The Case for Big Things:
Public Value Mapping U.S. Space Policy from Sputnik to SpaceX

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ABSTRACT

In little more than fifty years, the United States' involvement in space has brought the country and the world some of the greatest scientific and technologic achievements, yet these have also come at a tremendous cost. Space policy came of age in the Cold War and was used as a proxy for the all-encompassing competition that engulfed the two Superpowers of the time, the United States and the Soviet Union. This paper will investigate three eras of space policy each characterized by a significant event or chain of events that brought about a change in policy. The cases will be used to analyze a trait—public values—that can often be overlooked by other methods of evaluation. Public value mapping (PVM), developed by Bozeman and Sarewitz, will be used in conjunction with an open systems analysis, developed by Kraemer, to identify the public values of U.S. space policy over time and map them on a public values failure or success axis against an open/closed system axis. The underlying purpose of this paper is to better understand why the U.S. invests in large science and technology programs like space and how this understanding can be applied to other areas of governmental interest that contain public values. The PVM analysis identifies several key elements of success from the space cases, including external events, political windows, and strong, aware, and nimble leaders.

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I. INTRODUCTION: SPACE AND THE DOING OF BIG THINGS

I. Introduction: Space and the doing of big things

On October 4, 1957, a ball of Soviet aluminum "the size and shape of a medicine ball and the weight of a fairly heavy man,[*]" filled with gaseous nitrogen, and equipped with two radio transmitters and four antennae, broke through the Earth's atmosphere and began to orbit the planet ("Sputnik in Flight," 1957). For twenty-two days, *Sputnik*'s battery-powered transmitter broadcast a shrill, urgent-sounding, repeating tone to any radio listening across the planet. It was even blamed for opening remote garage doors in Upstate New York ("Is Satellite Overdoing the Open-Door Policy?," 1957). *Sputnik* and the "permi-crisis" (McDougall, 1985) that followed represents the first inflection point in American space policy, but it wouldn't be the last.

The response to *Sputnik* set off a new era of government involvement in space and has been used as a symbolic political rallying cry for issues of all colors ever since. President Obama, in his 2011 State of the Union Address, told the nation that the budget he would be sending to Congress would "reach a level of research and development we haven't seen since the height of the Space Age . . . This is our generation's *Sputnik* moment" (Obama, 2011). Our national mythology places great emphasis on these "moments" and the nation's space program has had its share of searing events that have altered the course of policymaking in this realm. For example, President Kennedy's decision to go to the moon in 1961 and the resulting *Apollo* mission have also been co-opted by those who urge the government to do big things once again. Advocates' statements usually begin with "If we could put a person on the Moon, surely we can [find a cure for cancer / address climate change / etc.]." Finally, the past thirty years of U.S.

[*] 184 pounds, to be exact.

involvement in space has been shaped both by political leaders' ideology with respect to government and by tragedies like *Challenger* that question the state of the space program and force changes to it.

This paper will analyze three case studies of U.S. space policy, each reflecting an era defined by a "moment" that altered the policy landscape. The first era, Early Space, begins after World War II and ends with the creation of NASA in 1958. The launch of *Sputnik* drove the United States' thinking on space in a wholly new direction. The next era, Moon and Back, begins with President Kennedy's 1961 announcement that the country would send a man to the moon and return him safely before the end of the decade. This announcement resulted in a massive mobilization of resources and talent that yielded spectacular results but with a level of resource mobilization that ultimately proved unsustainable. The era ends in 1969, as *Apollo 11* achieved Kennedy's goal and left space advocates and opponents asking, "What's next?" The final era, Space, Inc., begins with President Reagan and continues through the present day. The case illustrates the difficulties and promise of a rising private market and the government's sometimes ambiguous role in this more crowded marketplace. It also illustrates how leadership and ideology can shape space policy. A summary of the three eras analyzed in this paper is found below, in Table 1.

Era	Dates	Description
Early Space	1946–1958	An era characterized by a losing battle for limited governmental spending and a practical, military intelligence-based space program was upended by *Sputnik* and the public, political, and media fracas that followed and resulted in the creation of the nation's first space agency, NASA.
Moon and Back	1961–1969	An era characterized by the decision to send humans to the moon with the resulting resource mobilization and political backlash; seen by the public and policymakers as the crowning achievement of NASA and used for political gain in years since when advocating for (or against) big governmental initiatives.
Space, Inc.	1980–Present	An era characterized by a maturing of the commercial sector of space brought on in part by government leaders who advocated for more private sector involvement in space policy, though which has not come without significant challenges and missteps.

Table 1. A description of the three eras of space policy analyzed in this paper.

These periods of space policy are well-studied, especially in attempts to understand or quantify the significant or benefits of the space program. Generally, traditional research evaluation measures returns on investment, patents generated, or citations to work (Bozeman & Sarewitz, 2011). In other words, traditional research evaluation tends to measure the trees instead of the forest, and sometimes even the wrong trees in the wrong forest. These traditional methodologies have, however, yielded important insights into the working of U.S. space policy in the past (Autio, Hameri, & Nordberg, 1996; Logsdon, 2001; McCurdy, 1994; Whitney, 2000). This analysis will take space policy evaluation in a new direction by employing a method of scientific program evaluation called Public Value Mapping (PVM), introduced by Bozeman and Sarewitz (Bozeman & Sarewitz, 2005, 2011; Bozeman, 2002, 2003). PVM is posited as a qualitative approach that complements the fields of more traditional research by addressing public values to give a deeper understanding to policymakers in order to influence their decision (Bozeman & Sarewitz, 2011). An in-depth discussion of this model and its application and refinements follows below in Section III.

An analysis of U.S. space policy is used as an analytical tool that answers the questions, why do we do "big things" as a country; and whether we do these things—go to the moon, map the human genome, develop new sources of energy—because they fulfill public values or for some other reason, be it political, economic, or military. This paper does not set out to solve the complexities that factor into these decisions. Rather, this paper will organize internal and external motivators that play important roles in how these eras were defined and, importantly, identify and analyze public values. I begin with the premise that large governmental initiatives should be undertaken in order to fulfill public values. These public values are ever-shifting and difficult to uncover, but they provide a starting point for debate. Lessons of the U.S. space program using PVM analysis can inform the difficult decisions we face today in how to allocate finite government resources to address problems and fulfill public values with innovation in mind. PVM fills an important analytical role that more traditional research evaluation methods cannot.

II. LITERATURE REVIEW

Asking why we choose as a country to pursue a space program or any other big scientific initiative tends to invoke somewhat abstract notions of the value of discovery, humankind's innate curiosity, or the public good. More difficult answers are the kinds which attempt to quantify these qualities or that takes a more in-depth look at the mechanisms of these programs. This section will summarize a small selection of research on space policy benefits and public opinion.

II. LITERATURE REVIEW

A. BENEFITS OF NASA/SPACE PROGRAMS/BIG SCIENCE

Autio et al. (1996) approach the question of the value of big science initiatives like space by looking at the benefits beyond the direct and measureable ones that are realized by academia, industry, and the public. The authors note that the "epistemic," or knowledge-based contributions of big science are typically touted as the main contribution of big science initiatives funded with public money, but that the "tacit and private knowledge" gained by firms and used in a competitive marketplace are not well quantified (Autio et al., 1996). In fact, there are five "motivating dimensions" in addition to epistemic that are identified in the paper: educational, political, financial, technological, and strategical. Focused attention to these motivators could significantly increase the technological and economic impact of interactions around big science centers, an important metric for continued and future funding of such projects.

Gaubert (2002) takes umbrage with the current usage of the word "space" as a line item in government or research budgets because of the vast range of activities encompassed within the term and the resulting impacts on industry when these activities are all lumped together. The author argues that invoking "space" was once a way for "countries to endow themselves with a tool based on long-term vision" (Gaubert, 2002). Since that time, countries have needed to grapple with short-term challenges within an industry whose activities now vastly exceed the original scope of the term they fall under. The next question is whether, with the current expansion of the field ever-deeper into the commercial realm, public funding is still required for space activities. Gaubert believes that it is, because countries use space to pursue "intrinsic areas of state responsibility" such as defense and science and because it is the states' responsibility to establish the framework for future commercial success in the space and aerospace industry by investing in research that will lead to these breakthroughs (Gaubert, 2002). In short, the

interconnected nature with regard to public and private entities—private entities need public funding and public entities need private goods and services—argues for the continuation of public support for space activities. The way that space activities are funded, often as a single line item or under the discretion of a single agency or ministry, threatens the continuation of this public-private interface. Political decisions, Gaubert argues, that treat space activities in a very general way, can lead to arbitrary reductions in funding, with little understanding of the disparate impacts or the disparate goals of the space activities affected (Gaubert, 2002). Space is no longer done for space's sake, but as an important tool in a variety of fields that use space technologies in a very specific way.

Another scholar analyzes the evolution of the rationale for space programs, from the military applications and context of the Cold War to the international, cooperative initiatives that now define space policy (Fisk, 2008). The subtle, yet profound impact of space exploration, argues Fisk, is the change in how we relate to one another and how we relate to our place in the universe as a whole. "For most people, I suspect, the change in attitude, the penetrating new insight, followed from the historic picture of Earth taken by the crew of Apollo 8 en route for the first time to the Moon" (Fisk, 2008). The enduring salience of this insight, borne from massive investments in space programs past, to Fisk, is a strong reason for reversing what he posits is the current underutilization of space-related resources. To Fisk, then, recapturing the nation's imagination in math, science, and engineering, as accomplished during the Apollo years, can and should be replicated for our nation's future success.

Other studies begin by noting the "enormous" scope of the societal impact of spaceflight (Dick, 2007). The broad scope of impacts ranges across at least six areas: the national and international impact of "turning points," commercial and economic impacts, applications

satellites, societal impact, cultural impact, and ideology and space advocacy (Dick, 2007). The author introduces these impact areas, summarizes existing literature on each, and ends with a call for further research and discussion.

Logsdon (2001) identifies two additional and often overlooked payoffs from space programs—the ability to view Earth from space which has reconnaissance benefits for peace and security and environmental stewardship benefits. The reconnaissance and environmental benefits of space are often overshadowed by the economic and social payoffs, which include communications, weather forecasting, remote sensing, and navigation (Logsdon, 2001). Yet, Logsdon argues, early space reconnaissance satellites may have averted a nuclear war by allowing the U.S. to learn more about Soviet missile capacities, which were otherwise unknown. In addition, the color photographs of Earth taken by the Apollo and Voyager missions were instrumental in establishing an environmental consciousness in years since. Logsdon writes that, "If going into space has contributed to a more peaceful and more sustainable life on humanity's home planet, that may be the greatest benefit of all" (Logsdon, 2001).

B. Public Opinion and Space

How responsive is government to public opinion? Context matters; generally, for domestic issues, it is responsive, but for international issues, it is not, argues Steinberg (2011). Space policy is difficult to analyze because it has both domestic and international components. Analysis of public opinion polling can unearth clues as to how the public has viewed space in different times in the past fifty years and whether government policy has been attuned to this phenomenon. This analysis is especially important because of the commonly accepted narrative of the space program, especially with regard to the *Apollo* program, that a massive public surge

of support propelled U.S. action (Kraemer, 1992; Launius, 2003). Interestingly, it seems as though public opinion did play a role in the 1960s—by being a major factor that led to the *reduction* of the NASA budget (Steinberg, 2011).

Addressing the *Apollo* mythology is an important step in the discussion of space and public opinion. For decades, many have reasoned that if only the U.S. had the kind of support for other programs (e.g., energy policy) that it did in the 1960s for the Moon mission, it would generate government action. Analysis of opinion polls from the time paint a different picture. For example, a Gallup poll from 1961, the year President Kennedy announced the plan to go to the moon, found that only one third of Americans thought that such a mission would be worth the cost (Steinberg, 2011). The same poll found that, unlike many popular retellings of the time, Americans were unsure as to whether the Soviets were ahead of the U.S. in the space race; approximately equal proportions thought that it was, wasn't, or had no opinion (Steinberg, 2011). In fact, the moon mission did not have popular support at any time in the 1960s, with the exception of the time period of *Apollo 11*, the moon landing mission (Launius, 2003). One scholar puts the lukewarm reception of *Apollo* into perspective, noting that public support even at the time of the Moon landing was only just above fifty percent, "despite the fact that the landing was perhaps the most momentous event in human history since it became the first instance in which the human race became bi-planetary" (R. D. Launius, 2003).

Removing the rosy tint of public opinion and space history, one still finds that the space program has consistently been held in high regard by the public, especially relative to other agencies such as the Internal Revenue Service or the Environmental Protection Agency (R. D. Launius, 2003). The reasons for this high approval rating are complex and not well understood. Some insight is found in the observation that public perception of NASA, that it is a good agency

but spends too much money, is not unlike the reception that other public policy programs and agencies receive (R. D. Launius, 2003). People are not opposed to it, in theory. The next question is then, why do people support the space program? The rosy view, which has some support, would be that the space program enjoys support because it does big, important things. It sends people to the Moon. There is certainly anecdotal evidence to support this (R. D. Launius, 2003). However, it appears that most people "who support the space program support it for its more enduring scientific value than for its dramatic one-time achievements" (SK Kraemer, 1992).

What type of enduring scientific value do people support and what type of people support enduring scientific value? This compound question has yielded insightful results for researchers. One does not have to be a scientist to value science, a fact made clear in the findings of one researcher, who interpreted the results of one study to mean that only twenty percent of those who support the space program could be considered scientifically literate, meaning a basic grasp of scientific terms and concepts (SK Kraemer, 1992). This researcher, who at the time was the Director of the Special Studies Division at NASA saw this as a troubling failing of science communication by her agency and perhaps driven by misperceptions of space from popular culture by those who supported the agency (SK Kraemer, 1992). Other researchers have attempted to identify the "issue public" for space, "groups of people who strongly attach themselves to a particular issue and who act based on that attachment over a period of time" (Whitman Cobb, 2011). Whitman Cobb found that the typical NASA/space supporter was younger, Republican, male, and of high socioeconomic status (Whitman Cobb, 2011). That study stopped short of attempting to tease out the causal mechanisms for this narrow group's support of space.

The final question in this debate is whether public opinion matters for the level of funding for space programs. One argument that it should not, is that the public has a wildly inaccurate perception of the share of the federal budget, which has been below one percent for the last twenty years and at its peak in the mid-60s commanded 4.5 percent of the share of the budget. The public, however, estimates that NASA's budget is closer to twenty percent of the share of the federal budget (R. D. Launius, 2003; Steinberg, 2011). The public also feels that NASA's budget is overblown. However, amidst public calls for a budget reduction, is there any evidence that policymakers listen? The answer is, again, complex. A study using public opinion data from the General Social Survey looked for an impact of public opinion on the federal budgetary allocation for NASA, on a two-year lag to account for the budgeting process (Steinberg, 2011). The study found that no one analysis (the study used four different variations of data) was dispositive, but that when taken as a whole, it could be said that NASA funding was responsive to both groups who wanted to cut or increase funding (Steinberg, 2011). One important fact to note is that on the whole, NASA's funding since the 1960s has been relatively stable, only increasing or decreasing incrementally; it would thus be inaccurate to conclude that its funding rises and falls in strict lockstep with swings in public opinion.

C. Conclusion

This paper will use the rich history of scholarship on space policy to better understand the important links between the purported economic and social benefits, public opinion, and decisions that have defined the past half century of discovery and exploration in space. The lessons from the case studies will help lead to a better understanding of the drivers and impacts of space policy that can help to identify important elements for catalyzing other "big science" initiatives in the future.

III. METHODOLOGY

This analysis employs two frameworks—public value mapping and open systems—to analyze three case studies on space policy. Each case study focuses on a distinct era of space policy selected for the unique policy challenges and dramatic inflection points they feature. A narrative case study of each era will be followed by PVM analysis of the era. The findings from the three eras will then be integrated to identify key drivers and barriers for large governmental initiatives like space exploration, lessons which can also be applied to current and future questions about big government initiatives.

Public value mapping and open systems analyses were chosen from a review of literature encompassing the area of study in government research evaluation and science and technology studies, specifically economics of R&D (Jones & Williams, 2000), academic research and industrial innovation (Mansfield, 1991), government innovation (Roessner, 1989), and systems innovation (Geels, 2005). Public value mapping was selected because of its focus on qualitative analysis and its application to broader public programs like space policy. It is an analytical method that allows for a thorough analysis of complex policy programs like space policy without the need for massive amounts of raw data or complex calculations. The open systems analysis framework was chosen as a response to the inadequacy of the market failure analysis embedded in public value mapping. It uses a broader scope than market failure analysis which is especially relevant to a government policy regime that originated in an environment devoid of an existing private market. This section will describe the theory behind public value mapping and open systems analysis and will describe how they are applied to the space policy eras.

III. METHODOLOGY

A. Case Studies

This analysis relies on case study research method to provide the narrative structure for the PVM analysis to reside. The case study is used to "understand a real-life phenomenon in depth, but such understanding encompassed important contextual decision—because they were highly pertinent to [the] phenomenon of study" (Yin, 2008). The inquiry of phenomena in a case study recognizes that there will be more "variables" than "data points" for analysis and that multiple sources of evidence are necessary, along with prior development of theoretical propositions, for a successful study (Yin, 2008). Especially important for PVM, case studies allow the researcher to probe the causal links of an event or series of events to help fill in necessary details and context for use in the analysis (Yin, 2008).

