

THE POLICY EVOLUTION AND PRIVATIZATION OF COMMERCIAL SPACE SYSTEMS

By  
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I cannot thank you enough for the love and support you all have shown me throughout the years, from my time in Pascagoula, at Arizona State University and here at the University of Mississippi; your love has been unconditional and your support unwavering. You pushed me to continue on with my thesis, providing constructive feedback and emotional assistance. I love you all dearly.

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Thank you for taking the time to help me disseminate what information I needed to focus on, in regards to space policy, and offering your expertise on space law as to guide me toward additional sources to research so that I could successfully complete this thesis.

## **DEDICATION**

I dedicate this thesis to my grandfather, Dr. Jack Hoover, and to the spark he ignited in me when I was a young man to pursue the studies of public policy through his example of being a leader for his family, friends and community at-large. You were always a role model for me and I hope this thesis demonstrates my commitment to civic engagement as well.

“We choose to go to the moon in this decade and do the other things, not because they are easy, but because they are hard, because that goal will serve to organize and measure the best of our energies and skills, because that challenge is one that we are willing to accept, one we are unwilling to postpone, and one which we intend to win.”

--- John F. Kennedy

**ABSTRACT**

Nestor Karim Delgado: The Policy Evolution and Privatization of Commercial Space Systems

(Under the direction of Dr. Joseph Holland)

From the Wright Brothers to SpaceX launching the Falcon Heavy, space systems, and the policies that govern these systems, continue to evolve at a rapid rate. However, as space travel becomes commercialized, the federal government is beginning to realize that it would be cost-ineffective to continue to manufacture, maintain, and operate space systems completely through their own agencies. In result of this, it would be proactive for policymakers to decide what policy tools would be most effective in regulating space systems and the space ports in which they travel. The purpose of this study is to present research on the background of space systems and examine privatization as a governmental policy tool within the context of these systems. This thesis concludes that it would be advantageous for policymakers to advocate for a policy agenda that would promote the complete public ownership of space ports while allowing space systems to be manufactured, maintained, and operated in a public-private partnership between private companies, such as SpaceX, and government agencies, like NASA. To draw this conclusion, this thesis presents many formats, approaches, and philosophical attributes of privatization, and analyzes the merits and failures of these different characteristics. Furthermore, this thesis critiques the presentation and analysis of privatization within the context of space systems and space ports.

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## CHAPTER 1

### INTRODUCTION

#### **Purpose of the Study**

Starting with the Wright Brothers and most recently, with Northrop Grumman acquiring ATK Rockets, the evolution of space systems as we know it today has had a profound impact on American society. Whether it's through commercial airlines such as Delta or government agencies such as the National Aeronautics and Space Administration (NASA), space systems allow humans to travel and transport goods at a safer and more efficient rate. This safety and efficiency is paramount to agencies and companies that seek to travel further and faster through our solar system, but the main question stands: what is the most cost-effective way to transport material through the solar system? Should space systems remain under government control or should private companies be given more autonomy?

For over twenty years, numerous countries have shared the International Space Station (ISS), an international module used to gather data on air quality and asteroids. This data is then shared amongst the participating countries in a seemingly peaceful exchange. As is with most diplomacy, peace is a state of being that most countries do not experience for long, and now that private space companies, such as SpaceX, Blue Origin, and Virgin Galactic are beginning to emerge, governmental bodies need to begin addressing the legality of the privatization of space. A common point of debate between government officials and constituents often is in regards to whether or not an aspect of public life should be privatized or remain in the hands of the government. Privatization utilized as a policy tool, whether it is in education, the military, or social security, can allow citizens to be more hands on with policy. When it comes to space systems, however, the answer is more difficult because the debate of space itself is non-appropriate to civilian life as of right now.

The objective of this thesis is to present an assessment of the evolution of space systems and examine the privatization of these systems. For the purpose of this thesis, reference to a “space system” means a system that transports a human being or goods from Earth and into space; while a “space port” would best be defined as a facility that has the capacity to repair, house, or launch a space system.

### **Research Question**

These issues that I foresee led to simple curiosity: what policy measures will need to be taken by the public and private sectors to balance private competition and public fiscal responsibility in the privatization of space ports? What pieces of legislation must be amended to ensure the policy measures will be successful? Although there are specific policies from the Federal Aviation Administration (FAA) that could set a foundation for thought, there is not any concrete data or established research on the privatization of space ports. This is where the ultimate problem lies, while there are possible governmental mechanisms to regulate the space system industry, there are not mechanisms in place to adequately regulate space ports.

Understanding space port infrastructure is imperative and by overlooking a key component of the privatization of space systems, policymakers have left themselves short-handed because they weren't looking in the right place. In order to understand how to properly regulate private space companies such as SpaceX, they must address the ports their systems will travel before addressing the systems themselves. Otherwise, the space system industry is left with an open border policy where space companies would have the opportunity to cut corners and ineffectively transport goods and humans between planetary systems.



### **Policy Problem and Specific Policies**

Ultimately, the policy problem at hand is addressing how policymakers can regulate and, in some way, privatize the space ports that space systems use. As I stated before, the way that it is set up right now, space companies have the opportunity to test modules as frequently as they would like and send them into space facing minimal regulation from the FAA, Federal Communication Commission (FCC), and National Oceanic Atmospheric Administration (NOAA). As technology for the modules improve, this lack of regulation could become more dangerous and cost ineffective as space company elites could send space systems into space in greater speed and volume, which could lead to the formation of space monopolies. This study will address privatization as a policy tool and whether or not, privatization, along with regulation, would prove to benefit space systems and the space ports between Earth and space.

Policy initiatives from the FAA, Department of Defense (DOD), and NASA are important to analyze in regards to understanding the mechanics of the policy evolution of commercial space systems. The Next Generation Transportation System, unmanned aircraft systems, and NASA's Airspace Operation and Safety Program serve as possible interactive policy initiatives that would take the technology of space systems to the next level at an increased speed.

When it comes specifically to these foundational policies, inter-agency collaboration is key to success of the implementation of these programs. For example, the "Next Generation Air Transportation System (NextGen) depends upon the FAA's collaboration with partners in the aviation industry in order to produce an additional \$11.4 billion boost that will benefit the entire National Airspace System" (FAA Staff, 2017). However, this collaboration does not end solely with the FAA. NASA's Airspace Operation and Safety Program also works with the FAA "to

develop NextGen technology and provide advanced automated support to air navigation providers and aircraft operators to reduce delays and ensure greater safety.” (Gipson, 2017) The DOD’s unmanned aircraft systems could expedite the process for the FAA and NASA to transition from a radar-based air traffic control system to a NextGen satellite based system but unfortunately, the “DOD Unmanned Air Systems (UAS) currently do not have direct access to the National Airspace System, unlike manned aircraft.” (DOD Staff, 2017) With inter-agency relationships like this in mind, this thesis will provide an example of how space systems can benefit from the collaboration between space companies and federal agencies to achieve the same goal: improve space system technology and space port efficiency.

### **Organization of Thesis**

In this thesis, I will present background research of the evolution of space systems. First, I begin with the inception of space systems led by the discovery of commercial human flight by the Wright Brothers in 1903 and proceed to 1947 where Charles Yeager piloted the first aircraft to travel faster than the speed of sound. Following this, I address the foundations of the space race by beginning with the impact that the Chicago Convention of 1944 had on international aviation, followed by the Soviet Union’s launch of the first man-made Earth satellite, Sputnik 1, in 1957 which culminated in the aggressive space policy agenda of President John F. Kennedy in the 1960s leading to Project Apollo, the signing of the United Nations’ “Outer Space Treaty” and eventually landing an American on the moon. Next, I go to 1998 where the first two modules of the International Space Station are launched and joined together in orbit which led to Congress passing bills that addressed space competitiveness and space launch activities. Finally, I look at the lifespan of the ISS beginning in 2000 when the first crew took residence to the current commercialized space race with joint ventures, such as the United Launch Alliance and the

merger between ATK Rockets and Northrup Grumman, and private companies, such as SpaceX, Blue Origin, and Virgin Galactic.

In chapter three, I present background research of the government's use of privatization as a policy tool. I define and analyze privatization and address the impact it has had over the past forty years and specifically how legislative privatization movements have panned out over this time.

Following this, I will provide policy recommendations using the background research of space systems. Finally, I will provide a conclusion that summarizes this research project.

## CHAPTER 2

### POLICY EVOLUTION OF SPACE SYSTEMS

#### Phase 1: Wright Brothers (1780s-1930s)

Starting in the early 1900s, the usage of air systems was purely experimental and found to be quite foundational. Two air systems in particular kick started the technology that would later be developed into powered aircrafts: the balloon and the glider. The successful public and private experimentation of the balloon by Joseph-Michel Montgolfier in June 1783 sparked a variety of scientists and visionaries to test out manned gliders and balloons that would defy the law of gravity (Spitzmiller, 2017). In 1785, the first real test of distance was completed when “French inventor Jean Francois Pilatre de Rozier and French army officer Francois Laurent made the first manned hot air balloon flight over Paris for approximately 25 minutes” (“Across...”, 2017, p. 1). Almost a century later in 1852, a French engineer, Jules Gifford was able to pilot the first steam-powered airship which travelled over fifteen miles and then concluded that the airship could have travelled farther if there were calm conditions. (Sharp, 2012) Later throughout the 1890s, a German glider pilot, Otto Lilienthal, built and successfully flew full-size gliders over 2000 times in a variety of designs that he researched in the 1870s and 1880s. Lilienthal’s overall contribution to flight was more significant from a psychological standpoint given that his success showed other potential gliders and scientists that human flight was possible (“Lilienthal...”, 2017, p. 1).

