Conceptual Light Attack Aircraft Design

The Evolution of the U.S. Space Program and its Impact on Society

A Thesis Prospectus Submitted to the
Faculty of the School of Engineering and Applied Science
University of Virginia • Charlottesville, Virginia

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

,

Technical Project Team Members
Will Ayscue
David Gibbs
Catherine Hanafin
Lauren Hancock
Blake Mager
Brendan Schneider
Hope Wheeler

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

Signature _____Will O'Sullivan Ayscue_____ Date 11/22/2020

Approved _____ Date _____
, Department of

Approved _____ Date _____
, Department of Engineering and Society Introduction

STS Prospectus

Introduction

When we look into the night sky, we are staring at the same space that generations of humans before us did. Nothing has changed about the outer space its self, but the way in which humans utilize it and view it has. The meaning of space has evolved dramatically since Cold War. Beginning in the 50's and continuing through the end of the Cold War, space exploration was primarily driven by the USA and USSR through government run agencies. The technological prowess of each nation was on the line, as well as national security and defense. The moon landing in 1969 by NASA marked a great point of national pride, as did the development of the entire Apollo program, for the American public. Once the Soviet Union dissolved, and with it, military threat, space began to transition from a platform for defense to a platform for economics. New satellite technologies for communication surveillance offered a new frontier for the private industry. Once the American Space Shuttle program ended in 2011, NASA had no means for launching humans into space, and relied on the Russian Roscosmos. This led to programs being initiated on Capitol Hill that would make NASA utilize the private industry to support its operations of the ISS. In 2020, this public-private-partnership has made the space launch industry a $300 billion a year industry.

Space is now an inherently political area, and the way humans utilize it and view it are changing. Today, the decision makers are not only governments, but also private companies that partner with public administrations to provide satellite technologies to ordinary people. The most pressing questions are how has the meaning of space changed, how has the publics view of the

space program evolved, and how has the public-private partnership redefined how space technologies are developed and implemented.

The evolution of America's space program has simultaneously followed and led the meaning of space for Americans. This thesis will describe how this meaning has evolved and who the decision makers are that control the development of space technologies. Winner's Perspective can provide insight into the evolution of the space program as it describes the political framework around space technologies. The STS theory of Large Technical Systems can help guide investigation in the public-private partnership that has also evolved as the space industry matures. These tools will allow me to identify the role that space technologies play in the political sphere, and why the government's interest in space has evolved. Furthermore, I will be able to identify what factors led to NASA relinquishing control and authority in space exploration to private companies.

Research Question

The purpose of this investigation will be to answer the question, "how has the meaning of space exploration evolved since the 1950's?" Subsequently, I must answer "how has the public's view of the space program changed?" And finally, "How has the public-private partnership changed?"

Literature Review

There are two main themes that guide the discussion around the evolution of the space program, and how the meaning of space has evolved since the 1950's. The first theme is the public's impression of space technologies and how during the Cold War, American dominance in space was directly connected to national pride. American's not only saw the Space Race as a

necessary defense undertaking, but also as an opportunity to display American technological prowess (Leib, 1999). The second theme revolves around the public-private partnership that has made the space program so successful. While NASA maintained control over the entire space program during the Cold War, developments in the past two decades have shifted the responsibility and agency to private companies.

The public's perception of the space program was most easily defined during the Cold War's Space Race. The success or failure of NASA linked directly to American pride and nationalism, especially heightened by the perceived threat of the Soviet Union and subsequently communism (Erickson, 2018)

As Erickson (2018) points out, the success of the American space program over the Soviets was a result of structural and societal differences between the two countries. The United States' program relied on open and accountable management as well as the collaboration between universities, private industry, and the government. Furthermore, the American society benefitted from its free market and capitalism. Innovations in space technologies directly benefitted from the prevalence of commercial technologies like computers chips and computer technologies. Leib (1999) takes this a step further and argues that the societal characteristics that differentiated the United States and the Soviet Union were used by the politicians to bolster support for the space program. Leib shows that politicians touted the space program's successes by saying they could only be accomplished in a free market by free people. All of the spacecraft developed under the space program carried themes of democracy and freedom, including *Freedom 7, America,* and *Columbia.* Planting the flag on the moon was the most potent symbol of American technological prowess. What this reveals is that the technological feats

accomplished by the space program were seen as the result of America's free and open society, that promoted and championed innovation and collaboration.