B. Public Value Mapping

Public value mapping (PVM) seeks to address two key problems that plague evaluation of science policies:

> 1. [T]he lack of adequate conceptual apparatuses to compete against market failure and other economics-based models.
> [...] 2. [A]pproaches to evaluating science and technology outcomes have been dominated by techniques and methods anchored either in microeconomics [...], supporting the economic productivity value set, or bibliometrics [...] supporting the academic productivity value set (Bozeman & Sarewitz, 2011).

PVM is an approach that aims to "increase the public values component of science policy . . . by making it possible to consider diverse values using methods and criteria comparable to those already widely accepted and used for scientific and economic values" (Bozeman & Sarewitz, 2011). Designed as a complement, not a substitute, to traditional market and other research evaluation approaches, PVM arises out of the theory of public value failure developed

by Bozeman. Its goal is not "prediction or proof," but "plausibility" as to whether a system is a public failure or success (Bozeman & Sarewitz, 2011). A detailed description of the genesis and application of PVM follows, along with refinements of the method for the case studies on U.S. space policy that are the focus of this paper.

1. Public Value Failure

Like its theoretical companion market failure, public value failure describes a scenario where goods and services fail to achieve a specific goal and government intervention becomes necessary. For markets, this goal is the efficiency of markets; for public values, this goal is the realization of public values. But what is a public value and where is it found?

The answers to this line of inquiry can be evasive. There are, however, definitions of what a public value looks like:

> A society's "public values" are those providing normative consensus about (1) the rights, benefits, and prerogatives to which citizens should (and should not) be entitled; (2) the obligations of citizens to society, the state and one another; (3) and the principles on which governments and policies should be based (Bozeman, 2007).

Grounding these lofty definitions is an important step to aid the identification of the values from the case study. Jorgensen and Bozeman (2007) reviewed over two hundred scholarly articles and identified, analyzed, and critically compared seventy-two values (a list of these values is found in the Appendix). These values provide a broad view of possible public values and can be categorized according to the specific aspect of public administration or public organization the value affects (such as the public sector's contribution to society, the value category, and the common good, a value set) (Jorgensen & Bozeman, 2007). This classification

of value categories and sets is included in the table in the Appendix. The authors' list of public values will be used in this analysis as the stable of public values to be drawn from.

The next inquiry is where to find examples of these public values being expressed? Public values can be found in a variety of sources, starting with a nation's laws and constitution, public opinion survey, public policy statements, and the congressional record (Bozeman & Sarewitz, 2011). Bozeman and Sarewtiz are quick to emphasize that public values do not encompass every conceivable "value" presented by a policy advocate. For example, many science policy initiatives are justified by the benefit to the economy that would result from implementation. Economic benefit used here is not a public value in and of itself, but rather a surrogate, or instrumental, value for happiness, which is a public value (Bozeman & Sarewitz, 2011). Why not promote these broader public values—happiness, leisure, safety, curiosity—instead of using an instrumental value such as economic growth? It would seem to be a tough sell for many decision-makers, who likely feel more comfortable with a more measurable justification—hence the dominance of economic-based studies. PVM is one way to counter this.

PVM also seeks to elevate the public science discussion to include notions of equity in the distribution of benefits. Economic efficiency studies do not capture the distributional effects of the outcomes. Further, the authors are skeptical of the historical, linear model of scientific progress, that basic science leads to technology, which leads to the production of goods and service, which finally leads to economic growth. The issue of equity is also important in the discussion of the subversion of public values throughout the public science policy stages. The authors note that discussion of public values is prevalent in the earlier stages of policymaking because they are appealing justifications for expenditure; however, these values are minimized in the middle stages of policymaking due to the surrogacy of economic and productivity values as

measuring sticks for all other values (Bozeman & Sarewitz, 2011). Public values can sometimes reemerge at the final stages, when policymakers seek to assess the implementation of the policy, but here too, they are often subverted in favor of more measureable criterion of evaluation.

2. Core assumptions of PVM

Assumptions of PVM will help to guide (and ground) this analysis. This section will highlight assumptions that are particularly relevant to the analysis of space policy. The first relevant assumption is that PVM is either prospective, formative, or summative in the policy it assesses. This gives the researcher flexibility to move across temporal boundaries to assess the past, present, and future implementation of a particular policy. This assumption also allows the researcher to compare multiple policies in different stages, a completed policy with a proposed policy, for example. Next, PVM focuses on the environmental context for research and programmatic activities and seeks to place the various institutions and individual actors in their respective contextual environments. Doing so allows for insights to be lifted from an examination of political history in ways that would be difficult, if not impossible, without PVM. At the heart of PVM lies the mapping of the causal logic, "relating goals statements [] to science and research activities, impacts and outcomes, both measured and hypothesized" (Bozeman & Sarewitz, 2011). This mapping is used to aggregate social indicators; or to place the particular policy on the spectrum of public value success and failure.

3. Development and application

There are certain criteria in PVM that serve as indicators of public values failure or success in PVM analysis, but that do not themselves constitute a list of public values. Table 2 below lists and defines these criteria.

Table 2. PVM Criteria and descriptions (Bozeman & Sarewitz, 2011; Bozeman, 2007).[1]

Criteria	**Description** (From Bozeman & Sarewwitz (2011) unless noted)
Mechanisms for values articulation and aggregation	"Political processes and social cohesion insufficient to ensure effective communication and processing of public values."
Imperfect monopolies	"Private provision of goods and services permitted even though Government monopoly deemed in the public interest."
Scarcity of providers	"Despite the recognition of a public value and agreement on the public provision of goods and services, they are not provided because of the unavailability of providers."
Short time horizon	"A short-term time horizon is employed when a longer term view shows that a set of actions is counter to public value."
Substitutability versus conservation of resources	"Policies focus on either substitutability or indemnification even in cases where there is no satisfactory substitute."
Imperfect public information	"[P]ublic values may be thwarted when transparency is insufficient to permit citizens to make informed judgments" (from Bozeman (2007).
Benefit hoarding	"Public commodities and services have been captured by individuals or groups, limiting distribution to the population."

Each criterion is an indicator for a policy evaluator to keep in mind throughout the evaluation. In this analysis, the list of criteria will be used as a sort of interpretive aide in conjunction with the identified public values of the era to place that era on the continuum of public value success and failure.

Figure 1, below, graphically depicts the steps of PVM for this analysis. The first step is to identify public values. Evidence is gathered from a variety of sources (government mission statements, academic literature, public opinion polls, etc.); the main goal is to identify and name the relevant public values. To assist in the identification of public values, the comprehensive list, developed by Jorgensen and Bozeman (2007) and introduced above, is used to identify specific

[1]The PVM criteria compiled in this table are drawn from Bozeman's 2007 book and Bozeman and Sarewitz's article (2011); the criterion "Ensure subsistence and human dignity" found in the 2007 book is omitted here because it does not fit space policy cases; "Imperfect public information" was found in the book only but kept here because of its applicability to space policy; finally, "Benefit hoarding" is found in the 2011 article only and included here for its applicability to space policy.

public values in each era. Next, the criteria indicators are used to identify public values failures or successes with consideration of the public values identified in the previous step. The findings from the first two steps are then considered together, or combined, to allow for a broad assessment of each case study in terms of public success or failure. The outcome of this step is to place the era on the continuum of public values failure or success. This is a necessarily simplistic step that incorporates the earlier nuanced analyses of public values identification and success/failure into one mark along the continuum. The real power of this analysis comes when several similar cases (here, three eras of space policy) can be compared at once. Further strengthening the utility of PVM is its use of a grid that displays the public values failure/success continuum on one axis and market failure or success on the other. Including the market framework, the means by which public policies are often evaluated under, acknowledges the import of the more traditional method of evaluation while also incorporating the public values model for the same case study. This traditional PVM grid can be found below in Figure 2. A refinement on this model is introduced in the next section along with the modified grid used in this paper.

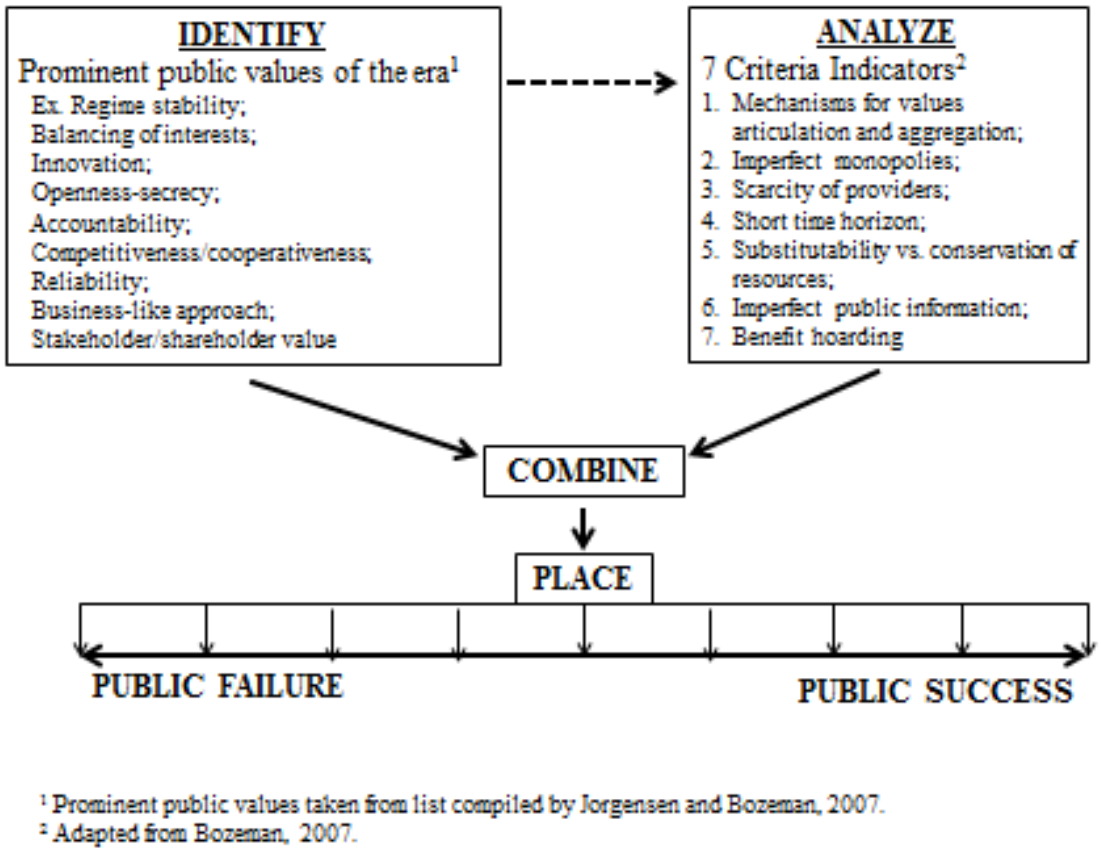

Figure 1. Schematic of PVM analysis from (Bozeman, 2007; Jorgensen & Bozeman, 2007).

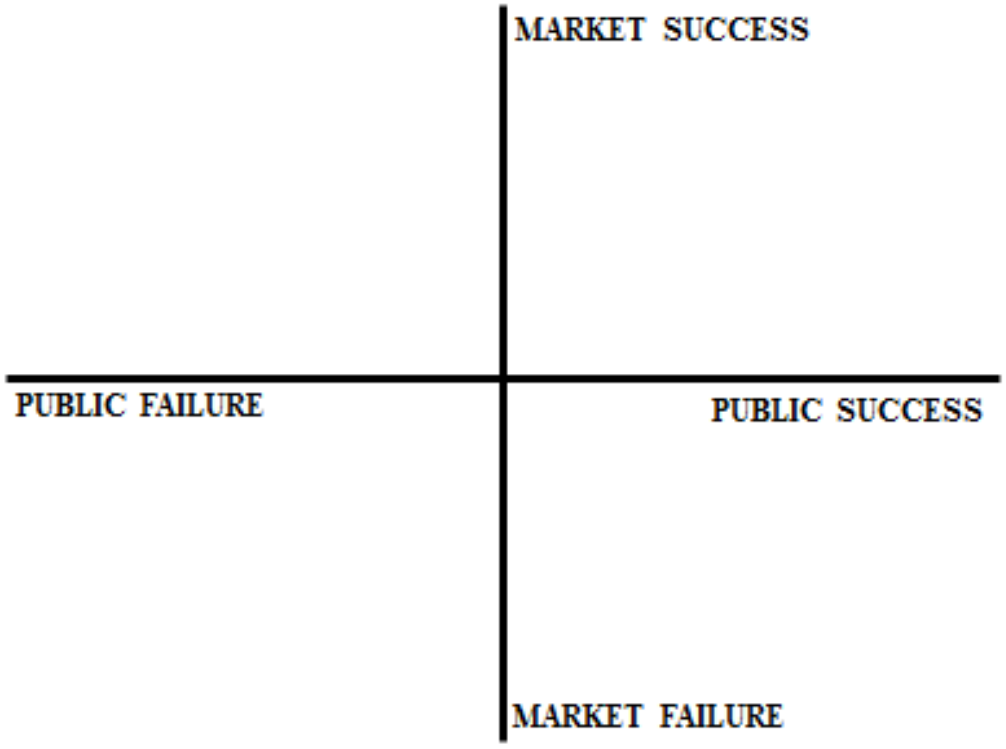

Figure 2. Traditional PVM Grid.

4. Refinements

i. The scope of the cases and the selection of eras

The U.S. space program during the time periods studied was not strictly, or at times, even primarily, a science program. It had national security, military, and commercial attributes too. This analysis will thus focus on broader themes of the three eras, each with their own unique scientific, military, prestige, and commercial components. These eras were delineated after a review of the space policy literature, primarily Kay (2005) and MacDougall (1985), that detailed the critical inflection points—the launch of *Sputnik*, the decision to go to the moon, and the influence of Reagan's ideology on NASA's mission—as the beginnings or ends of important

eras in space policy. Each inflection point signaled a fundamental alteration of U.S. space policy and an examination of the events and actors in each era add crucial detail that cuts through the historical fog and provides insight into the public values that drove policy outcomes.

The first two early space programs (Early Space, 1946–1958, and Moon and back, (1961–1969), have been selected because of their historical significance as well as their enduring mythological status as a touchstone for advocates of big programs who yearn for the type of public support and political will supposedly enjoyed by the policymakers of the *Sputnik/Apollo* era. Casting the early space program as purely scientific for the strict application of PVM would thus strip the rich non-scientific historical insight from the analysis and present a misleading account of the times. PVM has been presented as an evolving framework for ideas; this paper will contribute to this evolution by applying it to case studies of a significant government program with a scientific component.

The analysis of the space program since the 1980s (Space, Inc., 1980–present) will provide a contrast to the earlier periods of the U.S. space program because it marks the beginning of a true push by the federal government to include commercial entities in space policy. Its inclusion will foster discussion of how government agencies utilize their budgets to accomplish long term, expensive programs and how the private sector interacts (or competes with) such programs. The beginning of the Reagan Administration marks the beginning of this era because his presidency marked the hard shift towards commercial applications in space.

ii. Open systems as proxy for market failure analysis

Market failure or success in PVM analysis does not fit space policy well, as it was never designed to create a "market," unlike other science and technology policy programs like biotechnology, robotics, etc. Therefore, in this analysis a surrogate for market failure called open

systems analysis is used because it allows for a richer analysis of a system, space policy, that would not have existed as a standalone market at the time it was conceived.

Open systems are "social arrangements, political practices and policies, intellectual premises or outlooks, or technological systems" which allow access to anyone based on their interest, ability, and/or commonly available standardized equipment (Kraemer, 2006). Kraemer explores the ongoing tension between open and closed systems using a framework employing three sets of variables in the political, ideological, and legal spheres that work to shape the resolution of the policy issue. Kraemer's hypothesis is that "the creative social enterprise that enfolds modern science, technology, and the American experiment . . . [is] one that thrives best when it proceeds openly, faithful to the principles of transparency, pluralism, public questioning of claims to truth and right, and optimistic skepticism" (Kraemer, 2006). She argues that open systems, which allow more participation and transparency in innovation, are more successful from a market standpoint.

Patent policy and procurement policy are influential in the way they shape the "distribution and recovery of public capital investment in scientific research and technology" in an open system (Kraemer, 2006). For example, the federal government spends money on R&D through employing engineers and scientists at an agency or via R&D contracts or grants with the private sector, universities, or non-profits. A "mission agency" like NASA spends at least seventy-five percent of its R&D budget on grants or contracts with external actors (Kraemer, 2006). The identification of the firms or entities receiving NASA monies is an important part of an open system. . Patent policy has also played an important role throughout the history of agencies like NASA and in the study of open systems. If patents can be transferred openly between entities then it is an open system.

III. METHODOLOGY

Open systems analysis is a powerful tool for understanding the governing ideology of a nation and its science and technology policy. It is included in this paper as a surrogate for a market failure/success in the Public Value Mapping analysis described and performed below. Each era of space policy will be analyzed as an open or closed system using the definition and examples displayed in Figure 3, below. Using examples from the case, the era will be placed along the continuum of the open systems framework that replaces the axis formerly held by market failure analysis, as seen in Figure 4 below. Open systems retain the essential ideals of a free market, with sharing of resources pluralistically and opportunities for many entities to participate, while incorporating particularities in how the federal system of science and technology operates. This is especially useful for analysis of an agency like NASA, because the agency itself created a market for space technology that would not have otherwise existed at the time. An open/closed systems analysis seems a better fit for analyzing space policy, as the policy was not designed to create a market per se.