One pair of visionaries took advantage of Lilienthal’s success through their desire to test a powered air system that would go beyond the limits of the human powered glider. This test took place in Kitty Hawk, North Carolina, in 1903 when Orville and Wilbur Wright became the first people to test and successfully run a powered airplane.

The Wright brothers' inspiration began as children when they were gifted, from their father, toy helicopters and kites to fly. From there, the brothers began to take a vested interest in air systems and how they could develop a model that would be powered independent of a human being. After the fatal crash of famed glider pioneer Otto Lilienthal in 1896, the brothers wrote to the Smithsonian Institute requesting any information they had on aeronautics. Using the information they received from the institute, the Wright brothers "built their first aeronautical craft, a five-foot-wingspan biplane kite, in the summer of 1899 as a preliminary test device to establish the viability of the control system that they planned to use in their first full-size glider - this means of control would be a central feature of the later successful powered airplane" (Smithsonian Institute, 2017, p. 1). Within the two years following, the brothers built two full-size piloted gliders, which they brought to Kitty Hawk, North Carolina and conducted numerous wind tunnel experiments on the gliders. After gathering extensive data, the brothers built a third, refined control system glider in 1902 that they flew between seven hundred and one thousand times over the course of twelve months. Using the blueprints of the 1902 glider, the brothers attached a twelve-horsepower gasoline engine in order to make the propulsion system of the biplane act independent of the pilot. After a few failed attempts in the fall of 1903, Wilbur and Orville Wright finally "had established the foundation of aeronautical engineering by successfully piloting a heavier-than-air flying machine" (Smithsonian Institute, 2017, p. 1).

News of the Wright Brothers' successful experiment led to a nation-wide fascination with the airplane, sparked by the St. Louis Exposition in 1904, which became the main stage for the showcase of the airplane as well as a place for pilots to share their piloting skills. Starting in 1904 and going beyond 1910, pioneer pilots, such as Roy Knabenshue, Lincoln Beachy and Charles Hamilton, competed for prize money at the Exposition to exhibit their innovation and

newly acquired skill (Bilstein, 2001). This growing competition led wealthy investors as well as the federal government to understand the importance of the role that the powered aircraft could play in American society.

The investment into the research of aircrafts were mainly completed by either independent scientists, universities, or the executive branch of the federal government. One of the most influential independent researchers of this time was Russian Konstantin Tsiolkovsky who was the first to acknowledge the need for a reaction engine to operate an aircraft in space. Considered to some as the father of astronautics, Konstantin Tsiolkovsky was inspired by the science fiction novels of Julie Vernes. Tsiolkovsky, as a school teacher, wrote about the idea that rockets would be capable of propelling an air system out of the Earth's gravitational pull. His writings then evolved into science experiments that he conducted based upon "gyroscopic stabilization, reactive power, and escape velocity which became known as the 'Tsiolkovsky Formula'" (History, 2004, p. 1). Using this foundational formula, many researchers at American universities were able to build upon his research and further the technology of space systems.

The role that universities played during this time was also significant, specifically at Clark University in Massachusetts in 1912 where a physics professor, Robert Hutchings Goddard, "mathematically proved that a device using rocket power could achieve escape velocity and travel to the Moon and the planets – in 1914, he received a patent for the idea of the multistage rocket" (Spitzmiller, 2017, p. 28). Using the data gathered and patent received, Goddard applied to the Smithsonian Institute for a research grant in September of 1916. "After reading the proposal, Assistant Secretary Gregory Abbot of the institute recommended that the Smithsonian should support Goddard's work and on January 5, 1917, Walcott wrote to Goddard informing him that he received a \$5,000 grant from the Hodgkins Fund for atmospheric

research” (Seanm, 2012, p. 1). Over the course of the next twenty years, the Smithsonian Institute not only financially supported the research of Goddard but published many of his papers addressing the potential for future manned and unmanned space flight. Other significant accomplishments that Goddard completed over this time were successfully launching a liquid-propelled rocket in 1926 and testing the first rocket with scientific instruments in 1929. Goddard’s work with rocketry were ground-breaking and led government officials to wonder how they could take advantage of the increase in rocket technology.

The first federal official to take a keen interest in the capabilities of the aircraft was the assistant secretary of the Navy at the time, Theodore Roosevelt. By applying for and securing a \$50,000 grant, Roosevelt was able to lead a research team to study the possibility of using an aircraft for military scouting purposes (Bilstein, 2001). Encouraged by Professor Samuel Langley’s ‘aerodrome’ and the Wright brothers flight in North Carolina, Secretary Roosevelt wanted to modify and improve a ‘heavier-than-air machine’ that could perform as a means of scouting, as a means of communication, and an attack vessel that could drop explosives on enemies’ camps. However, it wasn’t until the arrival of captain Washington Chambers in 1910 that the Navy began to appreciate the benefits of flight and fund the research of aerodynamics. (Lord, 2015) The reason being that the federal government continued to experiment with the balloon as well as the discovery of the pressurized cabin at Chicago’s 1933 World Fair (Spitzmiller, 2017). Using the technology of the newly discovered pressurized cabin, the National Geographic Society and the US Air Corps co-sponsored the *National Geographic Explorer I*, a hydrogen-filled balloon that was launched from Rapid City, South Dakota on July 28, 1934 in order to gather data on Earth’s stratosphere. At around 60,000 feet, the balloon began to tear and the crew descended until it burst at 3,000 feet where the crew parachuted to safety. In

order to avoid another accident, the previous co-sponsorship funded a new larger helium-filled balloon, the *National Geographic Explorer II*, on November 11, 1935 which reached 72,000 feet and obtained scientific data on the composition of the atmosphere for the first time in recorded history (“Flights..., 2015).

The wonders of Chicago’s 1933 World Fair were embraced and advanced by scientists like Wernher von Braun in Nazi Germany. Von Braun was a founding member of the Society for Space Travel, a group of German scientists who performed research and published articles that would later be vital to the foundation of modern rocket and satellite technology, and was ultimately influenced by the hypothesis of Hermann Oberth, who discerned that modern science could develop a machine to travel outside of Earth’s gravitational pull and that the machine could one day be posted for profit (Spitzmiller, 2017). After the Society for Space Travel disbanded because of the start of World War II, in order to continue to research rockets, von Braun went to work for the German army in late 1932 to develop liquid-fuel rockets which culminated into a doctorate in physics that he received in 1934. The contributions of von Braun only began in the 1930s when he and his team developed the V-2 ballistics rocket, which was foundational to the dynamics of ballistic missiles and space launch vehicles (Harbaugh, 2016). Needless to say, although the 1930s were a tumultuous time with World War II, it was nevertheless a significant decade in regards to the advancement of space systems world-wide.

### **Phase 2: Origins of the Space Race (1940s-1960s)**

Between the time when Robert Goddard flew a liquid-propelled rocket and the 1940s, there was significant social progress in regards to the advancement of space systems, such as the non-stop trans-Atlantic flight of Amelia Earhart, but there were not many significant scientific advancements that occurred. While space policy in the 1930s can best be described as a time of



significant ground breaking research because the physical materials had not yet been engineered to sustain a space mission but scientific testing procedures had been developed, highlights of the research conducted in the 1930s would be that jet engines began to be tested in wind tunnels and a supersonic wind tunnel had been completed. The jet engine tests paved the path to engineering rocket and space ships that could successfully complete missions (Staff, 2008). Tests like these led to a modern airliner, a Boeing 247, being flown for the first time in 1933 as well as a fully jet-propelled aircraft, Germany's Heinkel 178, taking flight for the first time in 1939.

Space policy in the 1940s however, took a significant step that would alter the international landscape for decades to follow. From November 1<sup>st</sup> to December 7<sup>th</sup> in 1944, 54 nations attended a conference in Chicago, Illinois that established a precedent for peaceful and seamless global air navigation. In doing so, the delegates of the conference created the International Civil Aviation Organization (ICAO), an organization that still exists to this day within the United Nations (UN), and "set out as its prime objective the development of international civil aviation "...in a safe and orderly manner", and such that air transport services would be established "on the basis of equality of opportunity and operated soundly and economically.'" (The History of the ICAO..., p. 1) This organization was one that led to "the highest possible degree of uniformity in civil aviation regulations, standards, procedures, and organization," and since 1944, there have been numerous conferences throughout the world that have resulted in the expansion of the organization to 192 member states and more than 12,000 international standards and recommended practices for global aviation programs to adhere by. (The History of ICAO...) These standards and practices were one that pioneers like General Charles Yeager of the United States Air Force had to adhere to, yet was able to break scientific barriers.