The American public was influenced heavily by the media during the Space Race. While many Americans saw their work as an important contribution to the containment of communism and the preservation of the American way of life, the media had the largest roll in determining public opinion regarding the Space Race (Werth, 2004). The success of the American campaign against the Soviets revolved around the widespread positive display of their achievements. This bolsterd patriotism and love for technology, and promoted national pride and inspired youth (Werth, 2004; Leib, 1999). The media relayed the successes and failures of the space program, which in turn raised or tarnished the American public's self esteem and pride. Werth (2004) argues that the space program was the first mobilization of US civilians to wage the Cold War, and their national identity was paramount to defeating the Soviets. The common theme in these papers is that the American public was greatly invested in the space program. National pride was directly tied to the success of the space program. The interaction between space and the public had never been so closely intertwined.

Today, the American public's perception of the space program is not nearly as clear as it was during the Cold War. While it is less powerful, enthusiasm for space exploration has been renewed at the hands of private companies like SpaceX (Chaben, 2020). This is one gap in information that I would like to pursue. To have a complete overview of the evolution of the perception of the space program, a survey would help identify where American's stand now with their investment in, and support of space exploration.

The public-private partnership has changed drastically since the conception of the American space program. All new innovation requires funding, whether through government

programs, or private investments. In the heat of the Apollo program in 1965, NASA received about 5% of the national budget, which it then used to design, and later develop and build its rockets using subcontractors. NASA maintained the rights to the intellectual property it developed (Chaben, 2020). Drastic changes in the program occurred in 2004, and again during the Obama and Trump administrations, that put pressure on NASA to utilize the private industry in order to fulfil its needs. NASA showed the private sector what it needed, and from there it was the private sectors hands to deliver. In this sense, NASA dominated the innovation of space technologies in the early years, and then shifted from providing oversight to insight regarding the development of space technologies (Weinzierl, 2018; Chaben, 2020). This reveals that the partnership between the NASA (a public agency) and the private sector has changed in terms of how the space program is funded. Furthermore, Chaben reveals that the decision to shift the partnership in favor of private industry was a decision that came from Capitol Hill. As Chaben points out, the new partnership framework increases innovation in space technologies.

The private sector has led the space technology innovation frontier. Private companies are able to adapt to market conditions and the need for new space technologies not because they are more well equipped, but because of the need to survive in the free market. Private industry has the need to be efficient and quick to develop new technologies because under the new legal framework, companies are allowed to keep their intellectual property developed for NASA's space program (Weinzierl, 2018; Miller 2019; Motz, 2019). These new technologies can also be employed as lucrative financial instruments to a broadening market for space technologies. Take, for example, SpaceX's Falcon 9 rocket. It was originally developed to support NASA's maintenance of the ISS, but has also created revenue for the company by providing additional launch capability to communication and observation companies by launching their satellites

(Weinzirl, 2018). In contrast, Chaben argues that because NASA was the exclusive customer of manufacturing companies, innovation was limited. This aspect of the public private partnership makes innovation in the space industry very attractive for private companies, and has only been a reality since the public-private partnership shifted towards the private sector developing space technology.

Another effect of the shift in the partnership between NASA and private space companies is the economic savings. The efficiency of the private industry keep costs low for NASA, but also takes the element of risk outside of the agency. Private companies that were used as subcontractors for NASA during the Cold War served NASA on a cost-plus basis, meaning they were paid for all of the development costs, and then some. Now, NASA doesn't need to worry about the costs of developing new technologies because they pay a flat rate for the use of rockets (Weinzirl, 2018). Weinzirl argues that this framework puts the pressure on private companies to deliver new technologies on a cost-efficient basis. The Falcon 9 rocket cost SpaceX only 1/3 of what NASA projected a similar project would have costed the agency to develop (Chaben, 2020). This shows that the legal and political framework that surrounds the public-private partnership has made space technologies not only more innovative, but also less expensive. This is a grand departure from NASA-led development of space technologies in the Cold War.

In summary, the change in public-private partnership has driven innovation in the space industry, and also made it more affordable. The economic benefit for private companies to develop technologies that in the past NASA would take the lead on are high, and NASA also benefits from partnership.

The space program has evolved since its inception in the late 1950's. The American public's perception of space has evolved along with the primary means of developing space

technologies. The intertwining of public opinion and national pride with the space program in the 1950's is unclear, although it certainly seems like the bond is much weaker than during the Cold War. The relationship between government, private industry, and NASA is clearer, and is still evolving today. We may be at the beginning of a new dawn of space exploration ushered in and fast-tracked by private industry. Analyzing these two topics through STS frameworks will provide new insights and further the definition of what space means to America, its citizens, and the private sector.

STS Framework and Method

The LTS conceptual tool will help analyze the formulation and development of new space technologies. This tool will help to identify and characterize the relationship between the builders, funders, and reverse salient present in the public-private partnership as it has evolved through the decades. It will also help to describe the momentum that space companies and NASA have and where the momentum comes from, whether from the expanding space industry, or from the need for nation defense. This tool will be a way to provide a view of the smaller, more fine points of interest that will help structure a big picture view of the evolution of the space program.