Open systems can be public values failures or successes, just as closed systems can be public values failures or successes; the two concepts are related, but not dependent to one another. An example of an open system/public success would be the internet. It is designed to be an open system, within limits, and it has likely contributed a net benefit to the public by facilitating the marketplace, communication, and other important aspects of modern life. An open system/public failure might also be the internet, specifically private data. Hackers are able to access private data that exists on the internet infrastructure, which results in a public values failure because of the loss in privacy and to the extent that the information can be used to harm individuals. A closed system/public success might be state driver's license programs. An individual must go through governmental channels in order to acquire a license, but if confers a

public benefit by allowing the state to track its citizens and giving the citizens the ability to take part in activities like voting and banking. Finally, a closed system/public failure might be a patent structure that allows companies to maintain supremacy of their patent rights, thus keeping generic manufacturers out of the marketplace and keeping the cost of those drugs higher for the public. I must stress that these are only anecdotal examples of possible combinations of open systems and PVM. Each example would be more than worthy of analysis in other papers.

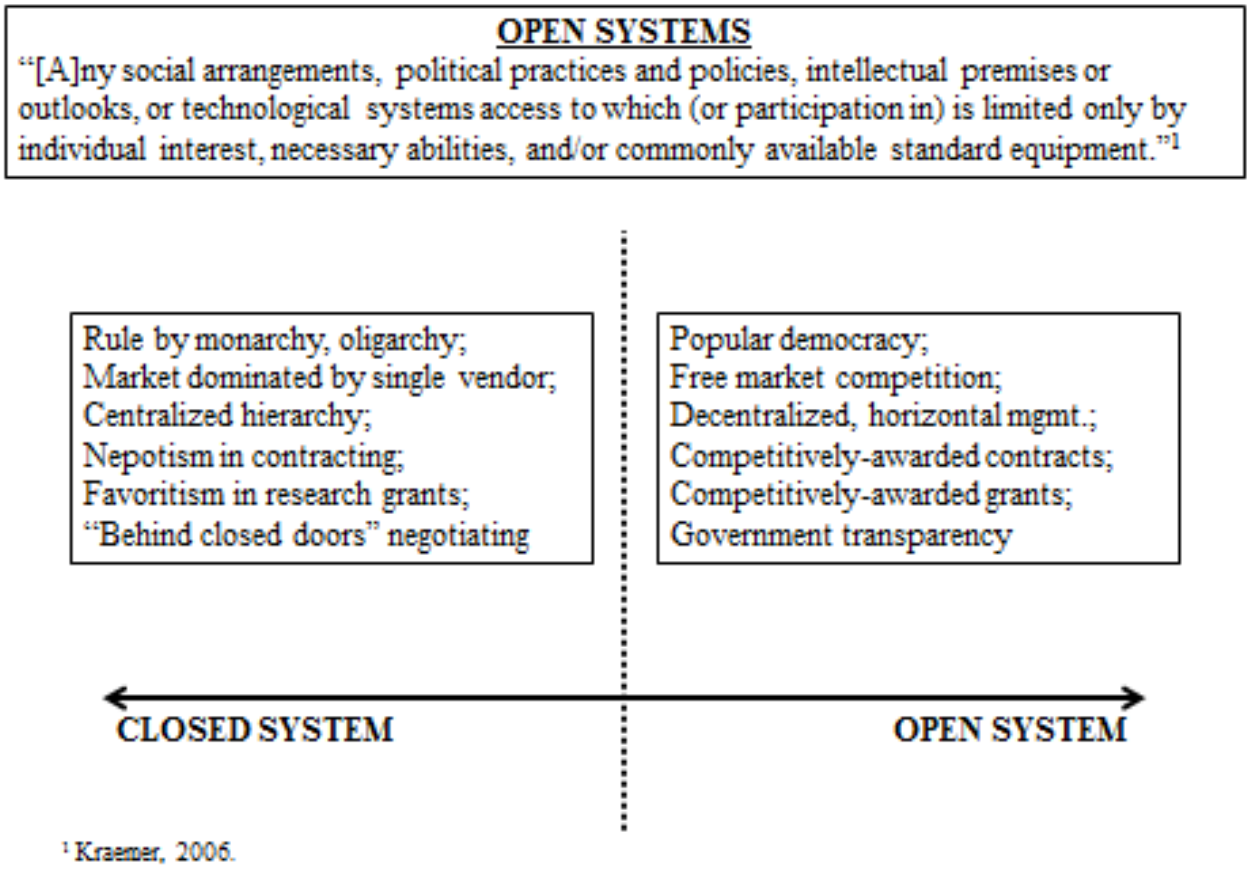

Figure 3. Open systems schematic developed from (Sylvia Kraemer, 2006).

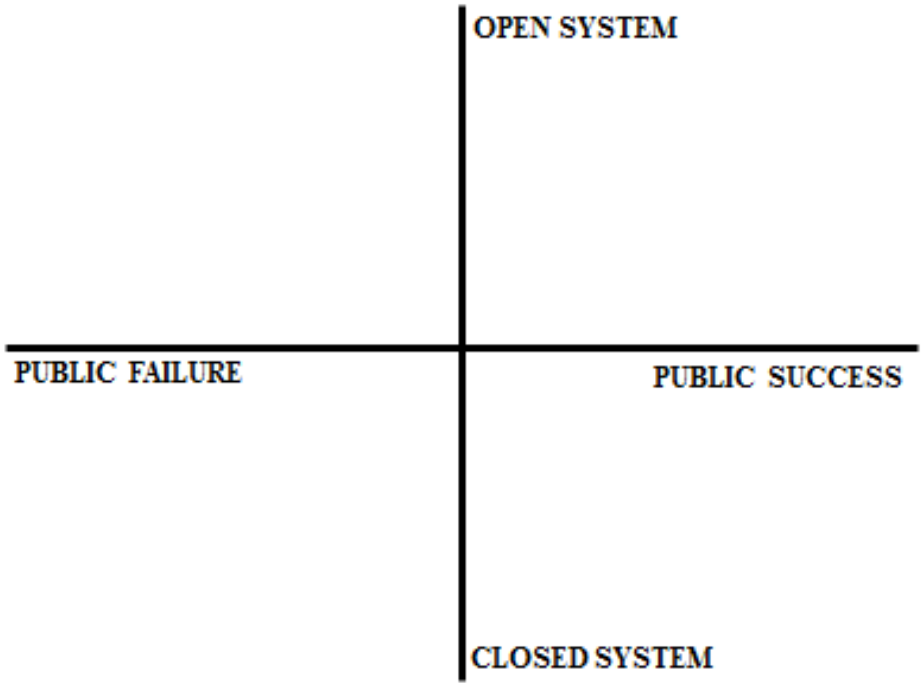

Figure 4. The modified PVM grid using open/closed systems analysis in place of market failure/success analysis.

5. Limitations

The substitution of open systems analysis into PVM is a better fit for analysis of the different eras of the U.S. than the market failure analysis it replaces, but there are limitations to the method. One limitation is the overlap of open systems in PVM. For example, secrecy played an important role in the Early Space and to some extent the Moon & Back Era. Secrecy is indicative of a closed system, but it can also be a positive public value. It cuts both ways, too. Companies rely on secrecy in order to compete in the marketplace, but this type of secrecy can prevent benefits from reaching the public at a low cost. The fuzziness and overlap inherent in the

marriage of open system and PVM requires a nuanced discussion, to move from the placement of an era on the PVM grid to a better understanding of the complex factors behind it.

Another limitation is the sheer scope of the U.S. space program, both manned and unmanned, civilian, military, and other. A focus on entire eras of space in the limited space available will necessarily leave important events and policies out of the analysis or give them underrepresentation if mentioned. Further, discussion of what I deem critical moments in U.S. space policy history were influenced in some way by events and people that go unnoticed here. However, I focus primarily on manned, civilian space policy because it's what has historically captured the public imagination. Further, the early space race and the moon mission play an important part in today's rhetoric to build support for large scientific governmental initiatives and it's critical to understand these early space policies in order to assess current and future opportunities. For example, the roll out of weather and navigational satellites are rarely invoked by politicians or advocates, but *Apollo* is almost always invoked (both to dissuade massive expenditures and to argue for ambitious programs). I thus focus on elements of these expansive eras in order to learn from the past to better assess the future.

Finally, bounding the eras across years (and sometimes decades) means that precise placement on the PVM grid is difficult, as public values and systems shift over the course of the era. For example, the Early Space era began with a minimal space program and ended with the creation of a large government agency. Refining analysis of an expansive era is difficult because public values play different roles at different points. For instance, secrecy was an important part of Eisenhower's military reconnaissance goals and in turn national security and military readiness. However, the secrecy led to a misinformed public and the panicked outcry after the launch of *Sputnik*. It would be difficult, based on single public values, to place an era along a

continuum. This is why the analysis is not based on a quantitative methodology of assigning weight to particular public values which would lead to a falsely precise placement on a grid. Instead, placement on the PVM grid is done by a holistic analysis of public values and open systems and is intended as a starting point for discussion, not the end. I chose to include expansive eras because the reasoning behind policy changes was as important to my analysis as the actual changes made was. Ultimately, as this and previous limitations show, PVM with open systems is not a precise method of analysis, but it is instructive despite its limitations.

C. Summary of Methodology

This paper uses case study narratives of three distinct eras of space policy to investigate the public values of the era, failure or success of those values, and the openness of the systems involved. A thorough review of literature and historical documents identified the three eras to be studied in this paper. The methodological underpinnings of this analysis have roots in public administration, government research evaluation, and systems thinking and can be considered as a response to the established market-based tools for evaluation. PVM methodology is refined by the use of a discrete set of public values identified by past research and by the substitution of open systems analysis in the place of market failure analysis. What follows are the case studies and PVM analyses of three eras of U.S. space policy, unfolding as described above.

IV. EARLY SPACE

A. Early Space Narrative

1. In the beginning, fits and starts

Until World War II, the government had done little to support advances in air and space technology, with the exception of the creation of the National Advisory Committee for

Aeronautics. This was due in part to fear of a centralized government as well as a perhaps equally strong optimism in the private sector to provide advances in the field (McDougall, 1985). Most early space ventures were bankrolled by private financiers (Kay, 2005). The government did support some scientific endeavors during this time, in fields such as medicine and agriculture, but this was done to further public values, not for science's sake (Kay, 2005). Under the assumption that space research was not in the public interest, government investment in space research was unsurprisingly minimal.

The U.S rocketry program grew in fits and starts in the years after the war. Development of intercontinental ballistic missiles (ICBMs) with a range of thousands of miles and cruising altitudes well-within the upper reaches of the atmosphere, ramped up in 1947 only to be drastically cut by an austerity-minded President Truman. Wehrner von Braun, the German rocket scientist who defected with his team of scientists to the United States in the waning days of WWII in part because of the promise of funding, was confined to test facilities in New Mexico and later Alabama, to research and refine V-2 rocket technology on a shoestring budget (McDougall, 1985). There are several reasons why the various ICBM programs faltered during this time: fiscal austerity diverted scarce funds to the development of bombers and jet aircraft; the assumption of American air superiority; a preference for manned bombers; and a pessimism that the investment in ICBMs would not be enough to solve technical hurdles (McDougall, 1985). In 1949, a Soviet crash R&D program produced an atomic bomb which forced the U.S. to change course, away from austerity and into a technological race (McDougall, 1985).[2]

[2] The Korean War also played a major role in the decision to move towards an era of increased military spending. The post-war ambiguity regarding the United States' relationship with the Soviet Union effectively ended when North Korea invaded South Korea (McDougall, 1985).

Yet, under President Truman, the United States continued to struggle to find the" right" approach to national defense spending (Baldwin, 1953).[3] Meanwhile, the Soviets made technological advances in weapons, especially rocketry (via missile programs), that magnified the sense of American unease and erased whatever advantage in missile technology the U.S. enjoyed after WWII.[4] Advances in technology[5] and the urgency injected by the competition with the Soviets, shortened the timetable for advancement of missile technology (McDougall, 1985). The Atlas program is a prime example of how quickly military R&D spending escalated in the 1950s. The program was created in 1951 with an initial outlay of $500k, the budget rose to $14M in 1954, to $515M in 1956, and to $2.1B in 1958 (McDougall, 1985). However, the fascination with rockets neither began nor ended with purely military applications; to many early pioneers in the field, the endgame was space exploration (McDougall, 1985).

In the U.S., the fate of post-WWII satellite programs mirrored those of ICBM projects. Initial buzz was often followed by budget cuts. U.S. interest in a satellite program dates back to at least 1945, after military officials and scientists were debriefed by von Braun and his team about the possibilities of space travel. A project called the Earth Satellite Vehicle Program began in the Navy Bureau of Aeronautics shortly after the war and even contracted work to design an engine and guidance systems. The RAND Corporation, a military advisory entity, issued a

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[3] A series of articles by *New York Times* reporter Hanson Baldwin from the time illustrate the difficulty facing the country in framing the proper level of defense (and offense) spending to combat the Soviet threat. Hanson adeptly pieced together the "riddle" posed by the vulnerability of having "live" frontiers for the first time in generations while also taking steps in ensuring that an escalating technological race would not put undue financial stress upon the country (Baldwin, 1953).

[4] For example, by the time the Americans (led by von Braun) began to work on the Army's Redstone rocket, capable of a 500-mile range, in 1950, the Soviets had already launched an equivalent rocket the year before. It was 1953 before the U.S. successfully launched the Redstone, effectively placing them four years behind their Soviet counterparts in rocket technology (McDougall, 1985).

[5] Such as development of a small hydrogen war head; an improved guidance system; and a blunt body reentry vehicle (McDougall, 1985).

prescient report on the satellite project, noting the technical requirements of such a vehicle and concluding that a space satellite was indeed possible. Perhaps the most significant finding was of the psychological impact of the satellite, which would "inflame the imagination of mankind, and would probably produce repercussions in the world comparable to the explosion of the atomic bomb" (McDougall, 1985). Despite the initial passion and promise of such a program, budget cuts and military reorganization led to the project's cancellation in 1948. Military officials could not justify the expense of the program with commensurate "military and scientific utility" (McDougall, 1985). This would become a recurring theme under President Eisenhower.

2. Ike's Great Equation and framing the debate on space

Dwight D. Eisenhower had impeccable military credentials and was perhaps the only politician who could credibly advocate for a national defense policy that championed restrained military spending. No longer able to rely on an "atomic shield" after recent Soviet possession of nuclear capabilities, Eisenhower had to craft (and fund) American programs to deter Soviet transgressions without committing too much of the nation's resources to military spending. Eisenhower realized that good intelligence was more valuable to a country than raw military might and set out to "maintain an image of military resolve without undermining American values, institutions, and economic health" (McDougall, 1985). These were the essential components of the "Grand Equation" envisioned by Eisenhower and his team: a policy that acknowledged the "intimate and indivisible" relationship between economic and national security and the great need to balance the two objectives (McDougall, 1985). To effectuate the Grand Equation in the early to mid-1950s, Eisenhower prioritized missile R&D and intelligence gathering over a more traditional, resource-intensive military buildup. These priorities naturally

led to a discussion of satellites for military reconnaissance, but they would require ICBM rocketry to reach outer space and beam useful images back to Earth.

3. An idea's time, come

In the 1940s, when a satellite program was first discussed and analyzed by entities like RAND, the consensus was that it could be done, but at considerable cost. The intervening years had seen the loss of the United States' atomic monopoly, advances in missile technology, and a presidential ambition for gathering military intelligence. As such, in 1955, President Eisenhower convened the Technological Capabilities Panel of the National Security Council, led by Dr. James Killian, to report on the ability of U.S. science and technology to identify, deter, and respond to a surprise attack from the Soviets. The panel recommended development of an ICBM and study of an artificial satellite program be made a national priority.

The USAF and RAND continued throughout the early 50s to identify military justifications for pursuing a satellite program. Specifically, the USAF wanted more information on how satellites could achieve a "politico-psychological advantage for communications and for the purposes of observation" (McDougall, 1985). A 1950 report by RAND focused on the political implications that a satellite with U.S. origins would have on both its allies and especially the Russians. The report came at a time when U.S. and Russian technological foci in space were opposed; the Soviets were focused on developing missile technology while the U.S. was charting the implications of a space program (McDougall, 1985). This distinction may come as a surprise given the ultimate timing of the countries' space flights, but it may explain why the U.S. space program grew to achieve more lasting success (McDougall, 1985).

The political implications discussed in the RAND report also help to explain how the events leading up to Sputnik unfolded. The "politico-psychological" impact of a satellite

predicted by RAND would come in large part form the unconventional nature of the satellite as a tool of reconnaissance (McDougall, 1985). Such a tool, however, could not be kept secret, at least indefinitely. The political fallout would thus temper any intelligence or military advantage gained. Allies would question the sovereignty of their airspace and the Russians would likely take an even more extreme stance and their response could be unpredictable and severe.