The first breakthrough since Goddard's rocket that would affect the future of space travel was General Charles Yeager's Bell X-1, the first aircraft to exceed the speed of sound in level flight. After serving for the United States Air Force in World War II, General Yeager was assigned to an experimental flight test in Ohio of July 1945. During his ten year tenure in Ohio, he became the first pilot to travel faster than the speed of sound in October in 1947 and then became the first pilot to travel twice as fast as the speed of sound flying the Bell X-1A in December of 1953 ("BRIGADIER...", 1975).

The late 1950s and early 1960s as a whole can be characterized as a political competition between the United States and Soviet Union to not only send an unmanned air system into space but to send human beings into space as well. Using the data and conclusions from Yeager's test runs in Ohio, the race between the Soviet Union and United States began to launch the first rocket out of Earth's atmosphere. While the Soviet Union "successfully launched the first man-made satellite, *Sputnik 1*, into space on October 4, 1957, the United States launched their first man-made satellite, Explorer 1, into orbit on January 31, 1958" (Loff, 2016, p. 1).

Not to be confused with the *National Geographic Explorer I*, the purpose of the United States' Explorer 1 was to "discover the amount of cosmic rays outside of Earth's atmosphere theorized by Dr. James Van Allen of the University of Iowa." (Loff, 2016, p. 1) Although the Explorer 1 was not the first satellite in space, Van Allen's findings led to the discovery of the 'Van Allen Radiation Belts,' where "the radiation detector [on Explorer 1] recorded two belts of charged particles trapped by Earth's magnetic field - one belt was 400 to 4,000 miles above the surface, and the other was 9,000 to 15,000 miles above the Equator, curving toward the magnetic poles." (Sullivan, 2006, p. 1) The data collected from Explorer 1 "showed that the amount of cosmic ray was lower than what Dr. Van Allen had hypothesized." Following this, four more

Explorer rockets were launched into space but only two successfully made the trip out of Earth's atmosphere. Dr. Van Allen's work continued and ultimately collaborated with Wernher von Braun, whose team built the initial rocket, on Explorer 2 and Explorer 3 by installing instruments that could gather further evidence of radiation field. (Loff, 2016)

A direct result of the political competition between the United States and Soviet Union was the passage of the National Aeronautics and Space Act of 1958, a bill signed into law by President Dwight Eisenhower that established NASA as the governing body over space related activities while ensuring that space activities would be completed in a peaceful manner. This bill also established the National Aeronautics and Space Council (NASC), which gave the President of the United States, and not the administrator of NASA, the ability to establish NASA's agenda and oversee all activities that took place, something that could be viewed as a measure of oversight to ensure that the United States was ahead of the Soviet Union (U.S. Cong, 1983). Furthermore, President Eisenhower gave public comment in regards to Section 205, which authorized peaceful cooperation with foreign nations adhering to international treaties, saying "I regard this section merely as recognizing that international treaties may be made in this field, and as not precluding, in appropriate cases, less formal arrangements for cooperation. To construe the section otherwise would raise substantial constitutional questions" (Eisenhower, 1958). This statement is one that was politically vague for reasons that are represented by the fact that if an international treaty did not favor the United States' progress over that of the Soviet Union, then President Eisenhower did not desire the political backlash that would ensue from Congress and the American public. However, it was later discovered that this in fact was not the case given Eisenhower's criticism of President Kennedy's pursuit to the moon, saying it was nuts. (Logsdon, 2011)

In the early 1960s, astronauts begin training for a manned mission to first orbit the earth and later, land on the moon. Despite plans for the United States to launch an astronaut into space by May of 1961, like the unmanned satellite, the Soviet Union was the first nation to send a man into space when in April of 1961, Yuri Gagarin flew from Earth into outer space on the Vostok 1. Although he only made one statement throughout his one and a half hour flight and the flight ended in near-disaster, the Soviet Union's accomplishment sent waves throughout the world. The Soviets sent another astronaut aboard the Vostok 2 for twenty-five hours in August of 1961 before the United States sent their first astronaut into space. (Pruitt, 2016)

Following this event, the pressure mounted on President John F. Kennedy because of a statement he made before a joint session of Congress on May 25, 1961 that "this nation should commit itself to achieving the goal, before this decade is out, of landing a man on the Moon and returning him safely to Earth." While acknowledging that it would not be an easy task, President Kennedy stated that the country should be realistic in its endeavors that if the will wasn't present, then the goal wouldn't be achieved. Kennedy's idea of a "great new American enterprise" was taken with full confidence as Congress approved an 89% increase in NASA funding that 1961 session then a 101% additional funding boost in NASA the following congressional session of 1962. This significant increase in funding led to the creation of Project Apollo, which "in 2010 dollars, cost \$151 billion, comparatively less than the Manhattan Project, \$28 billion, and the Panama Canal, \$8.1 billion." (Logsdon, 2011, p. 2)

Although the United States hadn't quite yet sent someone to the moon, on February 20, 1962, "John Glenn became the first American to orbit the Earth aboard the Friendship 7 of the Atlas-6 rocket." The data collected from this mission gave "NASA the opportunity to engineer the first Zero Gravity Facility in the United States in 1966. This Zero Gravity Facility allowed

astronauts to properly prepare for a mission to land on the moon by simulating a state of free fall or weightlessness (at or near microgravity) through the construction of drop towers, large shafts some 500 feet deep that allows test packages to free fall in a vacuum for just over 5 seconds.”

(Staff, 2008) The widespread political support for the space program simmered in 1963 following criticism from former President Dwight Eisenhower, who said the race to the moon was nuts, while responding to criticisms from members of the congress that the allocation of money was “being distorted from military space efforts to lunar adventures.” This shift from political support to criticism was met with a 10% decrease in NASA funding in 1963. (Logsdon, 2011, p. 198)

While President John F. Kennedy had redefined the space program on a national scale within the United States in the 1960s, the United Nations’ General Assembly had been working on the Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space which wasn’t signed into a cooperative treaty until January of 1967 when the United Kingdom, Soviet Union, and United States signed The Outer Space Treaty, which provided the basic framework on international space law. Principles of the treaty included: “the exploration and use of outer space shall be carried out for the benefit and in the interests of all countries and shall be the province of all mankind; outer space shall be free for exploration and use by all States; States shall be responsible for national space activities whether carried out by governmental or non-governmental entities; and States shall be liable for damage caused by their space objects.” (Wickaramatunga, 1967) Based upon the language of the treaty, the purpose of this treaty was to ensure that nations with a space program conducted activities with the thought of the global community at heart, did not overstep boundaries that could lead to war-like

declarations, and that countries understood they would be liable for the actions of their astronauts in space.

With the foundation of international space law established and the goal set by President John F. Kennedy on May 25, 1961 in mind, Apollo 11 launched from Cape Kennedy on July 16, 1969, carrying Commander Neil Armstrong, Command Module Pilot Michael Collins and Lunar Module Pilot Edwin "Buzz" Aldrin into an initial Earth-orbit of 114 by 116 miles. On July 18, Buzz Aldrin and Neil Armstrong made their second TV transmission from the space craft by climbing through the docking tunnel. The following day the first transmission was made from the moon, although the crew had not yet done a moon walk. On July 20, 1969, the crew finally decided to land on the moon and after a four hour rest period, Neil Armstrong set the tripod on the surface of the moon to make his famous "...one small step for a man, one giant leap for mankind" statement which over half a billion people watched on television world-wide. Over the course of eight days, the Apollo 11 crew had "additional flight objectives which included scientific exploration by the lunar module, or LM, crew; deployment of a television camera to transmit signals to Earth; and deployment of a solar wind composition experiment, seismic experiment package and a Laser Ranging Retroreflector." After a flight of 195 hours – about an half an hour longer than planned – the Apollo 11 splashed down into the Pacific Ocean where the recovery ship, USS Hornet, was waiting 13 miles away. (Loff, 2015)

Looking back at the efforts of President John F. Kennedy and Project Apollo, "the impact of Apollo on the evolution of the U.S. space program has on balance been negative." Despite President Kennedy's dramatic expansion of the United States' space program, the reality of the current situation shows how little progress has been made since in regards to human travel outside of Earth's orbit. The last human to leave Earth's orbit was in 1972 on the last Apollo

mission and most of Apollo's hardware had become museum exhibits for Americans to reflect upon what was achieved in the past. (Logsdon, 2011, p. 240)

