According to data from the FAA, there were 324 licensed launches between 1991 and 2019. Since 2020, the United States has seen 319 licensed launches and is on pace to exceed 324 (Federal Aviation Administration, 2023). The market boomed unlike any other in terms of size, significance, and capabilities offered. This was recently characterized in the affectionately dubbed “billionaire space race”, a phrase referring to the multi-million dollar enterprises such as SpaceX and Blue Origin started by CEO’s Elon Musk and Jeff Bezos, respectively. While the shift to stimulate work and research into stem has fueled media outlets, their respective

businesses have claimed a large majority of US launch contracts while vastly increasing efficiencies. According to data from *Space.com*, the number of active satellites was roughly 1200 each year from 1980-2000. Today, that number has reached upwards of 7500 active craft in orbit (Pultarova et. al., 2022), with SpaceX's Starlink constellation comprising over half the currently active satellites. The number of aerospace companies has multiplied, with small startups and large corporations alike entering the market to capitalize on emerging opportunities. Moreover, private goods now constitute the majority of the aerospace industry, surpassing government-funded projects in terms of revenue and market share. The significance of these services cannot be understated, encompassing a vast amount of what most people today would consider 'life-altering' critical technology. So life altering, that Ukrainian Digital Minister Mykhailo Fedorov referred to SpaceX's Starlink as "...indeed the lifeblood of our entire communication infrastructure now" (Satariano, 2023). From SpaceX providing communications for Ukraine in wartime, to basic weather and GPS satellites, the average American is intimately acquainted with products dependent upon essential space infrastructure. This global shift towards privatization has reshaped the dynamics of the aerospace sector, with private companies driving innovation, competing for contracts, and shaping the future of space exploration.

The distinct and rapid diversification of stakeholders has introduced instability into the aerospace industry, bringing forth new motives and directions. The emergence of startups, tech giants, and international players has expanded the range of actors involved in space activities, leading to increased competition, collaboration, and complexity. Chow (2013) highlights this diversity, noting the inclusion of not just traditional space businesses like satellite owner-operators but also those involved in processing space-derived data and offering related products or services. This expansion extends to companies reliant on space-based services for

their operations, complicating the regulatory landscape and necessitating a reevaluation of governance frameworks. Otherwise, important services such as weather forecasting, GPS navigation, cell phone calls, television, and radio may be susceptible to breakdowns, cyberthreats and physical threats. Introducing these stakeholders creates an environment that prioritizes profits, innovation, and expansion, typical of the trends observed in the 2000s aerospace landscape. However, this prioritization often comes at the expense of security and safety considerations. Reportings from industry experts and regulatory agencies often highlight concerns about the potential risks posed by inexperienced operators, cost-cutting measures, and the pursuit of aggressive growth strategies. Victoria Samson (2022) wrote in the *Bulletin of Atomic Scientists* about the general “lack of coordinations”. National security experts have agreed that “changing commercial launch technology alters the monetary costs of the types and timing of deliverables national space programs can produce. These potential transformations of national space programs affect: military procurement patterns, environmental destruction, informational supply chains, and military space operations” (Popp, 2018). These are just a handful of infrastructural processes affected, which in turn have further implications. Applying Winner’s framework to today’s industry reveals the ease with which these companies were able to acquire positions of influence. As Winner (1980) writes, “Ways in which specific features of the design or system provide a convenient means of establishing authority in a given setting” (p.124). Given the industry’s incentives towards growth, federal support through contracts and loose legislation, and the capabilities and influence gained through satellite work, the climate was primed for new actors. These strategies may demonstrate the national initiative to enhance the commercialization of space, but the justification of growth does not validate or vet those

involved. Through this ease of access, if nothing else, the legitimacy and trustworthiness of these corporations are called into question.

Despite the rapid expansion of the aerospace industry, governance mechanisms have struggled to keep pace, resulting in significant gaps in regulatory oversight. Data points indicate vulnerabilities stemming from inadequate regulatory frameworks, posing risks to both national security and public safety. The evolving nature of space activities, technological advancements, and geopolitical dynamics have outpaced the capabilities of traditional regulatory bodies to effectively monitor and control the aerospace sector. Reports from government agencies, academic institutions, and industry associations highlight the need for adaptive regulatory frameworks, enhanced collaboration between stakeholders, and increased transparency and accountability in governance practices. Similar observations were made in research conducted by Texas A&M (Migaud, 2021), calling for the construction of an adaptive governing framework regarding space to amend the growing inadequacies.

Additional challenges such as regulatory arbitrage, jurisdictional conflicts, and regulatory capture further complicate efforts to establish robust governance mechanisms. Attempts to make regulatory resolutions are often stifled, which was the case for many proposed policies such as the Space Preservation and Conjunction Emergency (SPACE) Act and the Space Frontier Act. (Bruno, 2021). Failed attempts to regulate debris and orbital property marks a key government's inability to create adequate legislation in this field. Even existing regulations have been shown to be weak, such as President Trump's Space Policy Directives (SPD), specifically SPD-3 and SPD-5. SPD-5 emphasizes the essential nature of cybersecurity, though cannot compel any agency to make accommodating changes. SPD-3 calls for more robust management of space traffic, but similarly does not invoke action. Instead, it transfers space traffic management

responsibility from the Department of Defense to the Department of Commerce. However, “it did not capture all the top-level standards, guidelines, and best practices that effective STM will require.... with the exception of updating the U.S. government's Orbital Debris Mitigation Standard Practices (ODMSP) first, SPD-3 did not identify which standards, guidelines, and best practices should receive priority in their development,” (Gleason, 2020) as found by the *Journal of Space Safety Engineering*. Orbital traffic and collisions are also addressed by the Orbital Sustainability Act of 2023 (S.447), which establishes programs to research and execute mass debris cleanup in LEO. Along with the scale of the sustainability effort, the retrospective nature we see serves as a testament to the lack of control pre-existing policies were able to exert on today’s industry.