Then, in 1954, a policy window opened that gave the U.S. the geopolitical cover it needed to launch a satellite. The International Geophysical Year (IGY), organized by the International Council of Scientific Unions, and announced by the National Science Foundation (NSF) as an international scientific venture focusing on the atmospheric and meteorological phenomena on a global scale (*The International Geophysical Year*, 1954). The NSF announcement set the scope of IGY projects, "measurements will extend from oceanic depths to a hundred and more miles above the surface of the earth where rockets will carry instruments to determine directly the nature of the upper atmosphere" (*The International Geophysical Year*, 1954). The U.S. now had the political cover—scientific exploration—that it needed to justify sending a satellite into space. The next question was how.

It would be difficult for the U.S. to achieve the goal of putting a satellite in space, however innocuous its stated purpose, without the involvement of military expertise and equipment. The administration thus needed a second satellite program that would achieve the goal of successfully launching a satellite during the IGY in as innocuous a way as possible, to pave the legal path to space, while still preserving an implied right to use space for future military reasons (such as via a secret military reconnaissance satellite program already under way in 1954).

Research would continue on the secret spy satellite program while officials considered two other alternatives for the IGY program. The two alternatives were named *Orbiter* and *Vanguard* and each came with a long list of pros and cons. *Orbiter* was headed by von Braun and his team within the Army and would use a modified Redstone rocket (a version of the V-2) as the launch vehicle. *Vanguard* was headed by the Naval Research Laboratory (NRL) which proposed to use the yet-experimental Viking rocket as the launch vehicle. The *Vanguard* project featured a more sophisticated satellite and tracking system and, importantly, was housed in a military research division that focused more on basic research, not weapons technology. *Orbiter's* satellite technology was more crude, but the rocket had been tested (and would soon head to production by Chrysler) and von Braun believed that it could successfully be used to launch a small satellite as soon as 1956 (Kay, 2005). Despite the advantage in readiness of the *Orbiter* project, it had both a military and Nazi heritage, perhaps too much for an administration bent on making the IGY satellite as non-threatening as possible. By a narrow vote of 3-2 by the present members of the National Security Council in 1955, *Vanguard* beat *Orbiter* and the U.S. now had a horse in the race (McDougall, 1985).[6]

Project *Vanguard* was having difficulty getting established. One of the sources of conflict was the relationship between the Navy lab and the aerospace contractor Martin which objected to the oversight by the research laboratory it was subjected to (McDougall, 1985). Another source of strife was shifting priorities amongst the DoD and Martin, away from *Vanguard* and to the development of the new Titan missile (McDougall, 1985). Finally, funding problems, both in the

[6] Interestingly, the vote was even narrower than even the 3-2 final margin indicates. Two members of the majority favored the Vanguard project because they felt that they did not know enough about guided missiles (like the Redstone rocket) to vote for it, so they voted for the experimental, scientific project. One member was absent, but later indicated that he supported the Army's Orbiter proposal. Had the vote tipped in the opposite direction, the space race could have looked very different (McDougall, 1985).

amount and the structure of financing, delayed the project at each step. Ironically, many of the setbacks faced by the *Vanguard* Project were a result of its status as a non-military project (McDougall, 1985). *Vanguard* ran out of time on October 4, 1957 when *Sputnik I* was launched into orbit from a launch site deep within the Soviet Union in what is known today as Kazakhstan. The announcement from the Kremlin was unassuming in a way that belied the obvious intent of the technological propaganda: "The first artificial earth satellite was successfully launched in the U.S.S.R." ("Setback for U.S. Prestige---The Satellite Effort That Failed," 1957). The Soviets had won the first round. The U.S. struggled to counter.

News reports breathlessly reported on the "brilliant success" of the Soviet scientific and propaganda machine (Jorden, 1957). Dissent swelled in the ranks of the Army, as some outspoken generals (and Dr. von Braun) affiliated with the branch's missile program suggested that the Army could have launched a satellite as early as 1955 ("Army Edict Halts Satellite Claims," 1957). Others pondered the military implications that the rocketry technology that launched *Sputnik* would have for American security and faulted the administration for not "realiz[ing] the tremendous prestige, propaganda, and political gains likely to accrue to the Soviet Union if it was the first to send up a space satellite" ("Editorial: Roads to Hell---or Heaven," 1957).[7] It would be difficult to overstate that the public reaction to Sputnik was one of alarm and second-guessing for many Americans. Even within the administration, a confidential memorandum to the president written approximately two weeks after *Sputnik*'s launch noted the "spectacular overtaking of the U.S. in a vital field where we have been accustomed to count on superiority, and now [the USSR] now competes with the U.S. as an equal."

[7] The president had, in fact, been told of the psychological and prestige-related benefits of being first into space, but his philosophy was not to call for a "crash" program for a satellite because of the budgetary implications, though he did miscalculate the political impact of being first in space (McDougall, 1985).

President Eisenhower's first official statement on *Sputnik* came at a press conference held the week after *Sputnik*'s launch. The president's goal was to quell Americans' anxiety by downplaying the competition between the two countries without seeming to belittle the Soviet accomplishment (Goodpaster, 1957a). He began with an acknowledgement of the Soviet accomplishment, "we congratulate Soviet scientists upon putting a satellite into orbit," before attempting to downplay the progress, or lack thereof, of *Vanguard*, "[o]ur satellite program has never been conducted as a race with other nations . . . I consider our country's satellite program well designed and properly scheduled to achieve the scientific purposes for which it was initiated" (Eisenhower, 1957). Eisenhower continually stressed the scientific nature of the satellite program and why he agreed to increase the budget for the program, "we said all right [to increased funding] in view of the fact that we are conducting this basic research this [additional scientific instrumentation] seems logical . . . There has never been one nickel asked for accelerating the program" (Eisenhower, 1957). Finally, tellingly, the president directly denied any military intelligence implications of satellites (despite having a top-secret program of the very sort), literally laughing off the idea and quipping that, "suddenly all of America seems to become scientists, and I am hearing many, many ideas" (Eisenhower, 1957).

Of course, the truth was that military intelligence was one of the primary goals of the Eisenhower administration's satellite ambitions. In the days after *Sputnik*'s launch, the president and a team of science and military advisors met and the president received confirmation that that Army could have orbited a satellite months before, and again noted that being first was never given priority. The president also asked for a five-year outlook as to whether a reconnaissance satellite could be launched (no longer a laughing matter to Eisenhower). The president's advisors

also noted that one unintended benefit of Sputnik was the establishment of freedom of space (Goodpaster, 1957b).

By December, 1957, the Soviets had placed two satellites into orbit—one containing a dog named Laika—and the United States appeared ready to finally enter the space age. The Vanguard rocket sat atop the launch pad in Cape Canaveral, Florida, ready to launch a softball-sized test satellite weighing four pounds into space. Unfortunately for the U.S., whose morale had been degraded by successive successful Soviet missile and rocket triumphs in the preceding months, the rocket made it only four feet towards its goal before exploding (Bracker, 1957). Although test rocket launches routinely failed, none had failed with such fanfare and in such harsh contrast to the Russian feat of launching a 1,000 pound satellite just a month before. Editorial pages across the country bemoaned the failure of "goofnik," while also giving readers pep talks of the "nowhere to go but up" variety ("Editorial Comment on the Nation's Failure to Launch a Test Satellite," 1957). The U.S. was finally successful in launching a satellite in late January of 1958 when *Explorer I,* a thirty-pound satellite was launched by one of von Braun's Redstone rockets.

It is difficult to overstate the impact that the Soviet sputniks had on the imaginations of people across the world. An ever-growing infatuation with science fiction in the first half of the Twentieth Century that only grew with each real world technological advance lent space an almost mythical quality (Kay, 2005). Space was the final frontier for human exploration and politicians used control of space as a proxy for world dominance. Finally, science and technology also had superstitions attached to it. Americans were confident that each new advance or discovery would yield untold benefits that would in turn beget prosperity (Kay, 2005). The fact that another country, much less the United States arch enemy now possessed this

"magic wand" of science and technology wizardry tested the core beliefs of many Americans. The early space successes of the Soviets could thus be considered Pyrrhic victories, however, for they awakened in their adversary stirrings of sweeping change in the U.S. approach to space.

4. Post-Sputnik Agenda-Setting

President Eisenhower's approval rating sank to an all-time low (48 percent) in the spring of 1958, just fifteen months after reaching its apex (79 percent). The media frenzy that came after each successive Soviet space exploit (and every U.S. failure) had chipped away at public support for the president as well as the policies for space that he championed. Although he had tried to keep the U.S. out of an all-out cold war, the sputniks had shifted the debate. Eisenhower acknowledged the magnitude of the threat posed by the Soviets in his 1958 State of the Union address: "[W]hat makes the Soviet threat unique in history is its all—inclusiveness. Every human activity pressed into service as a weapon of expansion. Trade, economic development, military power, arts, science, education, the whole world of ideas—all are harnessed to this same chariot of expansion" (Eisenhower, 1958). Interestingly, the president conceded that "most of us did not anticipate the psychological impact upon the world of the launching of the first earth satellite" while also downplaying the event (Eisenhower, 1958). Despite the overall message of U.S. military and economic strength, however, the damage to Eisenhower was already done as he and his administration sounded old and out of touch with the threat posed by the sputniks and the Soviets more broadly (Kay, 2005). The perceived lack of leadership from the White House, media fervor, and the launch of the enormous *Sputnik II* had transformed the "nine-day wonder

[of *Sputnik I*]" into a "durable perma-crisis[8] that broadened the ordinarily narrow margins for change in a complicated, pluralistic democracy" (McDougall, 1985).

The shifting political winds coincided with a shift in framing for space policy. No longer just a scientific or reconnaissance initiative, the U.S. space program now carried the burden of the nation's survival. Senator Lyndon B. Johnson, the wily Democrat from Texas, saw an opening that his advisors felt could catapult him to the White House. He was not the only one. Change occurred via congressional and administrative action. The National Defense Act of 1958 provided funding for science education, the President's Science Advisory Council was created and James Killian was named the first presidential science advisor, the R&D program later known as the Defense Advanced Research Projects Agency (DARPA) was created in the DoD, and federal spending on R&D rose drastically in the subsequent budgetary outlays (Kay, 2005).

5. A space agency is born

The most significant space policy change post-*Sputnik* was the creation of NASA in 1958. One of the most pressing questions was whether space would be a military- or civilian-led venture. To that point, much of the space-related technology, including missiles and rocketry, was military-based, though it was spread out across the different branches. Understandably, each branch wanted to retain control over the space programs it managed. The creation of DARPA, itself a controversial question of the extent of the Pentagon's authority, helped to provide temporary certainty when it assumed control of all space programs, military and non-military until the space agency was created (Morris, 1958). It was ultimately decided to make NASA a civilian-controlled agency.

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[8] The venerable *Life* magazine published an article shortly after *Sputnik I* titled "Arguing the Case for Being Panicky," a none-too-subtle public signal (McDougall, 1985).

The next question was what objectives a space agency would have for its activities. The President's newly created Science Advisory Committee provided four rationales in its "Introduction to Outer Space" report. The first was "the compelling urge of man to explore and to discover, the thrust of curiosity that leads men to try to go where no one has gone before." The second factor was the "defense objective for the development of space technology. . . . If space is to be used for military purposes, we must be prepared to use space to defend ourselves." Next came national prestige, to "enhance the prestige of the United States among the peoples of the world and created added confidence in our scientific, technological, industrial, and military strength." Finally, "scientific observation and experiment " would "add to our knowledge and understanding of the earth, the solar system, and the universe" (*Introduction to Outer Space*, 1958).

With these stated objectives, both the House and the Senate, in the new space committees created in the wake of *Sputnik*, held a long series of hearings debating NASA. Months earlier, Lyndon Johnson laid out his "five-point program" to get the United States up to speed in space. Again, he couched the need for a space program in dire terms, "[W]e must step-up the development of weapons which will assure our survival" ("Johnson Offers Space Program," 1957). As expected, Eisenhower was resistant to the all-out effort in space and only went so far as expressing his desire to have a "sensible, well-paced" space program (Kay, 2005). The two opposing political sides came to an agreement as the Space Act was pending in Congress as to civilian control of future space activities and in the creation of an advisory panel, modeled after the National Security Council, that would be led by the President (to temper it, lest it get too ambitious) (Kay, 2005).

The Senate Special Committee on Space and Aeronautics, chaired by Johnson, recommended passage of the Space Act in late summer 1958 by noting the uncertainty of the future: "We may, as some say, stand now at the edge of the battleground for Armageddon. Or we may, as others believe, be poised before the plains of the millennium. . . When we deal with space policy, we are dealing with national policy, in the broadest possible range" (Johnson, 1958). The law was enacted on July 28, 1958, less than a year after *Sputnik*, and, despite the stated objectives, was overwhelmingly a national security measure (Kay, 2005).

B. Identification of Public Values

U.S. space policy that grew out of WWII did so in fits and starts. Even after the launch of *Sputnik*, President Eisenhower attempted to limit the size and scope of the space program and its new agency, NASA. There were signs of change, however, especially relating to the American relationship with science, technology, and public funding that rapidly evolved during this era. A number of complex factors contributed to this phenomena and the historical background has been laid out previously, but suffice it to say that America no longer "stood [] aloof from science and technology" (McDougall, 1985).

Table 3. Public values of the Early Space Era adapted from Jorgensen and Bozeman (2007).

Public Value	Definition[9]	Application to Era
Regime Stability	The public sector presents itself with power, resources, and accountability to outside world.	Eisenhower's Great Equation sought to balance military strength with domestic productivity through a limited government.
Balancing of interests	Influencing relationship of two or more entities to come to an equitably satisfactory outcome.	Eisenhower sought to create a "reasonable" civilian-based space agency, NASA.
Innovation	Characterized by risk readiness, enthusiasm, dialogue, adaptability, and flexibility.	The history of space-related R&D was checkered with interagency/branch competition, cuts in funding, and unclear goals.
Secrecy	Confidential information strategically used in dealing with foreign powers.	Much of the U.S. space program existed under a shroud of secrecy.
Political Loyalty	A central value in a democratic state; recognizes that politicians are the ones who make the final decisions and provide the funding.	Favor for NASA was courted by James Webb and Lyndon Johnson by ensuring that important Congresspeople had plum NASA-related activities such as research facilities in their districts.

1. Regime stability

The public value of regime stability refers to how the public sector presents itself outwardly. In order to achieve a stable regime, a government uses its power, resources, and accountability to increase its standing in the world (Jorgensen & Bozeman, 2007). This was especially important to the Eisenhower administration, who sought to project an image of strength, both military and domestic, to counter the communist ideology advanced by the Soviet Union. Too much spending on military defense, or conversely too much focus on domestic prosperity, two variables of the Great Equation, could upend global stability and tip the balance towards communism, reasoned Eisenhower. He thus focused on developing superior intelligence technologies instead of developing ICBM rocketry technology like the Soviets. In short, the United States sought an advantage in information, via spy planes and in developing satellites,

[9] From Jorgensen & Bozeman (2007).

instead of extending the range of missiles to strike the potential enemy. This emphasis allowed Eisenhower to restrain the size and scope of military spending in the early part of his administration though it would have impact on U.S. readiness on the space front later in the decade.

Faced with a growing Soviet threat abroad, but determined to ensure prosperity at home by limiting the size of the federal government, Eisenhower enjoyed the spoils of his policies through the mid-1950s, with the highest approval ratings of his administration. Historical accounts of the years leading up to *Sputnik* tell of a generally happy American populace for whom a sense of complacency became the norm as citizens "indulged in the relaxation, temptations, and ultimate discontents of "normal" life" (McDougall, 1985). However, his distaste for large government investments in rocketry and missile technology of the kind that could propel a satellite into orbit led to delays by the U.S. in entering the space age after *Sputnik*. In retrospect, Eisenhower's policies in space in the years leading up to *Sputnik*, and his administration's reaction to the Soviet achievement may have been a miscalculation. Regardless, in retrospect, Eisenhower sought to stabilize his regime by hewing close to the ideology that spawned his Great Equation: to maintain an image of military strength (via superior intelligence technology) while limiting governmental spending to spur domestic productivity. Prior to October, 1957, this approach worked wondrously for the president, but of course that changed with *Sputnik* and Eisenhower was forced to abandon his hope of having a modest space program.

2. Balancing of interests

A significant theme of the post-*Sputnik* political landscape was the framing of space activities in relation to winning the Cold War and ensuring the survival of the nation. Eisenhower was resistant to an all-out space race, though he did acknowledge the all-encompassing scope of the Cold War in his 1958 State of the Union Address along with the need to marshal national assets towards ensuring the survival of the nation[10] (Eisenhower, 1958). In the speech, Eisenhower also remarked on the surprising psychological impact *Sputnik* had on the world and pledged not to make the same mistake on another front. While this speech was not remarkable insofar as Eisenhower mentioning the fight against communism—he had been doing so for his entire time as president—it is significant for the acknowledgement of the *Sputnik* surprise and for the emphasis of the war being fought on many fronts.

It was the space front that continued to capture the political and public imagination over the course of the next few months as the debate over the creation of a space agency took place in the back rooms of Washington and in the bright lights of Congressional hearings. Time and again during the hearings, the justification for space expenditure was to "win" the space race, especially during the uncertain times following the onslaught of Soviet space victories, to secure the place of the U.S. in the world's eyes. Eisenhower saw space as one of the fronts, not *the* front in the Cold War and he sought to limit the power and size of NASA in negotiations with members of Congress, particularly Lyndon Johnson. By taking an active role in the NASA negotiations, Eisenhower balanced the Congressional preference for a massive space agency with his administration's interest in a "reasonable" space agency.