### **Phase 3: The Skylab and International Space Station (1970s-2010s)**

The 1970s were a trying time for NASA as “many layoffs occurred at the Lewis Flight Propulsion Laboratory. These layoffs led to a significant decrease in American space research” (Harland, 2010, p. 1) and because of this, not many significant events occurred in the United States during this time. Despite this, the Soviet Union continued in their quest to become the world power in space technology. In 1971, the Soviet Union launched the first space station, the Soviet Salyut 1, into the orbit of the Earth. Named in honor of Yuri Gagarin, the Salyut 1 served as living quarters, scientific laboratories, and military reconnaissance platforms for the Soviet crew aboard. Although “it was derived from the Almaz reconnaissance platform designed in the 1960s by Soviet aerospace engineer Vladimir Chelomey and adapted for use with the Soyuz manned spacecraft originally developed by his rival Sergey Korolyov for the Soviet Moon-landing program,” the entire crew of the space station died upon return to Earth when they were depleted completely of oxygen in their individual pressurized space suits. The Soviets attempted to alter and improve the Salyut 1 into five more versions of the initial space craft, but they ended up exploding, like Salyut 2, or scientific programs, Salyut 3-7. (Harland, 2010, p. 1)

It wasn't until 1981 when the United States launched the first reusable spacecraft, the Columbia Shuttle, into orbit. The discussion to build such a vessel began in 1966 but didn't become a serious topic until the moon landing in 1969 when President Richard Nixon appointed a Space Task Group to design models of a reusable spacecraft. After years of deliberation and compromise, the construction of the Columbia Shuttle began in March of 1975. The Columbia Shuttle, officially known as the Space Transportation System (STS), finally took flight in April

of 1981 under the reins of a two-person crew, the commander, John Young, a veteran of Gemini and Apollo, and the pilot, Bob Crippen, with the ultimate goal of ensuring the STS worked well in space. For the next two years, NASA conducted test runs of the STS under heavy media scrutiny, especially with a near-disastrous landing of the STS-3. The first operation flight for Columbia was STS-5 in November of 1982 and then once more a year later, carrying the Spacelab experiment module as well as the first European Space Agency astronaut. Following a two-year hiatus, the Columbia flew the assigned crew as well as Democratic congressman Bill Nelson on board. In January of 1986, the Columbia's operations were then halted by the demise of the Challenger until 1989. Over its lifetime, the Columbia completed 28 missions and logged more than 300 days in space. Under the label STS-107, the Columbia was ultimately destroyed in 2003 when returning to Earth after a 16-day research mission, killing the entire seven member crew on board. (Howell, 2013)

Prior to the difficulties with the Challenger, Congress passed a bill in 1984 that addressed privatization within the space system and space technology industry for the first time. The bill was titled the Commercial Space Launch Act of 1984 and it set regulations as to how the United States government would facilitate the relationship between private space companies and the federal government. Aspects of this bill that were important for the private space market was the language of the bill "recognized the United States private sector as having the capability to develop commercial launch vehicles, orbital satellites, and operate private launch sites and services," as well as that it acknowledged the Secretary of Transportation as a commercial launch overseer, issuer of licensing, and promoter of safety regulations. (U.S. Cong, 1984) Both of these measures provided uniformity to the private space sector and can be seen as a first step toward further privatization in the space system and space port markets.



In the 1990s, “aero propulsion, space power and space propulsion came into focus which ultimately led to the development of the international space station.” (Staff, 2008) Before explaining the purpose for the international space station and how it came to be, it is important to acknowledge the foundational role that the Skylab played in its development. Although the lifespan of the Skylab was shorter than a year, serving from May of 1973 to February of 1974, the program proved that humans were capable of living in space for extended periods of time. During its time, it housed three crews and served as a solar and Earth observatory, a microgravity lab, and a medical lab that led to new technologies which included special showers, toilets, sleeping bags, exercise equipment and kitchen facilities that were designed to function in microgravity. The crews would run on regimented eight hour schedules that included medical testing and science experiments. The data that NASA eventually gathered from the three crews over the course of 1973 and early 1974 was vital to the development and final design of the International Space Station. (Loff, 2017) The International Space Station, seen as a “diplomatic collaboration between the United States, Russia, Japan, and Europe, operates as a research vessel where experiments are conducted and intelligence is shared.” (Wall, 2015, p. 1)

Seeing the impact the International Space Station could have on the commercial space travel industry, in 1999, Representative Dana Rohrabacher of California introduced the Commercial Space Transportation Competitiveness Act of 2000, which would have amended the Space Launch Act of 1984. This bill later was signed into law by President Bill Clinton in November of 2001. While the bill did extend the appropriations related to space launch vehicles previously outlined, it authorized the establishment of the Office of Space Commercialization and the Office of Commercial Space Transportation because Congress found that “space transportation may evolve into airplane-style operations; a 5 year extension on Title 49 of the US

Code will be beneficial for the United States' ability to be competitive in the international space transportation industry; and the responsibilities of the Associate Administrator for Commercial Space Transportation have increased significantly because the commercial space transportation industry has rapidly expanded." (U.S. Cong, 2000) This acknowledgment of the expansion of the commercial space transportation industry was once again another step toward the pending conversation that Congress would have regarding the role that privatization should play in the industry and just how big a role private companies should play in contrast to the federal government.

The first module of the station, Russia's Zarya, was launched in 1998 and over the course of the next two years, five different space agencies, NASA, Russia's Roscosmos State Corporation for Space Activities, the European Space Agency, the Canadian Space Agency and the Japan Aerospace Exploration Agency, built the \$100 billion station by adding other modules that had laboratories, living quarters, and solar panels to provide power to the station. Over the lifespan of the International Space Station, two human variables have been altered considerably since 1998: crew size and trip duration. On November 2<sup>nd</sup>, 2000, the station welcomed its first three man crew and since that time, the International Space Station had as small as a two man crew in the station following the Columbia disaster in 2003 and as large as a thirteen person expedition crew in 2009. Although the typical six-person crew has stayed on the station between three and four months at a time, the United States and Russia each sent up one astronaut to stay at the station for a year, Scott Kelly of the United States and Mikhail Kornienko of Russia, in 2015. While the crew members serve as scientists performing different experiments on the station, they must also oversee the maintenance of the station, therefore a background in engineering as well as a physical science is seen as a must for the modern-day astronaut. Since

NASA's retirement of the shuttle program in 2011, the participating nations have ferried their astronauts to and from Earth using Russia's Soyuz shuttle, but the United States plans to replace the publicly funded Russian Soyuz with two American private space companies' crews, SpaceX's Dragon spacecraft and Boeing's CST-100, by the end of 2017. The group of participating space agencies initially planned for the station to be operational until 2020, but NASA has requested an operational extension until 2024, which other nations such as Canada, Japan and Russia, have supported. (Sharp, 2016) The International Space Station shows how the essence of space travel evolved from a space race into one of international cooperation and collaboration in the 2000s, while space travel in the 2010s has resulted in the beginning of a commercialized space race.

Space travel in the 2010s has been characterized by the rise of private space companies, corporate mergers, and the potential for the creation of an individual military branch for space military operations. It was not until recently that space travel began to be impacted by the funding and innovation of private companies. In order to understand the policy landscape that both private companies and federal agencies have to acknowledge, it is important to point out Title 51 of the US Code and what its relationship with space systems and space ports is. In December of 2010, the US Congress enacted Title 51, a new positive law title of the US Code that improved the organization of the existing law and removed imperfections from the previous law. This US Code did not create new law or change the meaning of an existing law, it was simply for the sake of clarity and conciseness. Within this title, it addresses "Subtitle II: General Program and Policy Provisions," including the responsibilities of NASA; "Subtitle III: Administrative Provisions," which includes appropriations, contracting and international cooperation; "Subtitle IV: Aeronautics and Space Research and Education;" "Subtitle V:

Programs Targeting Commercial Opportunities,” which includes Commercial Space Competitiveness, the Office of Space Commercialization and Commercial Space Launch Activities; “Subtitle VI: Earth Observations,” highlighting land remote sensing policy and general remote sensing; and “Subtitle VII: Access to Space,” which highlights shuttle pricing policy, exploration initiatives, the International Space Station, and cooperation for safety among spacefaring nations. (United States, 2010) The importance of Title 51 of the US Code is something that cannot be ignored given the impact it has on space policy within the United States and how federal agencies and private companies are required to interact with each other within the United States as well as with foreign agencies or companies.

Under the leadership of three entrepreneurs, Elon Musk, Richard Branson, and Jeff Bezos, the private space industry is one that is rapidly growing and could one day define how humans on Earth travel domestically, internationally, and interplanetary. While Elon Musk has companies in the solar and electric vehicle industries, none are more fascinating than his aeronautic company, SpaceX. Currently, “*SpaceX* has developed a reusable rocket that provides cargo routes between earth and the International Space Station.” (Price, 2016) Another pioneer in interplanetary travel is Richard Branson, the CEO of Virgin Galactic spaceflight company, who has “created the SpaceShipTwo at a cost of \$750,000 per ticket to those willing to fly around the moon and land on a runway in the ocean.” (Price, 2016, p. 1) The final interplanetary travel pioneer is the CEO of Amazon, Jeff Bezos. His project, “Blue Origin,” is the most commercialized version of interplanetary space travel among the three projects. According to the website, “using a fully reusable vertical takeoff, vertical landing space vehicle, known as the *New Shepard* system, Blue Origin offers customers the opportunity to become astronauts for a day as they are immersed in a weightless environment with unparalleled views.” (Origin, 2007,

p. 1) This “Blue Origin” experience appears to be most consumer friendly whereas the “SpaceShipTwo” attempts to provide a more sophisticated flight and SpaceX is working as a privatized company with governmental goals of establishing cargo routes and human flights to Mars.

