An Analysis of the United States Space Agency and Its Role in America

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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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Fable of Tomorrow

I was seven years old and my dad bought me a picture book from Barnes & Noble. It was titled "The Sun & Planets". Filled to the brim with pictures of the galaxy, nebulous star nurseries, planets and asteroids. Some pictures so entrancing and colorful, I used to turn the pages slowly and hold my breath because the thought of just how *enormous* space was, occupied my curious seven-year old mind night after night. The book stayed closed more than open as I grew older but it still sits quietly on a white book shelf holding billions of planets between its pages.

I was thirteen years old and I asked my mom for money so I could buy posters at the scholastic bookfair. I walked to the register and checked out 3 books, a poster of the solar system, and glow in the dark stars to put on the ceiling of my room. I got my first laptop in middle school, and I would spend late nights on the Wikipedia pages of each planet and moon I could find. Canvases hung on my walls swimming with shades of black, blue, and purple, splattered with powdered-sugar like dots of yellow and white. My own little galaxy wrapped around my walls, painted by the little hands of an awkward middle schooler – a little galaxy like the one I had in my own mind.

I am twenty one years old and a few years of sleepless nights, too much coffee, and a little madness – I am going to join a team of engineers that build satellites. The most sophisticated machines flying thousands of miles per hour, a little handcrafted part of humanity floating around in space. Enabling possibilities of connecting people around the planet, providing infrastructure to create completely wireless and global systems. I can be a small part of making something with my hands – burning solder onto tiny resistors and capacitors, creating circuit boards with dry, chipped finger tips – an entire world of capability in something that can fit into

the palm of my hand and then fit into something bigger and bigger until it is one of the tiny moving lights you see traveling across the sky every once in a while. People look up and wonder – just for a moment – if maybe the light is a shooting star.

Introduction:

Looking up at the night sky in wonderment is not something new to almost every human being on the planet. Humans admire and are fascinated by space, stars, and the endless possibilities that such unexplored vastness could contain. The space industry and space technologies first developed as a result of the Cold War and competition that the United States had with the Soviet Union at the time. In the late 1930's and 40's, Nazi Germany had developed long-distance rockets and missiles as weapons that could go record-breaking distances and heights which led to the ignition of Soviet Russia and the US to develop their own missile programs. These missile programs were the seed that led to the development of a full-fledged space program in both these countries (A Brief History).

Over the years of technological development in the space industry, there have been a number of failed missions and wasted tax dollars, but there have also been many instances of the loss of lives. Some may even argue that the current projects and trajectory of NASA no longer aligns and represents the scientific pursuit desires of the actual civil society. Studies have shown that the attitudes and support towards NASA's scientific pursuits has fluctuated greatly over the years since the birth of the space program during the Cold War. During the 1960's and 70's, support for sending a man on the moon was incredibly big. Americans had a big surge of nationalism and American pride at this time due to the competition and national threat they received from the Soviet Union at the time. Over time however, studies and polls show that most

Americans support scientific efforts towards climate change, Earth protection, and more robotic space-flights – which aren't the kinds scientific pursuits that NASA is currently working on.

This poses an interesting question about the relationship between the civil and actively tax-paying American people and the government's space program. How has the discourse of space and space technologies changed over the years? What historical events, developments, or shifts have happened since the start of the space programs that has caused a mismatch between what polls show the American community wants and what policies and projects the government funds in the space program. A space program that started off as something that was enacting the public's expressed wants has turned into a space program that seems more and more disconnected with current public discourse.

This thesis aims to examine the views of American people in the context of history to build a picture of the changing technologies and discourse around space policy, and how the relationship between American people, the US government, and NASA has changed over time.

Literature

Existing literature has shown that NASA's space projects and developments have gone through significant scrutiny and changes in support over the years.January 28th, 1986, marked one of the most devastating days in the history of space exploration. The greatly anticipated Challenger rocket was set to launch with a crew of astronauts that contained one civilian teacher as well, but instead, the Challenger launch is now regarded as one of the biggest technical failures in NASA history.

Just seconds into the nationally televised event, puffs of smoke engulfed the space craft, and the entire craft – a burning ball of fire – split apart in mid-air, killing the crew on board. A committee was formed to investigate the cause of failure, and it was concluded that the rubber-

like sealant, also known as O-rings, between the rocket booster joints had leaks which caused highly pressurized fuel to penetrate other parts of the rocket (Ocampo, 2014). It was also discovered that the faulty O-rings, surprisingly, were a well-known problem among the NASA engineers. Engineers from the Morton Thiokol contractor for NASA had expressed concerns about the leaking from the O-rings, however, NASA and higher officials, based on previous successful launches, determined that the O-ring leakage was an acceptable risk. This obviously was not the case on the morning of the launch, when this margin of safety is exactly what caused one of the worst space-related disasters in the history of the United States (Vaughan, 1996).