3. Innovation

[10] "The Soviets are, in short, waging total cold war. . . . [The United States must] bring[] to bear every asset of our personal and national lives upon the task of building the conditions in which security and peace can grow."

Innovation in scientific discovery was the stated rationale for the United States' first public satellite program, *Vanguard*. Although *Vanguard* was used in part as a benign way to pave the way for U.S. space activity in the international community, it also yielded significant scientific achievements. As a contrast to the brute-force spectacles employed by the Soviets in their early satellites, the United States' first satellite, *Explorer I*, though small in stature and late-in-coming, yielded significant scientific discoveries that may have been underappreciated by the public at the time.[11]

Conversely, there is also evidence that the American public did not yet fully value or conceive of a governmental role in innovation due to the infancy of science and research policy at the time. The National Science Foundation was created in 1950 after considerable debate between Vannevar Bush and Senator Harley Kilgore on the role of government, the private sector, and the public (Neal, Smith, & McCormick, 2008). Large government science and technology programs to that point had origins in war (McDougall, 1985), and so it was difficult for the typical American to see the connections between government, science, and space. This was perhaps embodied in the delays and management infighting that occurred in the *Vanguard* project; to that point, contractors tended to prioritize the military projects (which themselves were fraught with infighting and budget cuts) over the civilian, scientific projects. Innovation in the sense of organizational capacity thus would not move forward on the space front until the next era.

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[11] For example, in its 10 ½ pound frame, the satellite housed two micrometeroroid detectors, a Geiger counter, and advanced telemetry instruments. The satellite also discovered the Van Allen radiation belts surrounding the earth. Although *Explorer I* was launched using von Braun's Army rockets, its scientific contribution as well as the contributions of subsequent early satellites launched by the U.S. present a high point for science in space which was arguably given short shrift in the later manned space programs of the next decade.

4. Secrecy

Some level of secrecy between a public administration and citizens is often required for the purposes of dealing with sensitive foreign policy actors, and no case illustrates this quite as well as Eisenhower's secrecy about his military reconnaissance satellite programs. The need for military intelligence gathered by sophisticated means was requisite for the type of national defense envisioned by President Eisenhower, which was lean and focused on gaining a strategic, not brute force, edge. Despite his public assertions to the contrary, Eisenhower had been keenly interested in the development of satellite reconnaissance vehicles since at least 1950, and the idea had been introduced as early as 1950 by the thinkers at RAND. His interest in military intelligence was several-fold; it allowed the U.S. to gather reliable information about Soviet activity, thus preventing overreaction from rumors about the state of Soviet technology and military movement, permitting monitoring of arms control agreements, and providing necessary information in the event of full-blown war (McDougall, 1985). The drawback of the focus on using space for military reconnaissance purposes was that it had to, by definition, be kept under wraps from the public and even most members of Congress and the administration. By pursuing a top-secret reconnaissance satellite program without a corresponding civilian-science program until 1955, the administration allowed for the shock of *Sputnik* to be magnified by the public (and especially the press) who did not know about the surveillance program until later. It gave the impression that the U.S. was not as advanced as the Soviets were in space technology, when the truth was actually considerably more complex, and more than likely in opposition to the prevailing media framing.

5. Political Loyalty

NASA facilities (in Cape Canaveral, Florida, Houston, Texas, and elsewhere) were located in the districts of key politicians by the skilled political mastermind and first administrator of NASA, James Webb. He once told NASA leadership that the reason for moving the Space Task Group from Virginia to Houston was, "to get the money" from Rep. Albert Thomas, "the controller of the money" in the House (Sylvia Kraemer, 2006). This network of political support expanded throughout the nation and continues to provide political support for NASA, although the direct beneficiaries remain in several states, looking similar to the map created by Webb in the late 1950s.

C. DISCUSSION OF PUBLIC VALUES FAILURE CRITERIA INDICATORS

1. Mechanisms for values articulation and aggregation

This PVM criterion assumes that public failure occurs when "political processes and social cohesion [are] insufficient to ensure effective communication and processing of public values" (Bozeman & Sarewitz, 2011). One of the difficulties, yet arguably one of the necessities, of the early U.S. space program was its requirement of secrecy and non-transparency. The series of reports and decisions that led to the establishment of a secret military reconnaissance satellite program was done under the cloak of secrecy. Members of Congress did not even know of its existence, not to mention the public. Yet, this fact is not sufficient in finding a failure of public values. The necessary secrecy of the satellite program arguably supported the public values inherent in the national security, military intelligence, and the Cold War value that the president and politicians espoused. Satellites were not yet viewed by the public (before the IGY was announced) as a purely scientific venture, given their close relationship with ICBM missile technology. There is also little evidence that the public clamored for a large scientific space

program given the newness of federal science with the history of a hands-off approach with regard to science and technology in the nation's past. The press did play a large role in values articulation, though it is debatable then, as it is now, whether the press articulated the "voice of the public" or not. Historians have indicated that the press were as taken aback by *Sputnik* as the public in the days following the launch, which implies that knowledge of the true scope of U.S. space policy at the time was also limited.

The reaction of the press and the seemingly defensive response by the Eisenhower administration does, however, suggest that there was insufficient communication and processing of public values by the end of the 1950s. This contradictory statement arises not out of a public values failure, but rather by rapidly changing public values in the months after *Sputnik*.

2. Imperfect monopolies

This criterion identifies instances where a private entity provides goods and services despite a public interest for a government monopoly (Bozeman & Sarewitz, 2011). The early space program was driven almost entirely by the government and while private contractors provided "goods and services," they were supplied under contract with the government, in furtherance of government specifications.

3. Scarcity of providers

At the time, no commercial space company existed; indeed, no commercial space market existed. To fulfill public space needs, Eisenhower and his DoD and later NASA utilized defense and aerospace contractors to develop rocket and satellite technology.

4. Short time horizon

Eisenhower's Grand Equation balanced military preparedness with economic stability and the looming space race threatened to unbalance it (it eventually did). Although he is perhaps

best known for articulating his thoughts on the military-industrial complex in his farewell address in 1960, Eisenhower was concerned with the unbalancing of his budget towards defense spending only three months into his tenure. Speaking to the American Society of Newspaper Editors in 1953, Eisenhower stated the costs of military spending: "Every gun that is made, every warship launched, every rocket fired signifies, in the final sense, a theft from those who hunger and are not fed, those who are cold and are not clothed" (McDougall, 1985). The clamor for a large space program that followed *Sputnik* and that had been rising in his administration and elsewhere in the government some years before, was to Eisenhower yet another entrenchment of amorphous defense-related spending, in this case even without clear military justification. The short time horizon employed thrust upon Eisenhower after *Sputnik* upended his long-term vision for a country with a "reasonable" space program and turned it into one with one of the most massive public projects in history.

5. Substitutability vs. conservation of resources

This indicator criterion is not applicable to the Early Space era because there was not a scenario, like in many ecological issues, where the free market considers human life or environmental resources a substitutable asset (Bozeman, 2007).

6. Imperfect public information

Given the nature of the growing cold war with the Soviet Union, it is no surprise that information regarding the early U.S. space program was limited, especially with regard to the military intelligence goal of the Eisenhower administration. The fact that the United States was ahead of its Soviet counterparts in many aspects of space technology, especially its guidance systems and scientific applications, was lost on a public affected by *Sputnik* in part because they did not know the extent of U.S. technology. This imperfect public information, although perhaps

a necessity of national security, contributed to the response in 1958 that the Eisenhower administration was ill-prepared to enter the space age. This view, however, may itself be subject to some speculation given public opinion polls of the time that showed that the American public wasn't sure who was "ahead" in the space race, with roughly equal percentages of respondents on either side and a sizeable number who simply didn't have an opinion (Steinberg, 2011).

7. Benefit Hoarding

Benefit hoarding could be said to have occurred in this era, specifically by defense and aerospace contractors who use public resources in the form of contracts to benefit their bottom line. While it is undoubted that there are broader national security and economic benefits that are enjoyed by the public in relation to the private firms' products, the military-industrial complex that Eisenhower warned of is an example of public money being used inefficiently. Also mentioned above is Eisenhower's lament that every dollar that went to military spending was a dollar that did not go to domestic programs to feed the hungry or educate children (McDougall, 1985). For most of this era, however, Eisenhower's fiscal restraint kept the private sector from the type of benefit hoarding it would engage in in later years.

D. PUBLIC VALUES DISCUSSION

For much of the Early Space era, space policy developed in tune with the needs of the Eisenhower administration, namely the need to develop military reconnaissance satellites and to forge the way towards open space via the scientific, civilian *Vanguard* initiative. Far from an all-out mobilization of resources for space, early in this era, space policy of the United States could be characterized as modest. Were it to continue on this trajectory, absent a *Sputnik*-like event, this era would likely be a public success because it kept Eisenhower's Great Equation in balance. However, because of the secrecy and lack of public information regarding the status of

the whole U.S. space program and because of the underestimate of the impact of *Sputnik* on the American psyche, this era falls on the public failure end of the axis. It is important to remember, however, that this analysis has shown that it would very much be an oversimplification to label the era an abject failure. The next section will consider this era through the lens of the open systems analysis.

E. Open Systems Analysis

President Eisenhower was an advocate for space as an open system insomuch as it advanced his goals of gaining military intelligence superiority and keeping government spending in check. He employed an open systems mentality as a policy tool in his "open skies" proposal to the Soviet Union, which would have opened up air reconnaissance between the two super powers (Khrushchev quickly dismissed this proposal) (Sylvia Kraemer, 2006). The IGY's invitation for a science-based satellite mission also presented an opportunity to employ open systems in international setting, as it gave the U.S. a chance to reach space in a benign manner, thus establishing freedom of space without the risk of inciting conflict with other countries, notably Russia. The resulting *Vanguard* program, however, faced difficulties in its work between federal entities and contractors, the latter of whom placed a higher priority in the more lucrative (and seemingly longer-term) military work offered by the DoD (McDougall, 1985). Eisenhower's reluctance to expand the military-industrial complex he foresaw to the aerospace realm was one reason behind the creation of NASA as a civilian agency and his open systems foreign policy resulted in a contrast to Soviet ideology as well as a scientific venture into space. It also resulted in the perception that the U.S. was losing in an important scientific and technological "race" that would take the country a decade and billions of dollars to catch up.

F. PUBLIC VALUE MAPPING OF EARLY SPACE

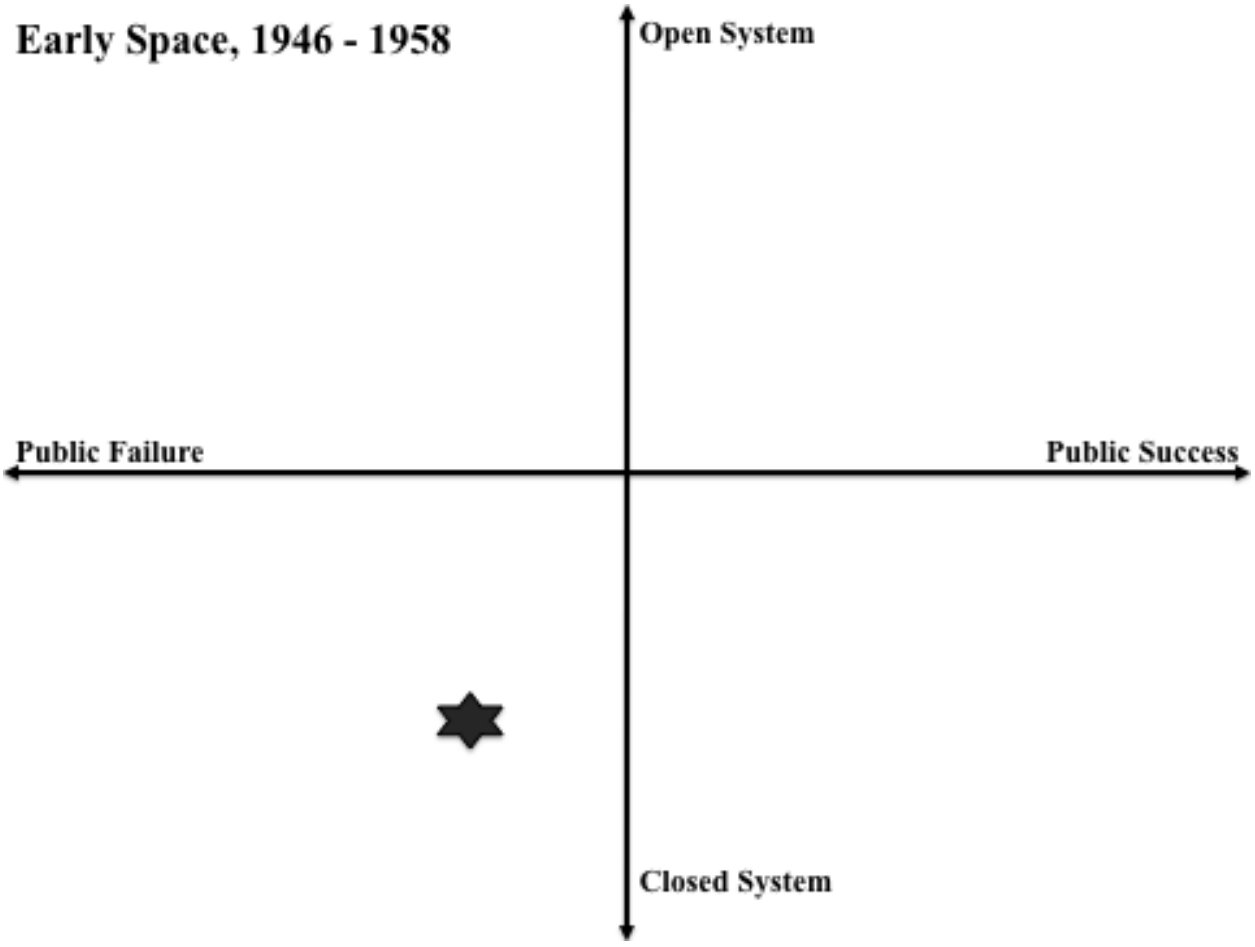

Figure 5. PVM Grid for the Early Space period, 1946 - 1958.

The early space program was essentially a closed system with many components that operated in secrecy or under the shield of military spending. This kept the program out of the public consciousness, but it also, as discussed earlier, set up the public for the *Sputnik* surprise that left many wondering where and what the U.S. space policy was. The early space program could also be seen as a public failure. The program did follow the small government ideals of President Eisenhower and there is little evidence that this hurt him politically during the first term of his presidency. However, the aftermath of *Sputnik* gave his political opponents (like Lyndon B. Johnson) and the press a reason to criticize the political miscalculation by the

administration that followed. It could thus be argued, in essence, that early space policy fulfilled public values until it didn't, and it wasn't that Eisenhower failed to fulfill these values early in his term, but rather he failed to see how they had shifted by late fall 1957.

V. THE MOON AND BACK

A. NARRATIVE

1. Man in space soonest

The United States now had an entire agency dedicated to meeting the Soviet challenge. By 1962, the country had launched more satellites than their Soviet counterparts, sixty-three in total, approximately half of them military in nature (the Soviets had only fifteen launches, none of them military) (McDougall, 1985). The scope of the "race," however, had advanced to manned spaceflight. NASA's *Mercury* program, whose goal was to send a human into space, was viewed by the public as the "primary (if not only) government program specifically designed to meet the stated goal of taking the "lead" in space away from the Soviets" (Kay, 2005). The seven astronauts, representing the highest caliber of test pilots the country possessed, were instant celebrities due to the import of the mission. The race to send a human being into space was entered into full bore by a United States kowtowed by the previous Soviet space exploits. The *Mercury* program seemed designed to reverse this recent fortune.

However, the now-familiar feeling of being beaten in the space race was felt in the stomachs of Americans the morning of April 12, 1961. Radar indicated launch of a Soviet craft in Central Asia. Radio Moscow announced later that morning that the craft, *Vostok*, had carried 27-year old Yuri Gagarin into orbit 200 miles above the earth's surface (Kay, 2005). The United States has lost another heat to the Soviets, this time after fully acknowledging its participation in

the race. After successfully testing a payload containing a chimp named Ham, before *Vostok*, *Mercury* was between this man-rated (but chimp-flown) test flight and what was scheduled to be the first manned flight with astronaut Alan Shepherd, when news of the Gagarin flight came (McDougall, 1985). Similar to the circumstances surrounding *Sputnik*, the U.S. was in a position to beat the Soviets only to lose in a very public, manner. In contrast to *Sputnik*, the U.S. could not credibly attribute its loss to a "surprise," for it now had a full-blown space program with its most prominent program dedicated to winning the manned space race. This loss was thus arguably a greater blow to U.S. prestige. As Kennedy took office, it was time again for the U.S. to set its sights higher (and farther) in an attempt to achieve Cold War victory.

2. Mission to the Moon

Much has been written about the decision and the resulting program to go to the moon . Talk of sending a man to the moon (and, perhaps more importantly, allocating money towards the venture) began as early as the formative months of the NASA debate in 1958 (Piland, 1958).[12] Eisenhower remained opposed to the program through the end of his administration because it allocated funds away from his military reconnaissance goals.