As private companies began to build more capital and federal agencies began to see the merit of purchasing cost-effective private space systems, in November of 2015, the US Congress passed and President Barack Obama signed into law a bill introduced by Representative Kevin McCarthy of California, the US Commercial Space Launch Competitiveness Act Of 2015 (SPACE Act of 2015). The bill ultimately allowed US citizens to “engage in commercial exploration and exploitation of ‘space resources,’” so long as the resource is not a biological life form. In addition, this bill pointed out that “the United States does not assert sovereignty, or sovereign or exclusive rights or jurisdiction over, or the ownership of, any celestial body,” which critics argue is contradicting because this bill asserts the ownership of space resources, which would violate the UN’s Outer Space Treaty. The two other important things that this bill does is to “include the extension of indemnification of US launch providers for extraordinary catastrophic third-party losses of a failed launch, and extends the ‘learning period’ restrictions which limit the ability of the FAA to enact regulations regarding the safety of spaceflight participants;” both through 2025. (U.S. Cong, 2015) The address of space mining as well as peaceful language in regards to potential sovereignty issues is important because as space travel continues to become more commercialized and companies further their technology and are able to send more space systems into orbit, issues of liability and the collection of space resources are bound to become a topic of serious discussion among foreign nations.

By extending various provisions of commercialized space travel, the SPACE Act of 2015 completed a necessary step to ensure that individual private space companies as well as private joint ventures continue to have the opportunity to build and launch space systems within the United States. A great example of a successful private joint venture that launches space systems within the United States is the United Launch Alliance (ULA) which was founded in December of 2006 as a split venture between Lockheed Martin and the Boeing Company. Based in Denver, Colorado, the ULA is able to “bring together two of the launch industry’s most experienced and successful teams – Atlas and Delta – to provide reliable, cost-efficient space launch services for the US government; including the DOD, NASA, and the National Reconnaissance Office.” The reason that this venture is far and beyond more important than any other to date is given the tenure this venture brings to the space community. Between the Atlas and Delta expendable launch vehicles, they have launched in over 1300 missions over the course of 100 years of combined launch experience. This statistic shows just how effective and reliable these launch vehicles are, which is reminiscent of how beneficial privatization can be in a public industry. (About ULA..., 2016) Around the time that ULA was founded, President George W. Bush stated that his vision for space exploration was to “promote international and commercial participation in exploration to further U.S. scientific, security and economic interests,” which according to Bernard Kutter of Lockheed Martin was a driving force for the genesis of the ULA. Kutter goes onto say that “we [Lockheed Martin] believe that when we engage the engine of competition, these services will be provided in a more cost-effective fashion than when the government has to do it,” and by his statement, it is shown that the implication of President Bush’s mandate was for the ULA to emphasis cost-effectiveness in an public industry that struggled with building, operating, and maintaining space systems in a cost-effective manner. (Kutter, 2006, p. 1) The

ULA was a revolutionary private undertaking in 2006 that has paid dividends in the success that it continues to have in the relationships shared with federal agencies and the continued success of its expendable space systems.

Another important example of this was the recent merger of missile and rocket maker, ATK Rockets, and one of the U.S. defense contractors, Northrup Grumman, in September of 2017. In a deal worth \$7.8 billion, it was reported that Northrup Grumman will “have access to lucrative contracts with the U.S. military.” (Reuters, 2017, p. 1) As the United States military sees space as the next battlefield and agencies such as NASA have been able to contract out smaller projects to private companies, mergers such as the one between ATK Rockets and Northrup Grumman will not only become more frequent but more lucrative in financial terms. Through the increasing capabilities of satellites and willingness of the government to pay for access to private satellites in space, the United States hopes to increase Earth observation, internet, and missile capabilities throughout the world. Although the United States Air Force has increased their capabilities in space throughout the years through research and private contracts, members of Congress worry that other nations are catching up to the United States and will soon pose a significant threat to United States’ space capabilities since aerospace is severely unregulated at this time.

Although this has yet to be made official, the current President of the United States, Donald Trump, pointed out earlier in 2017 that he would like to see the United States “develop a branch of the military that can focus on operations outside of Earth’s atmosphere, effectively what Congress has called, the Space Corps.” (Morris, 2017, p. 1) While high ranking officials of the United States Air Force find the potential creation of this branch to be redundant and pointless, a bipartisan group of Congressmen have found the idea to be worth seriously

considering. Although it would be the first new U.S. military branch since 1947, the Space Corps could be a step forward for the discussion of whether space, in itself, should be regulated by a congregation of nations and would, logistically, “take many functions currently handled by the Air Force and its Space Command and spin them off to a sixth military branch that would report to the civilian Secretary of the Air Force, similar to how the Marine Corps operates within the Navy.” (Morris, 2017, p. 1) Congressman Mike Rogers of Alabama was recently interviewed by Lulu Garcia-Navarro of National Public Radio in Washington D.C. and stated that, despite the backlash from the Air Force, the creation of the Space Corps is necessary because of the threat that partnering nations, such as Russia and China, pose in space. He goes on to say that 90% of military operations completed in space are done by the Air Force, but the Air Force has yet to modernize their tactics since the inception of the International Space Station in 2000. (Garcia-Navarro, 2017) Whether or not the Space Corps is actually created, there will come a time when the United States decides to either privatize or make operations completely public through the military. Only time will tell, but one thing is for certain, the conversation has started and there is not a reason that it should end anytime soon.

More recently, two major events have occurred that could shape the future of space travel as we know it today. In early February of 2018, SpaceX launched the heaviest payload capable reusable rocket, the Falcon Heavy, to-date from Kennedy Space Center in Florida, and President Trump’s administration released a budget that called for an end to direct funding for the ISS in 2024 with the desire to make the ISS a commercially-run venture by 2025. After “years of delays and a roughly \$1 billion investment by SpaceX,” Elon Musk’s company was finally able to successfully complete a demo launch of the Falcon Heavy, a reusable rocket with the heaviest payload to date, from Kennedy Space Center into space, on February 6, 2018 with a Tesla



roadster on track to hit Mars orbit in the coming months (Pazstor, 2018, p. 1). This is monumental for the commercial aerospace industry because it shows that the private sector now has the resources and capital to build space systems that would be more cost-effective for government agencies to use.

On February 12, 2018, just a week after SpaceX launched the Falcon Heavy, President Donald Trump's administration released a budget recommending that the White House stop funding the ISS after 2024, "which would entirely end direct federal support for the orbiting laboratory." The budget document stated that "it is possible that industry could continue to operate certain elements or capabilities of the ISS as part of a future commercial platform...NASA will expand international and commercial partnerships over the next seven years in order to ensure continued human access to and presence in low Earth orbit" (Davenport, 2018, p. 1). While these are merely recommendations and not set in stone, many Senators, such as Ted Cruz of Texas, have voiced opposition to the proposal, but if these recommendations were to come to fruition, then the result could shape future diplomatic relations in space and mark the beginning of a permanent public-private partnership in space. Both these events happening almost simultaneously show how the space travel industry is beginning to look more formidable as a commercial venture, rather than a government-operated one.

To think that from the experiment of a balloon in the late 1700s would come to the United States military potentially creating a separate branch to conduct space operations is unthinkable and shows just how far the evolution of space systems have come to date. The next chapter of space systems should involve an increase in private ownership of space systems and a greater voice from citizens in how space systems are transported between Earth and space. In order for this to happen, privatization as a policy tool must be utilized by lawmakers invested in

the advancement of aerospace policy. With technology advancing at such a rapid speed and private aerospace funding increasing at an exponential rate, the future of space systems is something that humans should be excited for and could one day help humans find other forms of life, establish residents on other planetary bodies, and create multinational companies that help other humans explore what space has to offer.

### CHAPTER 3

#### GOVERNMENT PRIVATIZATION AS A POLICY TOOL

Privatization, as a policy tool, tends to rely upon the private institutions within a society rather than on government to fill the day to day needs of the people. “Privatization comes in several formats: contracting with private firms, contracting with non-profit agencies, as well as urban dwelling practices.” (Savas, 1987, p. 3) The main features of a public-private partnership are that the government relies upon private firms to operate public structures at a high capacity, the public’s role in keeping the privatized service accountable decreases, and the goals of the service or good may change since they are in the hands of a private firm rather than the government. (PWF, 2015) The relationship between the government and non-profit agencies often are characterized by purchase-of-service contracts that occur in regards to hard services, such as refuse collection, and soft services, such as Medicaid. It is important to point out as well that these “purchase-of-service contracts are rather informal in nature and therefore, do not pose to be of much value to public managers and community agencies.” (Gazley, 2008, p. 1) The most unique format is in regards to urban dwelling practices and the direct socioeconomic impact that privatization in this regard has on the citizen’s life. A four-year research project, conducted by the Public Housing Authority in the late 1990s, in Miami-Dade County, Florida addressed crime perception and tenant satisfaction in publicly-managed and privately-managed housing communities. The research found that privatized sites had a larger problem with residential crime and had less social services available than did public sites; ultimately that “privatized management in public housing does not lead to greater operational efficiency.” (Bowie, 2001, p. 1) It is important to point out an example of privatized urban-dwelling practices to show the real-life application it has on citizens and decisions in utilizing privatization as a policy tool. These

formats can provide policy makers with options when it comes to the right way to approach privatizing a good or service. However, there are many characteristics to these formats that allow policymakers to have options when formulating a plan to privatize a good or service.