A few years later, the Columbia rocket was another highly anticipated mission, and the second disaster after the Challenger that caused widespread grief and concerns about the space programs and engineers within them. During test launches of the craft, it was found that pieces of insulation foam were breaking off and hitting the body of the rocket during lift-off. None of the test launches had ever had any dents or mechanical problems that caused further failures, so it was deemed that the foam breaking was an acceptable risk. On the day of the launch, the Columbia rocket made it successfully out of the earth's atmosphere, into space, completed its mission, and was re-entering the Earth – on its way to bring the crew of astronauts back home after a success. During re-entry, a piece of foam insulation broke off the craft and hit the shuttle's left wing with such force, that the dent was large enough to leave a hole in the wing. This hole caused gasses and pressurized fuel to enter the spacecraft which then blew up in mid-air, killing every member on board (Hogeback, n.d.). This was another huge technical failure on NASA's part as the foam problem was something that had been known and documented, and deliberately left untreated because nothing bad had happened during trials. NASA scientists and engineers, much like the time of the Challenger disaster, had known a problem, and chose to

create a margin of safety for the defect rather than working to fix the root of the defect in the first place (Dooling, 2019).

These are just a few examples of the numerous failures that NASA has had launching space vehicles. With this number of engineering failures and inconsistency, the fact that we haven't made it to the Moon again after the original Apollo mission, and the fact that no huge space-related breakthrough projects have been successful, one would imagine that funding for NASA and the space program has decreased over time from the Apollo era to now. However, studies show the funding for NASA has not decreased significantly over the last two decades. The NASA budget has essentially been on "autopilot" after the Apollo missions, and although there are significantly less number of projects and launches that NASA performs every year, it's yearly budget does not suffer from any kind of cuts that match this decrease in progress (Nasa's Planetary Science, n.d.). This means that American's pay the same amount in taxes to fund a multi-billion dollar program that has been decreasing its yearly output over the last two decades without any adjustments to funding. A number of failures later, American support and understanding of the space program itself has decreased since the 70s (Nadeau, 2013), and Gallup polls and public surveys show that what American's think is important is no longer what determines the highest priority projects and pursuits by the space agency (Foust & Foust, 2018). All of these nuanced observations make it imperative to study where and how the opinions of American civil society and tax payers drifted further and further away from the nature of space policies and projects that are implemented in the space program.

STS framework and Research Method:

This thesis will employ Actor-Network Theory (ANT) (Rodger, 2009) to characterize and define some relationships between the American public, NASA, the government, and US foreign

relations to establish the role that NASA plays in domestic as well as foreign affairs. [A brief introduction of ANT and explain why it is a good analytical tool for this project].

In terms of research data collection, this research uses document analysis to analyze the relationships between all the moving parts of the space program, how it gets its funding, what the public opinion shows, what governmental policy shows, what projects are being pursued, and the like. Documents including journal articles, policy papers, congressional meeting notes, newspaper articles, Gallup polls and a wide variety of other resources will be used to frame and analyze the nuances behind space policy decisions, who makes them, who funds them, what the public thinks about it, and what may be missing in this large network of a relationship.

Data Analysis: Contextualizing "Space"

The Space Program and the US Government During the Cold War

Presidential agendas priorities have changed significantly over the years, for example, issues pertaining to national health care was a true non-issue during most of the 1980's which cannot be said about the current political environment. In the same manner, after World War II, the major fixed agenda items of the presidency were related to economy and international relations. Space policy and the establishment of NASA really benefitted from this priority of international relations post WWII era. In 1961, President Kennedy announced the Apollo Project – funding and policies dedicated specifically to getting an American on the Moon. At the time, the Soviet Union was having breakthroughs related to space travel as they launched the very first vehicle into space, the Sputnik, and eventually the first man into space, Gagarin.

The first human space flight and space shuttle was a huge actor in the developmental efforts at the time. Common Americans felt a big surge of patriotism and fervently supported NASA's efforts to, not only develop in the space industry like the Soviet Union, but specifically

to accomplish human spaceflight, and in a grander way than the Soviet Union had. Although space technology efforts and satellites had been launched by the Soviet Union before, it did not trigger the "space race" or any sort of technological race with the US. The introduction of the space shuttle and the sending of an actual human into space bolstered US efforts to do the same. This determined NASA's efforts and project for the following many years as the Apollo 13 mission as well as the Columbia mission were huge national scientific pursuits that involved sending more and more humans into space for different missions.