Just days after the Gagarin flight, Kennedy asked his vice president, Lyndon Johnson, whether the United States had "a chance of beating the Soviets by putting a laboratory in space, or by a rocket to land on the moon, or by a rocket to go to the moon and back with a man. Is there any program which promises dramatic results in which we could win?" The president also inquired whether "we" were "working 24 hours a day on existing programs. If not, why not? If not, will you make recommendations to me as to how work can be speeded up." Finally,

[12] In a memorandum to the President's Science Advisor Dr. Killian, an employee notes a line item in the proposed 1959 DARPA (then ARPA) budget for $10 million for a million-pound thrust engine. The author of the memo noted "This would imply a "man-on-the-moon" budget I believe."

Kennedy asked two very pointed questions: "Are we making maximum effort? Are we achieving necessary results?" (Kennedy, 1961). At least with respect to the latter question, the answer was negative.

The vice president responded eight days later, starting with an indictment of the Eisenhower administration's failure to "make the hard decisions" and to marshal the greater resources of the U.S. to achieve space leadership. He then made a forceful argument as to why the U.S. should pursue an expanded space program, "regardless of [other countries'] appreciation of our idealistic values, [they] will tend to align themselves with the country which they believe will be the world leader—the winner in the long run." The vice president continued to lay out the options for the president, "[m]anned exploration of the moon, for example, is not only an achievement with great propaganda value, but it is essential as an objective whether or not we are first in its accomplishment" (Johnson, 1961). Kennedy formally announced his goal the next month in an address to a joint session of Congress: "I believe 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 the earth."

3. What the hell are we making this trip for?

The familiar popular narrative of the *Apollo* years is that that nation rallied behind the president and within the decade, Neil Armstrong was standing on the moon. The truth is more interesting. A look at NASA's budget from the year of its inception in 1958 through the 1960s tracks the philosophies of the presidents in office as well as the general political (and popular) support for the space program. In 1959, the NASA appropriation was $330 million and Dwight Eisenhower was president. After Kennedy's 1961 address to Congress, the NASA budget doubled, from $964 million to $1.8 billion, much of the funds in support of R&D efforts (Van

Nimmen, Bruno, & Rosholt, 1976). The NASA budget peaked in 1966, three years before *Apollo 11*'s moon flight, and never again reached the share of the federal budget (4.5 percent) enjoyed in the mid-60s (Budget), 2013). The decline in budget starting in 1966 reflected declining political and popular support for a moon shot, as well as the crash nature of the R&D program itself.[13]

To rally public support for the new *Apollo* program, Kennedy made a famous speech in 1962 at Rice University, "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" (Kennedy, 1962). A month later, the president met, in an adversarial meeting, with NASA Administrator James Webb and other decision makers to discuss funding for the *Apollo* program in comparison to other NASA programs. A short excerpt:

> Kennedy: Do you think [*Apollo*] is *the* top priority program for the agency?
> Webb: No sir, I do not. I think it is *one* of the top priority programs []
> Kennedy: You know I think it is *the* top priority, I think we ought to have that very clear.
> [] this is important for political reasons, international political reasons, therefore this is, whether we like it or not in a sense a race and if we get second to the moon, it's nice, but it's like being second any time. []
> Unidentified: Why can't it be tied to preeminence in space?
> Kennedy: By God, we've been telling everybody that we're preeminent in space for five years and nobody believes us, because they have the booster and the satellite. We know all about the [other advances in U.S. space, like the number of satellites launched and the scientific discoveries]…that's wonderful, but nobody knows anything about it.

[13] The infrastructure needed to support the space activities had to be built in the early 1960s and thus accounted for a large portion of the massive NASA budget at the time.

> Kennedy: The policy ought to be that this is really the top priority program of the agency and one of the [] top priorities of the United States government. [] Now this may not change anything about the schedule, but at least we ought to be clear, because otherwise we shouldn't be spending this kind of money because I'm not that interested in space. I think it's good, I think we ought to know about it and spend reasonable amounts of money on it, but we're talking about fantastic expenditures which wreck our budget and all these other domestic programs and the only justification for it in my opinion is to [beat the Soviets to the moon]. ("Recordings between President Kennedy and NASA Administrator James Webb," 1962)

A year later, in 1963, Kennedy expressed serious doubts about a long-term program with short-term hardships, both political and economic in nature, in another meeting with the NASA Administrator. In the meeting, a more humble, uncertain president, undoubtedly eyeing reelection and a looming budget battle with the GOP, sought affirmation from Webb. The President also spoke about the need to recast the mission in military terms, not just prestige. Kennedy was concerned that the long-term payoff of the immense investment would look like a "stunt" without more justification—"[T]his is mid-journey and therefore everybody says 'what the hell are we making this trip for?' But at the end of the thing they may be glad we made it. [But] the only way we can defend ourselves [politically] is if we put a national security label rather than a prestige label on this" ("Recordings between President Kennedy and NASA Administrator James Webb," 1963).

Kennedy was not the only one to have misgivings about the scope and pace of the *Apollo* program. The costs of the program were increasing and there was no indication that the USSR was advancing with a lunar program of its own (Kay, 2005). The focus of the space program on the prestige lunar mission, at the expense of scientific, commercial, and military interests, also rankled those who felt that their field was being minimized. Administrator Webb spoke of the

interdisciplinary advances in space and earth science during the 1962 conversation, but was brushed aside by Kennedy who again emphasized that the *Apollo* program was *the* priority for the nation and especially for NASA. Vannevar Bush, who favored an approach more in line to Eisenhower's, was concerned that the *Apollo* program was taking too many resources (Kay, 2005). Scientists were also skeptical of the *Apollo* program. An informal 1964 poll of 2000 members of the American Academy for the Advancement of Science (AAAS) in the magazine *Science* found staunch opposition in the scientific community to the program ("News and Comment: Space Program: Results of Poll of AAAS Members," 1964). The poll found that sixty-two percent of respondents did not believe that "vital national interests" were justification for landing a man on the moon by 1970. Not surprisingly, the majority of respondents felt that science (fifty-eight percent) was the most important justification for a manned lunar space program, well ahead of national prestige (thirteen percent) and military (seven percent). Finally, when asked to rank scientific fields according to their "potentiality for producing new knowledge," biomedical research (fifty-one percent) far-outclassed "manned lunar research) (ten percent). While this is a biased indicator, it does suggest that the scientific elite of the time did not believe that science was given priority during the Kennedy administration, in particular in relation to the lunar program. However, given the course of the *Apollo* mission, it is unlikely that the opinions of these AAAS members had a significant impact on U.S. space policy as a whole.

4. Mission Accomplished

President Kennedy was assassinated months after expressing his misgivings about the *Apollo* program to NASA Administrator Webb, so it is impossible to project how the next few years would unfold had he lived. His successor, the early NASA champion Lyndon Johnson, proved somewhat ambivalent about funding a future *Apollo*-like program, despite vigorous advocacy

from NASA leadership. Johnson oversaw the reduction of NASA's budget after its peak in 1966, in part due to political dealing where he ceded program cuts in return for a tax increase, the end of the initial capital overlay for facilities and infrastructure, and because the import of a signature Cold War mission had lost much of the political salience and urgency of the early 1960s (Kay, 2005). Perhaps more significant is the shift in tone in Johnson's comments about U.S. activity in space, where his once fervent opposition to Soviet space efforts had "mellowed considerably" into talk about cooperative efforts in space (Kay, 2005).

Nevertheless, the *Apollo* program proceeded towards its decadal goal, culminating in the July 1969 *Apollo 11* mission that brought Neil Armstrong, Buzz Aldrin, and Michael Collins to the moon and returned them safely to earth. This epochal moment in human history is often seen as the moment that "television sets around the country began to flick off," and attention turned away from NASA and space exploits (Kay, 2005). To the public and many politicians, NASA's mission, set in the months after *Sputnik*, was now complete. This did not come as a complete surprise to the agency as the political writing had been on the wall for some time. The agency continued to seek a suitable mission that would continue its progress into space and spark the interest of the public and politicians.

A number of reasons have been posited to describe this seemingly sudden lack of support for big NASA missions. The escalating Vietnam war was commanding attention and resources away from space programs. Americans began to view the uptick in interest in science and technology with more skepticism as social concerns began to confront the negative impacts of technology (such as the use of military technology in Vietnam) (Kay, 2005). Finally, perhaps most importantly, the political and popular support for another massive investment in space was lacking. By many measures, not the least of which was the lunar mission itself (of which there

was no Soviet counterpart), the U.S. was now comfortably "ahead" of the Soviets in space. This, in addition to a greater emphasis on international cooperation in space, which Kennedy had once toyed with and Johnson expanded when he became president, downplayed the stark need for direct competition in space technology. An alternate framing of NASA's decreasing budget is to view the massive budgetary increase of the early 1960s itself as the aberration, with the resulting decline as reflecting the extraordinary circumstances under which the program was created.

B. IDENTIFICATION OF PUBLIC VALUES

Table 4. Identified public values of the Moon and Back era.

Public Value	**Definition**[14]	**Application to Era**
Responsiveness/ accountability	The public administration accepts responsibility for development of its citizens and becomes a channel for democracy.	NASA marshaled considerable resources towards the achievement of the *Apollo* mission, but its budget was often under close scrutiny.
Listening to public opinion	Related to responsiveness and a component of a healthy democracy.	Public opinion as reflected in opinion polls did not show universal support for the lunar mission.
Regime stability	The public sector presents itself with power, resources, and accountability to outside world.	The *Apollo* mission was a signature program for the U.S. government in this decade.
Innovation	Characterized by risk readiness, enthusiasm, dialogue, adaptability, and flexibility.	The coordination and organizational structure established in this era is an example of the government working with private contractors.
Timeliness	Relates to the intraorganizational productivity and effectiveness of the public sector, especially regarding its ability to work with the private sector.	The public sector mobilized to meet the deadline for reaching the Moon.

[14] From Jorgensen & Bozeman (2007).

1. Responsiveness/accountability

In response to President Kennedy's goal to reach the moon by the end of the decade, Congress and NASA worked to provide the resources and vision necessary to complete the mission. However, as the years progressed and the budget continued to increase (as it did through 1966), some members of Congress became more skeptical of the expenditures of NASA (Kay, 2005). Progressive members of the Democratic party objected in the mid-1960s to the NASA budget because they felt that money would be better-spent towards social programs (Kay, 2005). These early objections were not supported by the majority of Congress, which voted down efforts to cut NASA's 1964 budget, but they planted the seeds for later reduction of the NASA budget by President Johnson. Further, politicians seemed to have lost interest in funding another large-scale space program designed to contest the Soviet space program. Administrator Webb's calls for funding for a follow-up program to *Apollo* fell on deaf ears, as did his warnings of another Soviet achievement in space. This signals a shift in the political sentiment regarding the Soviet threat and the place of the U.S. space program to respond to it. This view is also supported by a somewhat skeptical public who did not support the massive expenditures of the lunar program , even if they had initially been concerned with early Soviet space victories like *Sputnik* and *Vostok.*

In this era, the federal government was responsive to the public's wishes in at least the following ways. Following the Soviet *Vostok* launch and President Kennedy's call to go to the Moon, Congress and NASA diligently funded and worked towards achievement of this goal. However, as the *Apollo* budget continued to rise and as other concerns, especially regarding expenditures on social programs, began to rise to the forefront of national concern (coinciding with a weakening of the fears of Soviet space dominance), members of Congress, representatives

of the citizens, began to question the size and scope of the space program. As these concerns gained traction, the president (now Johnson) ceded to more pressing political concerns and cut the NASA budget. More importantly (as the initial uptick in spending was due in part to capital investments for the crash program), he did not signal support for an *Apollo*-like follow on program, despite the advocacy of his former political ally in space policy, James Webb.

2. Listening to public opinion

The decision to go to the Moon and the approval of resources needed to reach this goal, was not made as a result of overwhelming public support for such a program. Here, the administrations of Kennedy and Johnson used other rationales (national security, prestige, and even national survival) to usher the ambitious lunar program into existence. However, public opinion research studies show that it has a complex, somewhat ambiguous relationship to NASA funding (Steinberg, 2011). The important conclusion for this analysis is that listening to public opinion was not as much of a driver for *Apollo* action as popular lore might have it, but it would be an overstatement to conclude that either the administrations did not listen to public opinion or that they defied it. It may be that it was a component of the decisions of policymakers, but not an overriding one. Finally, public opinion from the time shows a largely divided public, with only a slight minority in support of the lunar mission (R. D. Launius, 2003). There was nothing overwhelming—in support or in opposition—about public opinion of the time; it likely served to nudge lawmakers, not guide them.

3. Regime Stability

The decision to go to the moon reflected a very conscious effort by the Kennedy administration to project an image of strength to the outside world, especially after the initial "defeats" in the early years of the space race at the hands of the Soviets. Like regime stability in

the previous era, the *Apollo* program served to counter the influence of the Soviets on the rest of the world. However unlike the earlier era, the urgency surrounding the initial announcement in 1961 faded as the decade wore on. Kennedy strove to publically rally the country for the lunar mission, but harbored private doubts and declined to accelerate the timetable due to the fiscal impact that it would have. Further, as evidenced by Johnson's cooling as an advocate for space when it became less politically potent, space was driven less by ideology than by politics. This was unlike the Eisenhower administration's more ideologically-bound reasons for setting the course of space policy (limiting expenditures to secure national economic growth) and perhaps less of a significant public value than it was in the previous era. In sum, Kennedy and Johnson initially saw the lunar mission in terms of regime stability, national survival even, but Johnson later abandoned his stalwart support for political reasons.

4. Innovation

The innovation of *Apollo* had arguably greater impact on the organizational mechanics of a large government program than it did on the purely mechanical, technological front. As discussed earlier, the *Apollo* program took on a complex mission with many moving parts and accomplished its goal within the deadline. It also proved that government could marshal the resources and private entities necessary to procure highly complex technologies on a one-off basis, unlike the prevailing industrial paradigm of the time of mass manufacturing (SK Kraemer, 1995).

5. Timeliness

Once again, a key component of the *Apollo* program was the deadline imposed by President Kennedy. NASA implemented organizational efficiency measures, some adopted from the military and using military project managers, to accomplish the complex task while working

with hundreds of entities under exacting specifications. This is perhaps the most significant public values success of the era because of the scale of the accomplishment at the time and for the long-lasting impact of the organizational model between the federal government and private contractors.

C. Discussion of Public Values Failure Criteria Indicators

1. Mechanisms for values articulation and aggregation

In stark contrast to the pre-*Sputnik* space era, the *Apollo* era space policy was very much focused in the public sphere and debate occurred in the newspapers of the time and in congressional hearings. Bozeman uses the example of powerful committee chairs who were bottlenecks to action in civil rights and national security issues in the 1950s as an example of when there are insufficient mechanisms for values articulation and aggregation (Bozeman, 2007). Senator Johnson would seem to be a prime example of a powerful committee chairman during the creation of NASA, but it appears as though his power actually helped to accelerate the development of the Space Act and in turn the articulation of a public value for aggressive action in space.

2. Imperfect monopolies

Unlike later periods of U.S. space policy, the private sector did not compete with the federal government to provide space services. In fact, the patent policy contained in the Space Act gave the government sole ownership to the inventions derived from NASA-sponsored research (with a waiver of ownership available from the NASA administrator) (McDougall, 1985). The question thus becomes whether it was appropriate for the federal government to have a monopoly over space technology at the time. If it was, then there would be no public values failure in the government's legitimate monopoly in the space sector. There is no evidence that a

private space company or space division of an aerospace or military firm attempted to enter the free market during this time period, so no public failure occurred due to an imperfect monopoly.

3. Scarcity of providers

A public values failure due to scarcity of providers occurs when there is a scarcity of providers who can provide scarce public goods and services (Bozeman, 2007). In this era, NASA called upon aerospace (and related) contractors to provide the unique goods and services related to the new space program. There were no shortage of providers willing, for a significant sum of money, to design, build, and implement the *Apollo* mission. However, due to the rigid timetable and high level of expertise needed by NASA, only a small number of contractors were able to provide the major services for the mission, which made it difficult for smaller entities to compete for larger contracts (Kraemer, 2006).

4. Short time horizon

The United States went from a country with a space program relegated to the sidelines of a budget-minded president to one with a massive peacetime mobilization of resources towards a singular goal in little more than three years. The benefits—jobs, advances in technology, optimizing organizational efficiency—are undoubted, but there is also evidence that the *Apollo* program overstepped its mandate, if it ever had one. Lack of public support for the level of spending has been documented. Also important to note is the lack of support from politicians like Lyndon Johnson and even Kennedy, who balked at funding follow-up programs after *Apollo* (Kraemer, 2006). Indeed, finding support for a sequel to *Apollo* that rivals its scope (and job-

creating effects) has been a problem plaguing NASA in the decades since.[15] It appears then that there is a mismatch between the fundamental goal of NASA, which has a long time horizon, and its signature *Apollo* program, which had a short, discrete time horizon. Future attempts by the agency or its backers to capture the "spirit" of the *Apollo* years as support for new missions may be misplaced, especially since the general public views the benefit of NASA in terms of its scientific achievements rather than its splashy, dramatic missions (Kraemer, 1992).

5. Substitutability vs. conservation of resources

This indicator criterion is not applicable to the Moon and Back era because there was not a scenario, like in many ecological issues, where the free market considers human life or environmental resources a substitutable asset (Bozeman, 2007).