Within these formats are specific approaches of privatization that policymakers can curtail and customize to fit the overall goal of their privatization movement. The most common approaches of privatization in the United States are as follows: complete privatization, privatization of operations, use of contracts, franchising, and open competition. Complete privatization is self-explanatory in that the government participates in an exclusive outright sale of assets to the private sector; whether in the method of share issue, asset sale, or voucher privatization. On the other hand, the privatization of operations is turning over the managerial and operational functions of a public facility to private sector entities, most commonly seen in sports facilities and tolls. Similar to complete privatization, the use of contracts is pretty straightforward given that it is the production of services by a private firm under the guidance of a contract with the public sector, most common in solid waste collection. Another approach is franchising, where the public sector awards a private firm the exclusive right to provide a service within a designated geographical area; typically revenue is gained through user fees, seen in cable and other utilities. The final approach is open competition, whereas many private firms can compete within a jurisdiction for customers; the most common examples are telephone and internet services. (Brooks, 2004) With the formats and approaches of privatization in mind, it is important to understand that there are a variety of philosophical attributes that influence the government to support or oppose privatization in a certain industry.

The philosophical positions that can destroy or inspire a privatization movement are the following: pragmatic, ideological, commercial, and populist. The goal of pragmatists is

ultimately to have a better government through the notion that “prudent privatization leads to more cost-effective public services.” (Savas, 1987, p. 4) An example of this would be in 2014, when the Harvard Business School released *A Business Leader’s Playbook for Supporting America’s Schools* where the authors point out “a rising tide of mediocrity” and they “direct business leaders to end ‘checkbook philanthropy’ and start taking transformative actions to change public schools, including advocating for policies, that ‘enable innovation.’” (Erickson, 2015, p. 71) The ideological, on the other hand, have a goal of less government in mind because they believe that the government is too big, powerful and intrusive in the lives of citizens and dangerous to democracy because their decisions are political and less trustworthy than free-market operations. A commercial approach to privatization encourages more business to be introduced in the market through the government spending directed toward private firms because the private sector can utilize state-owned enterprises and assets more effectively. The final attribute is the populist ideal which aims for a better society, populists believe this is possible through more choices in public services that rely upon the local community rather than bureaucratic structures (Savas, 1987). In part because there are so many philosophical approaches to privatization, policy debates regarding privatization often lead to disagreements between groups on whether or not privatization would be beneficial to a certain industry.

Although there are many formats, approaches, and philosophical attributes that policymakers must take into consideration when constructing a privatization movement, the word *privatization* can sometimes result in polarization given the partisan nature of the connotation itself, which can lead policymakers in districts that are more left-leaning, to not consider privatization, even if it is the best available policy option. There are those, in support of privatization, who claim that privatization can do the following: the private sector can provide

better quality products than the government can at a lower rate, a smaller government role will result in reduced costs to taxpayers, and less regulation will create more jobs. On the other hand, there are people, against privatization, who state that privatization will result in the following: the goal of profit making will endanger citizens and reduce available services, there will be an increased cost to consumers, transparency and accountability will decrease, the likelihood of corruption increases, privatizing national defense could put our country at risk in a time of war, and inequality between socioeconomic classes will continue to rise even further. (Leech, 2011)

Taking all of these characteristics and positions of privatization into mind, it is important to look at the different privatization movements over the past hundred years and how they have fared for the United States and other countries across the world.

It is safe to say that Americans can thank Ronald Reagan's National Commission on Excellence in Education for the current political climate regarding privatization. In April of 1983, Reagan's commission released *A Nation at Risk: The Imperative for Educational Reform*, which reset the terms of debate about public schools in America because the problem they saw was that high school graduates were unprepared for global economic success. During the late 1980s and 1990s, advocates of school privatization constructed a forceful intellectual argument that programs of the previous decades had produced bureaucratic educational 'entitlements' benefiting special interests, while failing mainstream and 'gifted' children. This rhetoric rolled over into other policy debates that led to numerous studies addressing the role of privatization, not only in education, but social security as well. In 1999, the Koret Task Force released 'The Federal Role of Education,' an essay that argues the weaknesses of American schools can be attributed to their 'forced adoption' of values; their ideal model is not the corporation but the private Catholic School, which, they argue, "holds children to higher standards than public

schools.” (Erickson, 2015, p. 85) When George W. Bush became president in 2000 the push for Social Security privatization accelerated the massive development of a tax-sheltered savings in the United States – favoring wealthier Americans, who constitute a majority of faithful Republicans. In the end, his privatization campaign failed and “Social Security became ‘the third rail of American politics.’” (Beland, 2005, p. 184) The origins of the privatization wave of the 1980s are important to consider when looking at different examples of privatization in a modern-day context.

For the sake of clarity and conciseness, we will look at privatization movements that have been successful domestically, on a local and national level, since the privatization wave of the 1980s and the impact that it has on the individual citizen, firm, and relationship between the public and private sector. One of the greatest resources that has seen mixed results with respect to privatization is water, specifically in regards to waste water treatment. On the local level, utilizing both asset sales and contracting, Franklin, Ohio has been able to reduce the cost of water bills by 23% since 1997 through the deregulation of the publicly-owned waste water treatment plant in 1995. Another example is in Mountain House, California, where the privatization of operations of their water treatment plant in the form of a public/private partnership resulted in a higher consumer satisfaction level and Southwest Water Company’s contract to be extended by the city twice already. (League of Women Voters, 2017) Both of these examples show how privatization can be utilized as policy tool that will decrease consumer costs, increase consumer satisfaction, and spur economic growth at a local level by encouraging local firms to have a larger role in certain sectors. On a national scale and in regards to the effects of privatization over numerous states, a report from the New Jersey Privatization Task Force found, in 2010, statistics on a variety of industries that were positively affected by

privatization. The task force found that since the mid-1980s, twenty-six states authorized privately financed transportation infrastructure, which tapped into a new source of infrastructure revenue. More to the point, the state of Virginia saved between six and 20 percent, from 1996-2001, on maintaining 250 miles of an interstate by contracting the service out for five years to firms within the state as well as the Governor of Florida who in 2008 gave out 32 “Virginia” contracts across the state that resulted in a 16% savings on maintenance costs (Zimmer, 2010). While many local and national privatization movements have benefited consumers, local and state governments, and local firms, success is not always the result.

Privatization has been successful in regards to the operations of local wastewater treatment plants and the maintenance of state infrastructure, but by the same token, it is imperative to understand that certain privatization movements have resulted in negative, unintended consequences. A common issue that arises when services are handed from public bodies to private firms is the level of transparency that may result. A local example of this can be found in Stockton, California, where the city agreed to a public/private partnership with a waste water treatment company similar to the agreement made in Mountain House, California. The greatest difference however was the lack of transparency that the private water company had with its local citizens and this level of transparency continues to be a problem to this day. A lack of transparency not only dampens consumers’ trust in the firm, but it could also stifle future privatization movements that the local government would try to introduce, hence not allowing local firms to become more involved in different sectors. On the national level, a Federal Bureau of Investigation operation found that judges, in Pennsylvania and Ohio, were taking bribes from officials of a private juvenile detention center and denying the detention of juvenile delinquents in local, public detention centers. Started in Luzerne County, Pennsylvania, this scheme was



ultimately dubbed as “Kids for Cash,” as Corrections Corporation of America, CCA, lobbyists would buy out public prisons and then bribe judges to fill them with juveniles brought to youth court. Despite the FBI sting, the CCA continues to send letters to states, encouraging them to privatize their prisons. (League of Women Voters, 2017) Operations like this across the state harm the integrity of the judicial institution within the state government itself and can lead an increasing opposition among voters to support candidates that are ‘tough on crime.’ As one can see, privatization has many benefits, but is also flawed in some respects, and so it is only right, that we address a privatization movement that is in the works.