The president's goal was not merely to reach the moon, but, more importantly, to rekindle national morale and demonstrate the United States superiority and strength against the Soviet Union (Handberg, 1998). More importantly, during this war and political climate, and surge of patriotism, the support and opinions of the American public went along quite well with the pursuits of NASA as well as the government policies about space that were developed at this time. As time goes on, this close relationship between NASA's developments and the academic and tax-paying American opinions about what should be pursued digresses.

During this time, the space agency was given importance to show US technological supremacy which indicated economic and political superiority to the rest of the world (Symington, 1974). Eventually, this "space arms race" against the Soviet Union, and in the future, against other countries with developing space programs led to a great amount of pressure on engineers and NASA members to deliver projects on deadlines. This air of urgency in order to please the government's demands and, on a national scale, show US prestige, created an absolute necessity for "safety margins" for certain engineering designs. It was incredibly time consuming and costly to determine and fix the root problems of any inconsistencies in a design, but incredibly more efficient to test an inconsistency sufficiently, and create a margin of safety for it

which would help determine what kinds of inconsistencies were "normal and expected" versus which inconsistencies were something that would actually cause failure (Feldman, 2004). This creation of a margin of safety in engineering, and the concept of acceptable risk, played a heavy hand in the failure of the Challenger and Columbia launches. Examining the nuances surround acceptable risk in engineering is out of the scope of this prospectus.

The Space Program during 1990's post Apollo 13 and Columbia Disasters

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Over the years after the Apollo missions as well as Columbia disaster, studies were conducted to gauge public support of the space program. A decade ago, most of the support to fund NASA came from white, male, baby-boomers, and males in higher socio-economic status that had a "greater" appreciation for the sciences and were also alive during the Apollo missions to the moon. This support is termed "Apollo Nostalgia" since most of the support for continued heavy funding of NASA came from those who were alive and admired the Apollo missions. However, more recent polls show that public support is largely apolitical. Supporting the space program and its projects is a more personal and educational opinion rather than a partisan one,

which interestingly enough, is not the trend seen in the US government. The US government shows that republican parties often support more funding for the space program as it is seen as a defense tool, whereas democrats do not (Nadeau, 2013). This implies that the government and its interests about funding the space program may not necessarily align or even take into consideration the public opinion – which is especially concerning since the American public tax dollars is what funds the government space program.

The introduction of normalized deviance, margins of safety, and other workarounds for engineering problems that were noticed as well as the subsequent failures of moon launches and space launches contributed to the slow demise of American support for these kinds of expensive projects – in a monetary as well as, in some cases, a human life sense. These big mission failures and consequences of normalized deviance are a huge non-human actor in American attitudes towards the space agency during this time. People - common people, as well as academics and financial professionals - questioned the huge amounts of taxpayer money being funneled into NASA since the United States was the biggest debtor in the world. Financial institutions and scholars, as well as educated Americans largely thought that NASA was pursuing projects for prestige rather than scientific merit. Americans expressed the ideas repeatedly through newspaper publications and polls that there was so many risks associated with manned space flight, that, in relation to reward, people felt that scientific discovery could be obtained from unmanned exploration; a better use of finances, as well as a lower risk pursuit in space for nearly the same, if not, a better outcome (Financial Times, 1988).

Introduction and Importance of Telecommunication Satellites and current opinions

The definition of space and its use is constantly shifting and changing as newer and newer technologies are developed. The next enormous breakthrough in space technology came

with the introduction of telecommunication satellites that allowed the world to connect with one another. The introduction of satellites that provided infrastructure for GPS, cellular communication, internet, and the like pushed the entire world to develop space technologies that increased connections and promoted faster and faster communication.

The rise of climate change activism, telecommunication, and other major global movements has shifted the American civil society's attitudes towards the projects and scientific pursuits the country should be taking.

Public opinion on what projects should be funded with taxpayer money versus what projects NASA gives highest priority are nearly opposite of each other. Polls show that although the public "broadly supports NASA", it thinks that the space agency should be focused more on Earth science and planetary defense rather than human missions to the moon or Mars. People have voiced the fact that Earth's climate crisis and climate change projects should be the top priority of NASA as well as monitoring potentially hazardous asteroids and space debris, known as "planetary defense". On the opposite end, less than 18% of respondents in this poll supported manned missions to Mars, and most people interviewed said it should, at least, be a low priority project for NASA compared to other ones (Foust & Foust, 2018).