6. Imperfect public information

A general lack of enthusiasm from the public regarding the *Apollo* program, contrary to popular mythology, has been well-documented (Launius, 2003). Also well-documented are the private doubts expressed by President Kennedy as the political and fiscal reality began to dawn in meetings with NASA leadership in the early 1960's, the moon landing still years away, but the NASA budget ballooning. These private doubts did not coincide with public statements of the time; if anything, Kennedy reinforced his goal of reaching the moon within the decade.[16] It is uncertain what effect Kennedy's doubts, had they been made public, would have had on an

[15] The space shuttle program, which will be discussed in more detail in the next section, was conceived, as the name suggests, as a sort of conduit for administering space services. It was arguably not the same type of ends-based mission like *Mercury* (sending a person into space), *Apollo* (sending a person to the moon), or even the future space station (putting people into space for long durations). The next logical manned space mission which would have the same ends-based goal as previous, signature NASA missions, would be to send astronauts to Mars. Such a mission has been discussed, but no clear plans (or, importantly funding) has been made to reach that destination.

[16] Interestingly, Kennedy did begin to move toward seeking a cooperative moon mission with the Soviets in 1963, apparently without consulting top NASA officials or his vice president. Kennedy was assassinated before providing more clarity on the rationale behind the proposal, which was rebuffed by Soviet leaders at the time and ignored by President Johnson upon taking office (R. Launius, 2012).

American public already indifferent to the *Apollo* program. Compounding the uncertainty is the uncertainty as to the extent and nature of Kennedy's doubts regarding the program.

7. Benefit hoarding

The *Apollo* program was almost solely conceived as a national prestige program with benefits, if they did accrue, being incidental to the overall Cold War-themed mission. In fact, the Webb and McNamara memo sent to Vice President Johnson as the *Apollo* program was being conceived cited the benefits to national prestige such a program would bring, "even though the scientific, commercial or military value of the undertaking may by ordinary standards be marginal or economically unjustified" (Kay, 2005). This mentality appears to have continued into the 1960s; an informal, non-scientific poll of AAAS members published in *Science* found that many respondents felt that money would be better-spent for scientific purposes elsewhere ("News and Comment: Space Program: Results of Poll of AAAS Members," 1964). In addition, a majority of the public in the 1960s felt that the government was spending too much money on space, especially in relation to its spending on other national programs like poverty, debt, and, surprisingly, the desalinization of water (R. D. Launius, 2003). It is important to note, however, that these polls were conducted at the height of NASA spending and still five years before the benefit of *Apollo*—walking on the moon—was achieved.

D. PUBLIC VALUES DISCUSSION

The Moon and Back era is placed as a relative public success. The sheer magnitude of the program and its ultimate success from an operational perspective is manifested in the public values of responsiveness/accountability, innovation, and timeliness. However, the notion that the *Apollo* program enjoyed significant public support has been shown to be inaccurate, or at least an oversimplification. So this era was a success not due to overwhelming public support, but

because government leaders set an ambitious goal designed to fulfill certain public values, to showcase national technological innovation, and for national defense reasons, and they achieved the goal in spectacular fashion. The key lesson of this era from a public values perspective is that viewing the era as a runaway public success, a kind of magic that must be recaptured for the "next" big government program, will always leave advocates short of their goal; the Moon and Back era occurred because of a confluence of political opportunity and deft maneuvering by master political minds and resulted in an achievement that was both spectacular and overpriced.

E. Open Systems Analysis

The NASA of the early 1960s was an agency under a very tight, very specific deadline, to reach the moon and return safely within the decade. This situation did not lend itself to an open system because it required very specific things that could only be offered by very few, generally large corporations like Lockheed Martin, Douglas Aircraft, Boeing, and other defense and aerospace entities. The agency itself, however, was created in the aftermath of a very public event—*Sputnik*—and was debated in a series of hearings and in newspaper editorials across the country. Unlike the space policy of the early and mid-1950s, which was conducted under secrecy or under cover of "science," the decision to create NASA was quite public. This era of space was more "open" than the previous one because of the public's interest in space of the time as well as Congressional pressure to achieve results. Another way to view the openness of space policy of the time is to view the proportion of in-house NASA employees to contractors, which rose to 11 contractors for every employee at NASA's peak in 1965 (SK Kraemer, 1995). For example, development of the Saturn V rocket had a team of five main contractors (North American Aviation, Douglas Aircraft Company, Rocketdyne, Boeing, and IBM) and a total of 250 subcontractors who all had to work in concert to meet the deadlines and strict specifications for

the rocket (SK Kraemer, 1995). Kraemer attributes the affinity towards contracting much of its work as well as establishing decentralized centers of research to the agency's heritage as a committee-structured organization.

F. Public Value Mapping of Moon and Back

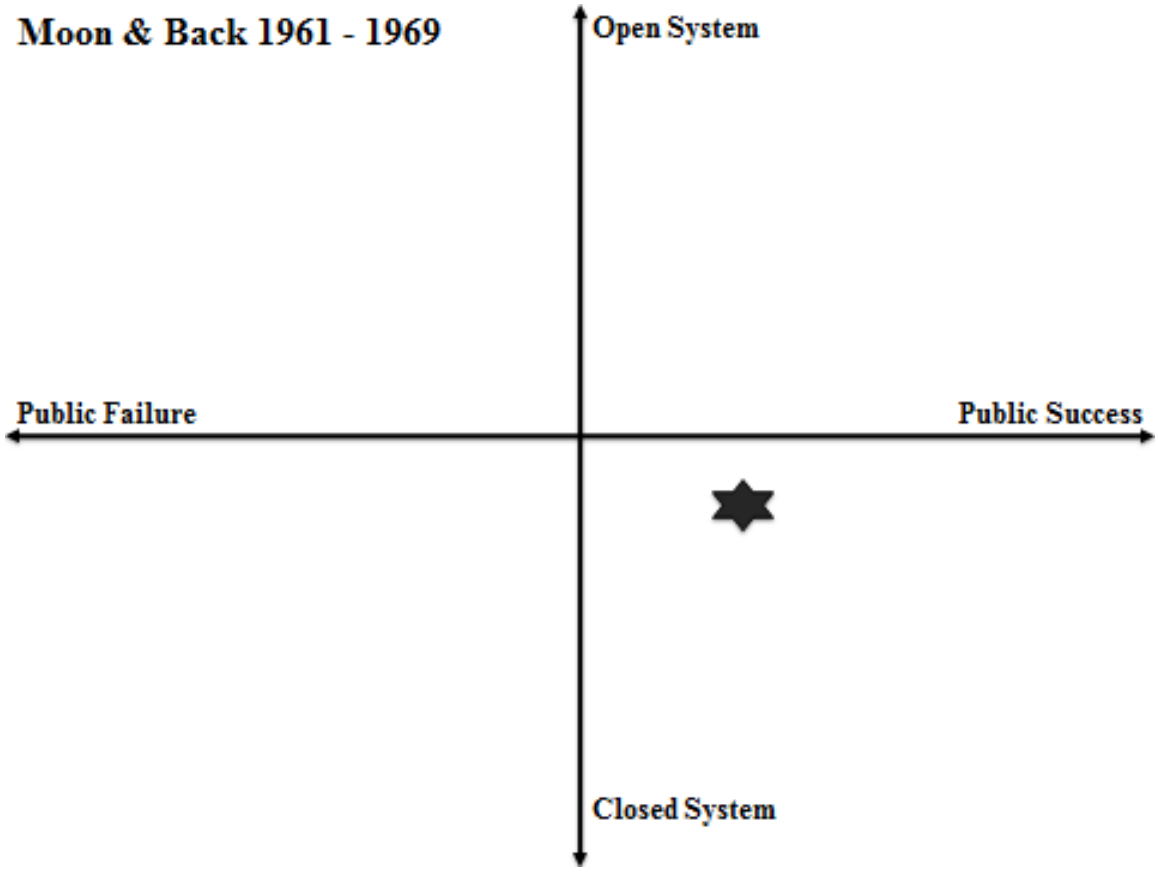

Figure 6. PVM Grid for the Moon and Back period, 1961–1969.

The so-called Golden Age of NASA was not a runaway public success. Rather, it was the culmination of several key factors—leadership, political opportunities, and the application of technology—that elevated the space program to the level it enjoyed in the mid-1960s. The rosy view that some now take of the era is quickly dispelled once the curtain is pulled back, revealing a president perhaps most associated with the space program, Kennedy, expressing private doubts about the *Apollo* program to the NASA administrator. It is also diminished by a public whose

support for the moon mission never ticked above fifty percent save for a brief time after the astronauts of *Apollo 11* walked on the moon in 1969. Yet it would be going too far to call the entire affair a public values failure. Going to the moon and returning safely does represent a milestone achievement of the human race and a pinnacle of U.S. mobilization towards a shared goal.

The space sector also took steps towards an open system during this time. The creation of NASA, unlike the formulation of space policy in the 1950s, took place largely in the public eye thanks to the hearings convened by Congress by the future Vice President. NASA followed the post-WWII practice of the DoD and contracted out goods, services, and development to the private sector at a level of eighty to ninety percent of its budget (SK Kraemer, 1995). This statistic does not imply that the private sector was a market competitor to NASA, as the contractor were working as agents of the federal government, but given the tremendous increase in budget during the time, a significant amount of money was flowing into the private sector contractors. Further, NASA was able to harness the efficiency of the private sector, which had expertise gained in the defense and aerospace industry, to marshal the complex, one-of-a-kind equipment required by NASA.

VI. SPACE, INC.

A. NARRATIVE

The words that flashed across the large video screen in NASA's Houston-based Mission Control center after *Apollo 11* returned from the moon now seem to be almost ominous due to the terminal declaration of "Mission Accomplished, July 1969" (Kay, 2005). For many, the U.S. space program had accomplished its primary goal—winning the space race with the Soviet

Union. Indeed, the next decade would be characterized as much for the international cooperation, not competition, of the two space powers. In order to maintain its relevancy, NASA would have to find new ways to explore space and capture the nation's imagination.

In 1972, President Nixon announced plans for a "space vehicle that can shuttle repeatedly from Earth to orbit and back" thereby "revolution[izing] transportation into near space, by routinizing it" (Nixon, 1972). Nixon emphasized the tremendous opportunity the Space Transportation System (STS) would have by "delivering the rich benefits of practical space utilization and the valuable spinoffs from space efforts into the daily lives of Americans and all people" (Nixon, 1972). Advocates of the STS predicted that as many as 50 shuttle flights would take place annually, and help the United States establish a "real working presence" in space that would blur the lines between the manned and unmanned space programs due to the ease of working in space the shuttle would establish (Nixon, 1972). The STS would come to define a large part of NASA's mission (or lack thereof) in the coming decades and it was itself borne out of a sort of political and technical lock-in of both NASA and the executive branch, who had invested such a vast sum of time, talent, and treasure into the manned space program in the previous decade that it would be difficult to move away from the signature characteristic of NASA towards a less prestige-oriented, science-based mission (Kay, 2005).

The 1980s brought another dramatic shift in NASA's mission, championed by President Reagan, who sought to redefine the relationship between the government and the private sector in space. This is the starting point for the next era, Space, Inc. Kay (2005) identifies a convergence of two significant events that led to this shift towards the private sector and the beginning of a new era in space: the "routinization" of space technology meant a fuller integration into the civilian economy and the Reagan administration's redefinition of space

policy from an ends-based (launch a satellite; send a man to the Moon) to a means-based (provide ongoing space shuttle services; have a permanent space station) framing. These two events created an atmosphere ripe for change in NASA as the rise of commercial space industry combined with a governmental agenda of privatization led to efforts to privatize formerly government-owned programs with weather satellites and the space station as notable, though not altogether successful, examples. Like the national security interests and prestige interest advanced by the NASA in the 1960s, the agency used the economic concerns held by the president to advance the programs of the agency in the 1980s (Kay, 2005).

The shift in U.S. space policy took shape through a reorganization of the policy formulation structure established by National Security Decision Directive 42 (NSDD 42), issued by the Reagan administration, which created the National Security Council Senior Interagency Group (SIG). The NSDD 42 also contained a statement of the goals of U.S. space policy, notably to: "obtain economic and scientific benefits through the exploitation of space; and [] expand United States private-sector investment and involvement in civil space and space-related activities" ("National Security Decision Directive No. 42: National Space Policy," 1982). In 1984, the Space Act was amended to declare that "the general welfare of the United States requires that the National Aeronautics and Space Administration seek and encourage to the maximum extent possible the fullest commercial use of space." That same year, NASA developed its own Commercial Space Policy and sought to implement its new mission by offering subsidized access to the shuttle, establishing government-industry-university partnerships to promote new space industries, and ultimately becoming the primary if not only customer of the fledgling space industries (Kay, 2005).

By most accounts, this did not go well. For example, subsidies in the form of reduced rates for commercial users of the shuttle's payload proved to be an obstacle for private commercial launch companies who could not compete with NASA's undercutting prices (Kay, 2005). This policy ended in the wake of the 1986 *Challenger* disaster which grounded the shuttle fleet and its commercial customers indefinitely. Six months after *Challenger*, President Reagan announced the end of NASA's commercial payload services: "NASA will no longer be in the business of launching private satellites. . . . NASA and our shuttles can't be committing their scarce resources to things which can be done better and cheaper by the private sector" (Reagan, 1986). The decision resulted in the number of U.S. commercial launches going from 2 in 1989 to 22 in 1998 (Kay, 2005). By 2012, worldwide revenue from 20 commercial launches was estimated to be $2.4 billion, although only 2 of these commercial launches were U.S.-based (for reasons discussed below, however, they were significant) (*Commercial Space Transportation: 2012 Year in Review*, 2013).

Another notable effort to privatize the U.S. space industry that ultimately ended in failure is the case of a small space company, Space Industries Incorporated (SII), which in 1984 introduced a plan to construct an unmanned space station called the Industrial Space Facility (ISF). The ISF would lease space to private companies and the government to conduct experiments in microgravity for industrial applications such as crystals, metals, and pharmaceuticals. The company estimated that the total cost would be $700M with a launch date of 1991, cheaper and available sooner than NASA's planned manned space station (Kay, 2005). By 1988, the ISF had gained traction as Congress appropriated $25 million to investigate a government lease on the station and the White House indicated its support of the project and the government's involvement in it (3 shuttle flights would carry payload on credit for future

revenue) (Broad, 1988). SII began to encounter difficulties finding potential customers, especially after *Challenger* and the issues of reliability and safety it raised, and asked NASA to become an "anchor tenant" and lease approximately 70 percent of the facility for $140 million per year for five years (Kay, 2005). NASA was resistant to this overture in part because of rising political pressure for its overbudget and delayed manned space station and declared that it had "no identified needs" to use the ISF (Kay, 2005). This statement served to undercut the agency's justification for its own space station (which it had expressly been trying to avoid by distancing itself from the private initative) and ultimately ended hope for SII to launch a private, unmanned space station. The ISF was finally dead in 1989 after a Senate committee ordered the National Academy of Sciences to review the proposal and concluded that there would in fact not be a need until the late-1990s when the manned space station would be complete. Valid or not, the perception of NASA after the shuttle subsidies and ISF episodes was that it was anti-business, despite its efforts to engage in public-private partnerships (Kay, 2005).

The trials and tribulations of NASA in the 1980s as it tried to engage the private sector set the course for the next few decades of space policy. Again, change occurred in fits and spurts. George H.W. Bush sought to electrify the public in a Kennedyesque way when he announced the Space Exploration Initiative (SEI) in 1989. His plan was to send Americans back to "the Moon, back to the future. And this time, back to stay," in addition to a mission to Mars (Stafford, Thomas P. (Chairman, 1991). However, after failing to ignite either the public imagination or loosen politicians' purse strings, the SEI program was quietly shelved a few years after its introduction (Kay, 2005).

President Clinton continued the policy direction in space set by Reagan and Bush by promoting business and commerce in space (Kay, 2005). He even advanced the idea of

privatization by announcing in his 1995 Space Transportation Policy plans for a successor to the shuttle that called for private sector financing (Kay, 2005). President George W. Bush commissioned a study on the future of space exploration that again stressed the importance of the commercial market in space and set a goal to return to the Moon by 2020 (Aldridge, 2004).

Today, the future of NASA remains embroiled in eternal budget debates and, with the retirement of the agency's shuttles, a debate on the future mission and direction of the U.S. space agency. Unlike previous eras, NASA now exists as one in an increasingly crowded space-related field both at home (defense-related space and commercial ventures) and abroad. The global space industry generated an estimated $250 billion in revenue in 2007 and other nations are beginning to take leadership roles in space exploration (Stine, 2009). President Obama has continued to embrace commercial partnerships in space, in line with his recent predecessors' emphasis on opportunities in space with the private sector.

An historic event occurred in May, 2012, when the first commercial spacecraft, built by the flashy company Space Exploration Technologies Corporation (better known as SpaceX), docked with the International Space Station bringing supplies and other cargo on contract with NASA (Chang, 2012). A main goal of the Obama administration's space policy is to "energize competitive domestic industries to participate in global markets and advance the development" of space industries such as satellites, launching, and "increased entrepreneurship" (*National Space Policy of the United States of America*, 2010). Contracting with private entities to perform space services, eventually including human transport, represents the shift towards partnering, not competing, with the private sector that began with Reagan in the 1980s.

B. IDENTIFICATION OF PUBLIC VALUES

Table 5. Identified public values of the Space, Inc. era.