In light of the previous successes and failures of privatization, there are ongoing privatization movements that must be addressed as well. One of the most recent movements that was sparked by interest from the Trump administration was the idea of privatizing air traffic control, or ATC. As of right now, the ATC infrastructure is operated through the FAA and funded through taxes levied on passenger tickets and airliner fuel. Trump’s plan would shift from a plan of taxation to that of franchising, where a new private, nonprofit board of directors, coming from airlines, unions, airports and FAA officials, would oversee the day to day operations of the privatized ATC and fund the system through user fees from activities like landing and takeoff. Countries like Canada, New Zealand and the United Kingdom have all successfully privatized their ATC operations within the past twenty years that has been the model for a variety of bills submitted, but not passed in Congress. The two most attentive publics, the Air Line Pilots Association and National Air Traffic Controllers Association, have voiced support for the measure, if it ensures that the new system will be as safe as the current one. However, the attentive publics that are going to serve as the greatest instigators against the proposal are the National Business Aviation Association and lobbyists from smaller airlines and

airports. The instigators claim that the privatization focus should not be on aviation operations, rather aviation infrastructure. It is important to point out that the proposed ATC privatization would not replace the NextGen collaboration between airports, the FAA, and DOD, but rather it would work in conjunction with the program's implementation. (Jetex, 2017) The prospect of privatizing ATC is promising for the aerospace industry because it shows that the efficiency and capability of aviation operations have outgrown the capability of the federal government.

Taking into account the previously mentioned formats, philosophies, perceptions, successes, failures, and recommendations of privatization are vital to the discussion of how air space systems are to be privatized and what combination of privatization characteristics would be most beneficial to space systems and the infrastructure of space ports between Earth and space. Thankfully, there are established private companies, such as SpaceX, Blue Origin, and Virgin Galactic, that would be able to compete to provide whatever privatized services or goods are requested from the federal government. In the next section, I will provide policy recommendations and highlight a privatization model that should propel the space industry into the future.

## CHAPTER 4

### RECOMMENDATIONS AND CONCLUSIONS

Within the next century, the United States, as an economic global powerhouse, has the opportunity to establish a space policy agenda that can become the model for other nations to propel commercial space travel into the future. For this to happen, there will have to be measures taken by both the public and private sectors that ensure competition in the space travel industry will remain healthy while the government doesn't engage in wasteful spending. In order for this to occur, it would be in the best interest of policymakers to promote an open competition, public-private partnership agenda in regards to the building and maintenance of space systems, while maintaining public control of the space ports.

#### **Recommendations**

To begin, it is important to highlight the two major budget items that will be addressed: the construction and maintenance of the space ports and space systems. It would be most beneficial for the federal government to maintain control of the space ports, whether that is the launch pads in Cape Canaveral, Florida or the module docking stations in the International Space Station (ISS). The necessity for a continued public hold on the construction and maintenance of the space ports has to do with the fact that commercial space travel is in its infancy and transportation infrastructure is an entity that should be under the government's control until the methods for construction and maintenance are perfected. Without the perfection of methodology, private companies would have the opportunity to cut corners and endanger the lives of workers as well as astronauts.

If NASA wants to be as cost-effective as possible when doing this, while ensuring the safety and accountability of space systems entering and returning to our atmosphere, then NASA

should invest more in launch pads and ISS modules to ensure that privately owned space systems, such as SpaceX's *Dragon*, are launching to and from earth safely and effectively. While the complete public ownership of the space ports is necessary because of the current state of commercial space travel, it could potentially become problematic ethically, economically and politically.

First of all, the ethical concerns of complete public ownership of space ports revolve around the human error of kickbacks and corruption. Much like the Volkswagen emissions scandal and the corrupt practices of Martin Shkreli at Turing Pharmaceuticals, I could foresee the potential for federal space port officials to be swindled by lobbyists from private companies, such as Boeing or SpaceX, to contract out services of the maintenance or construction of launch pads or ISS modules to fit the specific needs of the private company's space system while neglecting to adhere to federal regulations put in place. This negligence could put astronauts' lives at danger and lead to severe civil and, potentially, criminal charges against the private lobbyists and federal officials that could sever the federal government's relationship with top private space companies, putting the current progress for commercialized space travel at a halt.

Secondly, the economic concerns of complete public ownership of space ports would be the fact that this would not allow private competition to build more advanced and cost-effective space ports. While this may be true, the federal government has an obligation to its citizens to provide goods or services that are done in a safe and calculated manner. Such as it would be unwise for an airplane to take off from a runway that had pot holes or slippery conditions, such is so with launch pads or ISS modules that could have cheap, faulty material that could cause an air space system to malfunction and injure or even kill the astronauts aboard. Until the day when

materials and regulations are put into place that would keep private space companies accountable, the necessity for space ports to be in the sole control of the state is paramount.

Third, the political concerns of complete public ownership of space ports that I would foresee would include companies that would benefit the most from a complete open competition, public-private partnership policy model for space systems. The potential instigators in this would be companies such as SpaceX and Boeing, who would have the opportunity to compete for government contracts to build air space systems but would not have the ability to build and test their systems on privately owned launch pads. A response to this however would be that private companies need to understand that until the technology for space ports has a solid foundation, with conclusive research, then it is the federal government's job to ensure that its citizens are engaging in activities that they can do so in a safe and effective manner.

The current policy in place that relates most to my recommendation for complete public ownership of space ports is the Title 51 of the US Code -- for the sake of clarity, the remainder of this paragraph will refer to "space ports" as "launch and reentry sites." In order for the complete public ownership of launch and reentry sites to become a reality, there are currently two parts of the act that I find to be contradicting to a market that will allow private companies to build and maintain space systems while being held accountable for their actions in launch and reentry sites. The section of Title 51 of the US Code that I would recommend to revise would be Section 50901. Findings and purposes. Subsection (a). Part (9)., which states "the participation of State governments in encouraging and facilitating private sector involvement in space-related activity, particularly through the establishment of a space transportation-related infrastructure, including launch sites, reentry sites, complementary facilities, and launch site and reentry site support facilities, is in the national interest and is of significant public benefit; (United States,

2010) as well as Section 50901. Findings and purposes. Subsection (b). Part (4), which states “to facilitate the strengthening and expansion of the United States space transportation infrastructure, including the enhancement of United States launch sites and launch-site support facilities, and development of reentry sites, with Government, State, and private sector involvement, to support the full range of United States space-related activities.” (United States, 2010).

The revision that I would recommend would be to strike sections S50901(a)(9) and S50901(b)(4) of Title 51 of the US Code. This simple revision would ensure that the public sector maintains control of space ports and that the building and maintenance of the space systems would remain under contracts in a public-private partnership. The reason that these policy revisions are necessary is to ensure that the federal government maintains control of the space ports to ensure that private companies are not cutting corners and putting astronauts lives at danger. In addition, the policy revisions would provide the federal government the opportunity to place federal oversight officials at sites of reentry and launch, to ensure that companies, like SpaceX or Blue Origin, are adhering to regulations that FAA has set in place. Although this may seem like an overregulation of space ports, I believe it is important to point out that even though the commercial aviation industry is in a state of economic stability and technological growth, the federal government still owns the majority of airports in the United States, with local or state owned port authorities that oversee the day to day operations of an airport itself. The lack of regulation over space ports is surprising given the continued regulation of airports and the infancy in technology and economic viability of the commercial space travel market.

In the beginning of this policy action, I realistically believe that private companies would feel inclined to build their rockets outside the United States because the government would charge a fee for usage of the facility. However, to ensure that private space companies stay in the

United States, policymakers will have to provide tax incentives to these companies as well as offering low user fees for the companies to build, test, and launch their air space systems. Using the revenue generated from user fees, the public sector will have the opportunity to build new launch pads and testing sites, while improving existing ones, leading to private companies flocking to the United States to utilize the sites we have to offer them.

This isn't to say, however, that overtime space ports cannot be privatized, I believe quite the contrary. At the moment, it is important for the federal government to have the space ports in their complete control to develop a uniform set of regulations with knowledge of corresponding technology that would allow the space ports to be incrementally improved and become more cost-effective by private companies. However, this will take research and resources from the public sector. Ultimately, where I would like to see the state of space ports would be a short-term transition from complete public ownership to the use of contracts between the private and public sectors in regards to the maintenance of the space ports, similar to the infrastructure plans that Florida and Virginia devised in the 2000s (Zimmer, 2010). This transitional plan would allow the federal government to become acquainted with how the space ports operate, gather user fees from private companies testing and launching their space systems, and then regulate the privately owned space ports in a more efficient manner.

While a transition from complete public ownership to the use of public-private contracts for the ownership of space ports would be an adequate policy initiative, it would serve the interests' of the federal government best if they were to allow private companies to engage in an open competition market for the construction and maintenance of the space systems that maintains a public-private partnership with federal agencies. While companies such as Blue Origin, Virgin Galactic and SpaceX are leading the front for commercial space travel, they

should have the opportunity to build bigger and better space systems that would not cost the federal government a dime. It is important to point out that the United States has not used an American publicly funded rocket for human transportation since 2011 and should continue not to do so. One of the major government contracts that would serve as a model for this would be Boeing and NASA's current public-private partnership with NASA's Space Launch System. This \$2.8 billion contract can serve as a contractual foundation for future space system public-private partnerships and this could potentially strengthen a decades' long relationship between NASA and Boeing or create new relationships between NASA and companies such as SpaceX.