People may argue that the government is not very well aware of exactly what the common American wants, however many committees in Congress have held meetings where the point of discussion is this topic exactly. The subcommittee on Space and Aeronautics conducted a meeting in 2009 to discuss the fact that NASA's endeavors should be relevant to the changing wants and needs of the American people. Ratings and polling of American civil society shows that the most important scientific pursuits for people are developing alternative energy sources, environmental improvement, climate change projects, and a push for unmanned exploratory

missions. A direct quote from the meeting states, "NASA scores high ratings when it stands alone for public support, but suffers when put in a list of priorities with other competing goals….To Improve, we need to ensure that we have a worthwhile and challenging space flight goal that is adequately funded, and we also have to effectively convey that America's space program provides concrete solutions to a wide array of societal problems" (Giffords, 2009, p. 4).

Interestingly enough, despite knowing that the missions of the space program do not necessarily align with and convey what American people want since. 2009, missions for human astronauts to explore Mars and return to the moon are among NASA's most high-profile and high-priority cases. The Trump administration has expressed strong support for these initiatives saying that exploring different planets and getting Americans back on the Moon should be the NASA's core mission (Majority of Americans, 2019)

Discussion: An ANT analysis on the socio-technical imagination of Space

Space, as an entity, has gone through many changes and contexts depending on the most significant actors of the time. Space, at its foundation, is not simply a wonder to be awed by, a beautiful picture to paint, or just a place to bring to life the most advanced engineering creations, time and time again – it is, somehow, both all at the same time.

During the birth of the US space program in the middle of the Cold War, Space had been contextualized by the other countries making use of it. The Soviet Union successfully created a human-carrying space craft and sent the very first person into space, both very important actors that defined what space "was" to the rest of the world. In order to keep the US at the forefront of technology and development, the United States efforts at the time were streamlined to be the first country to send a man to the moon. As time went on, different actors came into play that shifted the context of space technologies.

After the US had successfully sent a man to the moon, the space program continued its efforts to send humans into space in better or more efficient space crafts which resulted in lost lives and failed projects. These failures were an actor that shifted the perspective of civil servants – the common people of the US. US academics, financial advisors, and even congressional committees started questioning the importance of man-made flights into space and advocated more and more for discovery-based projects: space vehicles that were robotic and could do discovery based missions on different planets that would preserve the lives of astronauts as humans were deemed frivolous in space when doing simple data collection and discovery. Public opinion started aligning more and more with pursuing non-human space projects, saving taxpayer money, and potentially even pursuing earth-saving and protection projects as global warming and its effects started becoming more prominent in the science community. This was the starting point of the divergence between public support for NASA's projects and the projects that NASA was pursuing.

With the introduction of telecommunication, satellites, and the rise of the age of communication, the context of space shifted once again to be a place that would allow the whole world to become connected – a context that hadn't been realized before with the missions to send humans into space. With this view of space and the realization that space could be harnessed as a place to allow the world to be more connected than ever before, creating new communication techniques and technologies became the forefront of development in the engineering world. Private companies started rising up to launch their own technologies that would aid in interconnectivity – GPS, WIFI, Global Internet, etc. Public opinion, once again, was aligning with the advancement and development in the communications sector, and still remained with discovery-based and environmental protection efforts, efforts to harness renewable energy, and

the like. The efforts of the US space program, however, still seemed to be on sending humans into space and potentially sending people to Mars rather than the types of efforts the public wanted to see. Public support for US space efforts, once again, continued to diverge from the projects the US space agency were pursuing as its highest priority.

Conclusion

In order to begin to close this gap between what the civil society of America wants and what the US space agency is doing, a huge push for increased communication and education must be made by the US government. If the government attempts to be more open with the public about where funding is being allocated, what projects have good potentials to be pursued, and with the benefits and costs of different space efforts, the public will be able to make more informed opinions that the US government can trust is based on education. With a push for more transparent policy-making as well as a push for education and understanding of the intricacies that rise at the intersection of space and engineering, it would allow common citizens to have opinions that are well-informed. With well-informed public opinion, it will become harder and harder for the US government to write-off or ignore the opinions of the civil society. This may begin to restore the gap that exists between what exactly the public wishes to see as its country's scientific pursuits and what a country itself pursues with a publicly funded budget.

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