Winner's perspective will be a useful tool in showing what technological artifacts have politics, and what those politics are. The space program was created out of political need, and became a source of national pride. The interaction between national pride and the space program can be better defined by this tool. The specific artifacts that can be analyzed are the Lunar Module, and SpaceX's Falcon 9 rocket and Dragon capsules.

The primary method for data collection will be from secondary sources. Old media from the Cold War era will provide invaluable insight into America's view of the space program, as well as the national pride associated with it. These documents will likely be biased because of the time in which they were published, and the fervor of the Space Race may obscure the true perception that American's had of the space program. Books and other resources written after the Cold War will also provide useful insight into how the space program was structured, and the national sentiment associated with space exploration. These documents will capture the spirit of how media portrayed the space program, as well as possibly the associated bias that comes with war-time media.

Another source of data will be from a survey intended to capture current American "space literacy" and how Americans view the space program.

Timeline

March 15th: First draft

April 15th: Polished draft

April 15th through May: Review

Conclusion

The meaning of space has evolved since the dawn of human space exploration. It has always served the purpose as a national defense platform, and more recently as an economic platform. The evolution of the American space program has included a shift in the American public's perception, as well as the public-private partnership that has guided along the way. National pride was closely linked to the successes in the space program during the Cold War, and has

since shifted away. The introduction of private space companies has also changed the way in which space technologies are developed and employed. Space innovation has never been more impressive while costing less and less. STS frameworks such as Winner's perspective and LTS theory will be invaluable tools to create a bigger picture of what space means to American society and the private sector, mainly by analyzing secondary sources, newspapers, magazines, and books, as well as primary sources such as surveys that will capture society's view on space exploration in 2020.

Bibliography

Chaben, J.B. (2020) Extending Humanity's Reach: A Public-Private Framework for Space Exploration. *Journal of Strategic Security,* 13(3), 75-98. https://www.jstor.org/stable/26936546?seq=1#metadata_info_tab_contents

Erickson, A. S. (2018). Revisiting the U.S.-Soviet space race: Comparing two systems in their competition to land a man on the moon. *Acta Astronautica, 148*, 376-384. doi:https://www.sciencedirect.com.proxy01.its.virginia.edu/science/article/pii/S0094576518306271?via%3Dihub

Kavanaugh, C. (2019*). New Tech, New Threats, and New Governance Challenges: An Opportunity to Craft Smarter Responses?* (pp. 30-37, Rep.) Carnegie Endowment for International Peace. https://www.jstor.org/stable/resrep20978.7?seq=1#metadata_info_tab_contents

Launius, R.D. (2009). Abandoned in Place: Interpreting the U.S. Material Culture of the Moon Race. *The Public Historian,* 31(3), 9-38. https://www.jstor.org/stable/10.1525/tph.2009.31.3.9?seq=1

Leib, K. (1999). International Competition and Ideology in U.S. Space Policy. *International Studies Notes,* 24(3), 30-45.https://www.jstor.org/stable/44235351?seq=1

Miller, A. (2019). Countdown to Commercial Crew. *Aerospace America*, 57(2), 19-23 https://advancelexiscom.proxy01.its.virginia.edu/api/document?collection=news&id=urn:contentItem:5VGS-D7B1-JC8V-44G6-00000-00&context=1516831.

Motz, J. C. (2019). The Changing Dynamics of Twenty-First-Century Space Power. *Journal of Strategic Security*, 12(1), 15-43 https://www.jstor.org/stable/26623076?seq=1#metadata_info_tab_contents

Simberg, R. (2016). Getting Over 'Apolloism'. *The New Atlantis,* 49, 51-60. https://www.jstor.org/stable/43893404?seq=1#metadata_info_tab_contents

Spencer, B. (2016). The Book and the Rocket: The Symbiotic Relationship between American Public Libraries and the Space Program, 1950-2015. *Information and Culture,* 51(4), 550-582. https://www.jstor.org/stable/44667589?seq=1#metadata_info_tab_contents

Stark, R. (1984). NASA: A Reliable Airline. *Harvard International Review,* 6(6), 37-39. https://www.jstor.org/stable/42773917

Weinzierl, M (2018). Space, the Final Economic Frontier. *The Journal of Economic Perspectives, 32(2), 173-192.* https://www.jstor.org/stable/26409430?seq=1#metadata_info_tab_contents

Werth, K. (2004). A Surrogate for War — The U.S. Space Program in the 1960's. *Amerkastudien/American Studies,* 49(4), 563-587. https://www.jstor.org/stable/41158096?seq=1