One policy initiative in the past that would serve as a foundational policy model for the privatization of space systems would be the Contract Air Mail Act of 1925, or the Kelly Act, which authorized the postmaster general to contract for domestic airmail service with commercial air carriers. This policy measure gave private companies the opportunity to compete for contracts with newly created air freight businesses. The mail carrying flights became so frequent that entrepreneurs in the field began to sell tickets for passengers to ride, along with mail, on the aircraft. As airplanes became more advanced and the market began to grow, tickets became cheaper, making human passenger aviation a reasonable alternative to driving or riding on a train. Soon after the market began to become established, mail carriers were making so much profit from human passengers that mail became a secondary point of focus (Frost, 2017). This then led to alternative mail delivery companies, such as FedEx and UPS, to become created which focus solely on transporting goods rather than people. While initially, mail delivery companies serviced people who needed large packages shipped across the United States or overseas, more recently, the demand for these services has increased significantly. The reason



being that when services provided by retail companies, such as Amazon, began to be more accessible by consumers online, the need for shipping grew exponentially.

The way that I ultimately see the Kelly Act coming into play with the public-private partnership between NASA and private space companies would be that, as NASA is currently doing, NASA should continue to contract out services related to the building and maintenance of space systems. As space systems become more technologically advanced and the commercial space travel market grows, then private space companies, as did commercial aviation companies, will have the opportunity to seize the transportation of goods from Earth to ISS, and instead, focus on commercialized space travel to other planetary bodies. This will then open an entirely new market, where new companies will have the opportunity to enter the interplanetary goods transportation market where they will provide services parallel to the operation of UPS and FedEx, except between Earth and space. This new market will be revolutionary in the sense that not only will it expedite goods transportation but it will effectively make it more cost-effective for federal agencies and it could have an unintended consequence on the goods transportation market here on Earth. For example, if the transportation of goods between Earth and space become more cost-effective, than what's to say that doesn't affect the shipping prices offered by UPS and FedEx, who would then compete with other emerging interplanetary shipping companies that interact with firms solely on Earth. Although there is not a theory to support this, I believe that as the cost to ship goods across Earth and between Earth and space become more cost effective from this new market, then the cost to transport humans across Earth and to space will become more cost-effective, having the potential to make it cheaper to fly than to drive or take a train somewhere.

Just as all privatization movements are unique, I believe that it would serve policymakers best to approach the privatization of space systems from a pragmatic, commercialized approach in order to establish bipartisan support. By selling this movement as a way to lower the costs of goods or space systems provided, while generating revenue from increased regulation on the services or space ports that are available, the federal government will be able to convince the attentive public that this is the best course of action. A pragmatic viewpoint will be important when officials from NASA explain to citizens why it is that policymakers chose to completely privatize the building and maintenance of space systems, in which they can explain that it is for similar reasons that airlines are privatized, to lower costs to the federal government and drive down prices for the consumer. On the other hand, a commercial philosophical viewpoint is important when federal officials speak with private businesses because they can frame the issue that complete public ownership of launch pads, ISS modules, and testing sites along with the open competition privatization of space systems benefits the private sector two-fold because there will be more money for companies to invest in space systems without having the worry about the construction and maintenance of sites to build, test, and launch the space systems.

It is no secret that this set of policy recommendations would have adverse effects on different parts of daily life. The four greatest sectors of life that would be most affected would be international relations, asteroid mining, medicine, and tourism. With the United States taking control of major launch pads in the United States and ultimately ISS modules designated for the United States, these policy recommendations would leave the international space community to be less diplomatic and more competitive. The reason being that foreign nations will compete to build bigger and better launch pads while lower user fees, or not charging anything at all, although this would be unsustainable in the long run. This increase in competition between

foreign nations will strain relations aboard the ISS which could lead to a commercialized station being built, ultimately leading to astronauts being contracted out by private companies to complete a variety of tasks such as exploration and asteroid mining.

In the short term, as the United States will be beginning to charge user fees to private companies, they will need to find alternative sources of revenue that could offset losses from potential companies leaving the United States to do business elsewhere. One activity that has the potential to build significant revenue would be asteroid mining. By owning the rights to the launch pads and ISS modules, the United States would have the right to give private companies permissions to use their facilities while requiring them to do a variety of tasks in space. In order to make the most out of the resources provided, it would be in the best interest of the United States to establish a public-private asteroid mining partnership that would allow private contractors to go into space, mine asteroids, and then the federal government and private companies would negotiate what percentage of revenue generated from each mineral they would receive. This endeavor would be one that would take years to perfect, but once the methodologies and practices are perfected, the United States will be in position to capitalize on the future of asteroid mining. Such as with industries on Earth, there are significant dangers that can pose threat to the safety and health of the workers completing the task, because of this aerospace medicine will be a sector that be researched and invested into by the federal government.

Research from NASA in the past few years have revealed that living in space for an extended period of time can have adverse, negative effects on the body, and while it is not known at the moment how we can counteract those effects, the federal government has the resources to research a solution. As of now, researchers have found that the body loses 1% of its

bone density per month in space, however, there have been bisphosphonates drugs that can slow down the process. In addition, it was found that space radiation is the most dangerous hazard when travelling in space because of the potential to develop skin cancer or degenerative tissue diseases and in order for astronauts to maintain full control of their muscle movements, they must exercise intensively every day (Gushanas, 2016). While the research conducted as of now is promising, it simply is not enough. If the United States is to eventually send astronauts to and from Earth daily, and hopefully, one day tourists, then new pharmaceuticals and surgical procedures must be developed to ensure that flights can be taken safely and as often as needed.

Although the dangers of space travel cannot be taken lightly, the prospects of emerging markets, such as space tourism are exciting and could define just how far federal space agencies are willing and able to take their research. If the procedures and methods are improved to the point to where it is affordable to the upper-middle class to fly to and from space, then what is to say that the aviation industry here on Earth doesn't tap into a more lower-middle class consumer base. Ultimately, if interplanetary ports become as common and accessible as airports, then airports will become the new bus stations of the world and this could redefine everything from the price of land on Earth to the prospect of colonizing other planets. The privatization of space systems, and one day space ports, will redefine what it means to travel, in terms of speed, price, and efficiency means to world travelers.

## **Conclusion**

Using the background research of the evolution of space systems and then taking research of privatization used a policy tool, I came to the conclusion that an open competition, public-private partnership policy agenda would be most beneficial for space systems while the complete public ownership of the space ports would also be the best direction for the government to go

until the technology is improved and procedures are perfected. This system will allow private companies to continue to remain in service while keeping them accountable for their actions by having strict regulations and forcing them to build, test, and launch their space systems from government-owned and operated launch pads and ISS modules. An increase in privatization, in the form of a public-private partnership, can be to the benefit of space companies, such as SpaceX, as well as the government to create a more cost-effective and efficient industry. The success of commercialized space systems is dependent upon the autonomy that space companies are given in regards to research and manufacturing. For this reason, I conclude by proposing that, in the public sector, federal agencies, such as NASA, should encourage the privatization of space systems through a comprehensive scale back of federal funding toward space system manufacturing, and the implementation of a regulatory plan of space ports so that a market can be established for companies to purchase 'space port rights,' at the expense of other private space companies leasing out the port for their own use or research. Whereas in regards to the private sector, private space companies will be encouraged to allocate more resources toward space system manufacturing and research projects.

Another significant benefit to these policy recommendations is that it encourages the United States to collect a significant amount of revenue from user fees while ensuring that we have the best space ports available in the world. By acknowledging in the long run that the complete public ownership of space ports is unsustainable, I have shown that this set of policy recommendations is not one that should be without future amendments. Commercial space travel is an emerging industry with lots of potential, however, for the industry to prosper, the United States must take it one step at a time, and not allow private companies to have as much

autonomy as they do at the moment because of the potential threats to humans being sent to space and the viability of the emerging market itself.

The major policy actor in this set of recommendations is NASA and therefore, it is paramount that they are front and center in the push for these recommendations. By collaborating with members of congress, who have significant influence in the shaping of space policy, NASA will be able to establish an agenda that is defined by accountability and feasibility. With NASA controlling all building, testing, and launch sites in the United States, private companies will not have the opportunity to cut corners or ignore federal regulations. In addition, with the increase in revenue intake, NASA will have the resources to invest in technology improvement and missions that travel beyond low Earth orbit. Both of these effects will prove to be beneficial for the future of space travel, because once space travel is commercialized and as common place as aviation, passengers will be at ease knowing that they will be safe and entrepreneurs will feel inspired to enter the market to provide an improved and more cost-effective product.

Imagine entering a large airport-like building in Cape Canaveral, Florida. You walk up to the counter to retrieve your ticket and the information on the ticket reads that instead of flying to Mobile, Alabama, your destination is the dark side of the Moon. You continue through the Transportation Security Administration's checkpoint, and once you and your luggage are cleared you enter into the common area where restaurants, music stores and bathrooms line the walls of the building. You find your Gate, A4, and overhear the flight attendant on the intercom, "SpaceX flight 474 to Sector 4 of the Moon will be boarding momentarily." This isn't a dream, with the policy recommendations I have provided, this is a near-distant reality.

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