Control problems transcend only issues of domestic regulation. The global nature of the aerospace industry presents challenges in uniting regulatory standards and addressing international border issues, further exacerbating governance challenges and regulatory oversight gaps. As put in the *Handbook of Space Security*, “most of the activities in this domain are unchecked primarily due to lack of an internationally agreed treaty in space” (Khan et. al., 2020, p. 4). With no amended or central governing treaty to dictate activity, sparking limitless concern for the possibility of malicious actors. The under-addressed timbre of space legislation, especially pertaining to commercial capabilities, can be accredited to capitalistic pursuit of financial gain and market dominance. Samson considers these roadblocks to appropriate regulation, describing what might occur if one tries to limit the capabilities of the US commercial sector. “What ends up happening is that the capabilities are driven overseas, beyond the control of the US government. This capability is out there in the commercial sector, whether the United States likes it or not” (Samson, 2022). This mentality has maintained US space law in its infant

state, in turn eliciting foreign and domestic concerns over the quality of the industry with respect to exponential growth.

These global concerns, however, are not limited to legal ambiguity or collaborative semantics. External threats from countries like China and Russia pose real risks to the security of our most precious assets in space. Reports from intelligence agencies, cybersecurity experts, and defense analysts highlight ongoing efforts by foreign adversaries to exploit vulnerabilities in space systems, disrupt satellite communications, and interfere with critical infrastructure. Foreign entities and governments are acutely aware of the critical nature of our space systems, ensuring we actively seek to disrupt potential threats. In a May 11, 2017 Statement for the Record for the Senate Select Committee on Intelligence, the Director of National Intelligence provided the following assessment of adversary space capabilities and intentions:

Russia and China perceive a need to offset any US military advantage derived from military, civil, or commercial space systems and are increasingly considering attacks against satellite systems as part of their future warfare doctrine. Both will continue to pursue a full range of anti-satellite (ASAT) weapons as a means to reduce US military effectiveness. (Coats, D. R., 2017, May 11)

Legislative initiatives such as the Space Protection of American Command and Enterprise Act (SPACE Act) and the Orbital Sustainability Act have attempted to bandaid previous wounds, though these efforts have not resulted in change. Still, these bills address problems in hindsight, and are not outward looking. The assessment of the current policy landscape surrounding the protection of orbital assets has revealed inadequacies related to cybersecurity, physical safety

from debris, and anti-satellite systems. In a recent publication by Willbold et. al. (2023), a survey was conducted involving 19 engineers and developers who represented a total of 17 distinct satellite models. Among these models, three respondents acknowledged that they had not instituted any measures to thwart third-party intrusion. In five instances, respondents either expressed uncertainty or chose not to provide comments, while the remaining nine had indeed implemented certain defensive measures. However, even among these seemingly more secure cases, there were uncertainties. For instance, only five out of the nine respondents had established any form of access controls.

Conclusion

The analysis presented underscores the powerful impact of increased private sector involvement on the aerospace industry's regulatory frameworks and governance practices. Through the lens of Langdon Winner's theory of technological politics, this study has revealed a paradigm shift characterized by evolving technologies, stakeholder diversification, and regulatory challenges. The results of such changes hold profound implications for national security. The findings of this study suggest that the evolving landscape of aerospace governance and existing regulatory frameworks be further understood to address emerging challenges while safeguarding public interests. The increased privatization of space activities has led to a complex interplay between commercial interests, technological innovation, and national security concerns, highlighting the need for adaptive governance mechanisms.

Moving forward, policymakers and industry stakeholders must prioritize the development of comprehensive regulatory frameworks that balance innovation and competition with national security imperatives. This requires ongoing dialogue and collaboration among government agencies, private sector entities, and international partners to address regulatory gaps and

mitigate potential risks. Attempts to do so up to this point have failed as a fully comprehensive analysis of the industry's vast and various facets is needed. It is my belief that a new type of regulation, one more suited for the rapid change of technology and evolving landscapes, must be configured before there can be effective legislation. Further research in this area could contribute to a deeper understanding of the socio-political dynamics shaping aerospace governance. By examining the long-term implications of private sector dominance on regulatory practices and societal outcomes, scholars can inform policy discourse and stimulate further innovation in space exploration and utilization.

In essence, the evolving landscape of aerospace governance presents both challenges and opportunities for policymakers, industry stakeholders, and society at large. By acknowledging the complexities of privatization, regulation, and national security within the aerospace industry, stakeholders can work towards a more equitable, accountable, and sustainable utilization of space resources in the years to come.

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