Public Value	Definition[17]	Application to Era
Accountability	The public administration accepts responsibility for development of its citizens and becomes a channel for democracy.	Since the mid-1980s, the U.S. has suffered two catastrophic accidents involving its shuttle fleet as well as other notable failures.
Competitiveness - Cooperativeness	Competitiveness infers the ability to win public contracts, while cooperativeness means that public organizations must be coordinated by cooperation.	Cooperation with other countries has been a hallmark of the past few decades of space policy; the commercial market for space services (like launches) has also risen to prominence recently.
Stakeholder/shareholder value	Related to parsimony, productivity, and effectiveness.	A few ill-fated attempts to engage the private sector have led some to question NASA's involvement in commercial space.
Reliability	Related to timeliness, effectiveness, and rule of law.	The shuttle system was supposed to be a cheap, reliable way to get to space, which it has proven to be anything but.
Innovation	Characterized by risk readiness, enthusiasm, dialogue, adaptability, and flexibility.	Innovation continues in fits and starts for an agency whose budget has remained constant over the decades, but who still struggles to fund and complete large projects like the International Space Station.

1. Accountability

NASA has been held accountable for its failures and missteps by way of Congressional hearings after incidents and as a part of the continual need for budget appropriations. During this era, NASA suffered several well-known failures, including the shuttles *Challenger* and *Columbia*, the Mars Climate Orbiter crash (due to a unit conversion error), and a faulty mirror on the Hubble Space Telescope which required a daring spacewalk to repair it. Some, if not most of these tragedies can be traced to a desire to contract out key components of the technology and

[17] From Jorgensen & Bozeman (2007).

service (Kay, 2005). From a public value perspective, the fact that NASA leadership is brought in front of Congress after each failure attests to fulfillment of the public value of accountability, but the notion that these tragedies continue to occur calls into question whether the agency is truly being held accountable for its mistakes.

2. Competitiveness-Cooperativeness

This era can be characterized by both competitiveness and cooperativeness. In the early 1980s, NASA was a direct competitor to private space companies as a provider for space services on its subsidized shuttle flights. Originally envisioned as a cheap, reliable, and frequent service, the STS proved to be anything but. Further, the subsidized services undercut private companies' attempts to enter the market. The policy change after the *Challenger* disaster ended this type of direct competition between NASA and the private sector and has resulted in tremendous growth of that industry, though NASA is still the main customer. NASA has also shown cooperation with other nations, as evidenced by the Russian *Soyuz* vehicle that transports U.S. astronauts to the International Space Station.

3. Stakeholder/shareholder value

As previously mentioned, some of the recent missteps of NASA can be tied in part to agency cost-cutting or a desire to do more with less. One component of the related public value of cooperativeness is the understanding that due to the lack of market forces, a public organization must cooperate with other entities both public and private to provide public goods (Bozeman, 2007). This runs counter to the idea of shareholder value, which emphasizes value in the form of cost savings and profit. NASA has had a difficult time balancing these two competing values, as seen in its status as sometime competitor to private entities and sometime customer to the same entities. If one considers the American public to be the shareholders in

NASA, it is unclear whether this era of space policy, which has been moving ever-more steadily towards privatization, meets the traditional expectations of shareholder value.

4. Reliability

The Space, Inc. era has represented a movement from the spectacular achievement-based programs of earlier eras towards an era where the government provides space services for both public and private benefit. One of the groundbreaking technologies that matured in this era was the STS, which promised cheap, reliable, and frequent transportation of people and goods into space. This vision, as it has been described above, has not lived up to its promise, though it may be a moot point now that the shuttle fleet has been retired.

5. Innovation

NASA has struggled to acquire funding for big programs in this era, as has been the case since *Apollo* (which is an argument that *Apollo* was truly an aberration). Nevertheless, the public continues to support NASA more for its incremental scientific discoveries and less for its splashy prestige milestones (SK Kraemer, 1992). This would indicate that unlike previous eras where innovation was characterized by advances in space technology and the complex organizational structure of procurement, this era's innovation value is more in line with the scientific branch of NASA.

C. DISCUSSION OF PUBLIC VALUES FAILURE CRITERIA INDICATORS

1. Mechanisms for values articulation and aggregation

The U.S. space program has continued along a steady path of funding throughout the Space, Inc. era, though consistency of funding does not itself equate to sufficient mechanisms for values articulation and aggregation. Perhaps a more accurate statement for this public values indicator is that there is no evidence from this era that public values (especially those listed in the

previous section) are *not* being articulated or aggregated, so absent strong evidence either way, this indicator has relatively little to bear on this era for analysis.

2. Imperfect monopolies

A public values failure occurs here when private entities provide goods and services even though a government monopoly is deemed in the public interest. The entrance of private entities into a market for, as an example, the launching of private satellites, began to become more widely encouraged by NASA in this era. National governments were no longer the sole occupants in space. However, it is not clear whether this environment changed as a result of a change in public value regarding space services as a public good or whether it was due to a number of factors including the maturation of the space industry by the 1980s and on into the present day. It is clear now that regardless of how the shift occurred, the government is not deemed to have a monopoly interest in space for public values reasons.

3. Scarcity of providers

There is little indication that public provision of goods and services were not delivered due to a scarcity of providers in this era. However, the private provision of goods and services (like private satellites) were impeded at times in the early 1980s due to the public subsidies for space services provided by NASA pre-1986. The rise of commercial space launches since that time indicates that there is no shortage of providers, but again the lessons of NASA's initial forays into the private market carry on.

4. Short time horizon

Unlike the previous two eras, a sense of urgency has been lacking generally in the space context. NASA has maintained a relatively steady budget as a portion of the total federal budget for decades now, though this masks specific cuts in projects and an inability to secure funding

for large individual projects. The lack of long-term, big projects could be an indicator that Congress and the presidents of this era have not embraced a long-term vision for space (though the two Bush presidents have announced ambitious initiatives that were later abandoned). However, it could also mean that the smaller scientific missions of NASA, such as the various space telescopes or scientific satellites, are more valued by the public, which again has support in the literature (Steinberg, 2011). In sum, it is possible that a lack of interest in long term, large scale projects reminiscent of *Apollo* does not indicate a short-sighted vision for space policy, but rather the preference of both policymakers and the public for NASA to continue work on science- based missions that do not require the massive mobilization of resources seen in decades past.

5. Substitutability vs. conservation of resources

This indicator has more relevant applications to the natural resources area of study as it focuses on the typically economic valuation of goods such as "distinctive, highly valued" natural resources that treat the resources as substitutable or endorse policies which back the risk with unsuitable indemnification (Bozeman, 2007). While it has not been applicable to earlier eras of space policy, it can be applied to this particular era because of the management strategies that arguably under-valued the risks of human spaceflight in the two shuttle disasters. The reasons for the two tragedies are complex, but a portion of the blame lies with an insufficient chain of command between NASA and contractors, seen more directly in the *Challenger* disaster. Because the agency has emphasized cutting costs and contracting out services at an increasing level in this era, it is possible that the human resources and risks of space flight have at time been undervalued by contractors and the public sector.

6. Imperfect public information

Again, this era is unlike previous eras because space was not used as a proxy for nationalistic progress or as a front in the Cold War. The transparency or secrecy of the space programs, unlike Eisenhower's secret military reconnaissance satellite program or Kennedy's private wavering regarding *Apollo*, of the Space, Inc. era did not have the same import as in previous decades. There are, however, interesting findings regarding public opinion of NASA, as described earlier. The fact that most Americans, while generally supportive of NASA, nonetheless believe that its budget is too high is undercut by the belief that the NASA budget makes up a far greater percentage of the budget (they estimate 20 percent) than it does (about 0.5 percent) (R. D. Launius, 2003). This signals an obvious gap in the general public's knowledge surrounding the space program and calls into question the results of some of the opinion polls about U.S. investment in space. At any rate, it is an indicator that the public has imperfect public information about the size and scope of NASA, but it is due more to ignorance or apathy, not a strategic decision to alter information transmitted to the public by NASA.

7. Benefit hoarding

There is little evidence that this indicator is applicable to the present era, absent the early example of NASA itself capturing the market for public commodities and services by subsidizing space services in the early 1980s.

D. PUBLIC VALUES DISCUSSION

The push from the top of the federal government for increased cooperation on the international and commercial front in space has characterized this era of space policy. Although entry of private companies in the space market was at first resisted in the form of competition with NASA, subsequent policies have done much to encourage and stoke the growth of this

market. There have been drawbacks in this era as well, some tied to the increased push to rely on private entities for space services (*Challenger*). These large-scale missteps keep this era from becoming a clear public success. However, the continued public support (however misinformed the public may be), the move towards public-private partnerships and a robust private space market, and the scientific breakthroughs valued by the public keep the era from becoming a public failure. Instead, the era has been placed as a minor public success on the public values scale.

E. Open Systems Analysis

The last thirty years of space policy has undoubtedly skewed towards the commercial sector within the purview of NASA's non-military space activities.[18] This has been the result of Congressional mandate (The Commercial Space Launch Act of 1984) and presidential directive (beginning with the Reagan administration and continuing in subsequent administrations). The shift towards reliance on the commercial sector has continued to advance; in 2012, Space X carried a cargo payload to the International Space Station under a NASA contract. While this development has pushed the civilian space system towards an open configuration, it is tempered by some facts that suggest that it is not as open as it appears to be. The federal government continues to be the primary source of R&D funding for the aerospace industry, in 2002 over 60 percent of aerospace R&D was paid for by the federal government (Sylvia Kraemer, 2006). Further, a dynamic, open marketplace that open systems thinking envisions does not exist. Large aerospace contractors like Lockeed Martin, Boeing, and Rockwell continue to dominate the landscape (Sylvia Kraemer, 2006). This dominance is due in large part to the specialized nature

[18] It should be noted here that the DoD's space budget rose above the level of NASA's budget for a time in the 1980s because of the Reagan administration's Strategic Defense Initiative; it fell below NASA's budget during the Clinton administration (Sylvia Kraemer, 2006).

of the goods and services the firms provide; as they gain experience in the development of the technologies, it makes it easier for them to receive future awards and, correspondingly, more difficult for newer, smaller, less-experienced companies from winning them. Further, Kraemer (2006) suggests that the politically-driven spread of aerospace facilities across the country (NASA can claim that all fifty states have contracts and/or grants worth $25k or more) achieved its goal—political support for NASA funding—though little more, as the awardees continue to be concentrated at the top. There is also evidence that academic grant recipients for space science are similarly concentrated (for example, California Institute of Technology and The Johns Hopkins University together represent one quarter of academic and non-profit funding), though at a smaller scale budget-wise than manned space activity (Sylvia Kraemer, 2006).

F. PUBLIC VALUE MAPPING OF SPACE, INC.

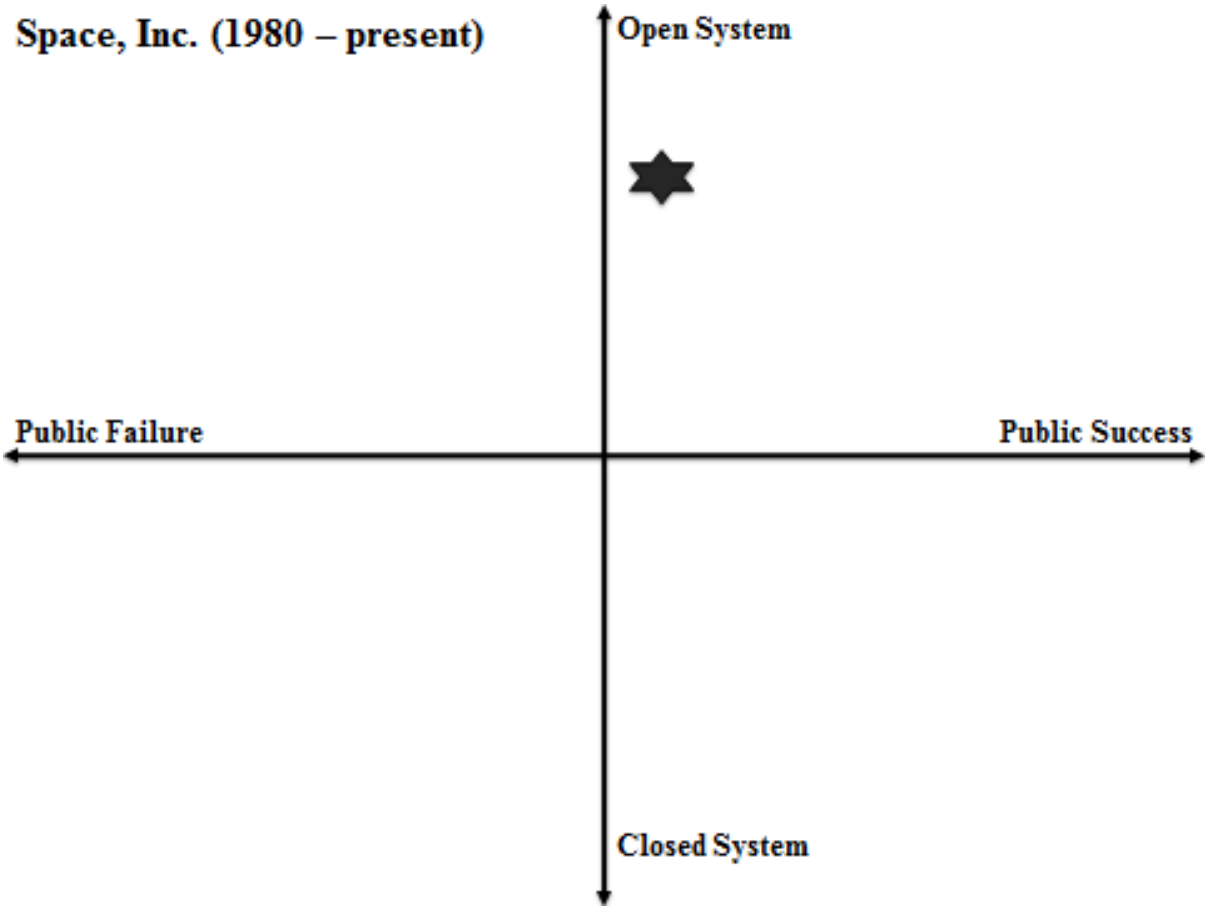

Figure 8. PVM Grid for the Space, Inc. Period, 1980–present.

Civilian U.S. space policy has taken steps in opening up over the past thirty years as it has become official policy for the government to cede at least some control in operations to commercial entrants. The market for space services like satellites or remote sensing and the launches that facilitate these activities can be volatile, however, and much of industry R&D is funded by the government, however, so it is not a complete "open systems" success (Sylvia Kraemer, 2006). Further, while commercial space has been a goal for decades now, the market is still largely dominated by giant aerospace contractors. The recent development of smaller,

nimble companies like SpaceX or Virgin Galactic may be changing this dynamic, but it remains to be seen the ultimate impact.

The ongoing popularity of NASA nudges it into public values success, though the agency has been hampered by human and public relations disasters in the previous era as well as the ongoing struggle to fund big projects like a return to the Moon or a trip to Mars. The popularity of NASA seems to be rooted more in its continued scientific achievements, not in its capacity or promise to do take on large, resource-intensive, prestige-based projects like *Apollo* (SK Kraemer, 1992). The sheer magnitude of the agency's accomplishments in the first decade of its existence seems to hover over both proponents and detractors of the agency. Whether NASA of today fulfills the "compelling urge" to explore the outer bounds of human ability is debatable in relation to the role of the agency in past decades. However, it seems certain that regardless of the budgetary fate of one agency, enterprising individuals and companies will continue to work towards this vague yet deep-rooted objective.

VII. CONCLUSION

The space policy landscape has gone through tremendous changes over the past half century. Table 5, below, summarizes the public values exhibited in each era. There are several significant findings from a comparison of the public values of the eras. One is that the public value of innovation is expressed in each era, though it does so in different ways. The early inter-branch R&D competition that characterized space policy in the late-1950s transformed into the massive mobilization and organizational efficiency of the *Apollo* program before entering into the current era, where NASA has struggled to find its next "big" project but has continued to make scientific advancements and private sector partnerships. This is an example of a public

value developing over time and highlights the importance of mapping public values instead of simply reciting them to gather more insight.

Regime stability is another public value that was expressed in the earliest two eras. Like innovation, it too took on different meanings in the different eras. In the earliest era, space policy was an integral part of Eisenhower's ideology of maintaining a balance between military readiness (of which space played a role for its intelligence potential) and domestic economic growth (which necessitated limited expenditures on space and other military programs). After *Sputnik* and into the Kennedy administration, regime stability in the space policy context was used as an argument for a massive, crash program in space. Space was employed for regime stability as a proxy (at times) for national survival against the looming Soviet threat. In both eras, the space program furthered U.S. regime stability in the eyes of key policymakers.

Relatedly, when public values are considered as a group from era to era, a pattern emerges that relates to how space policy was used by policymakers in each era. In the first two eras, space policy was used as a proxy for furtherance of presidents' broader goals. The public values associated with the Early Space era generally relate to space policy's use as a tool for military reconnaissance and geopolitical subterfuge (secrecy, regime stability). In the Moon and Back era, the lunar mission (and the public values of regime stability, innovation, and timeliness) signified Kennedy's use of the space program to deal a significant blow to the prestige accrued by the early Soviet space exploits. The public values associated with the most recent era now envision space policy for its own sake. Values like competitiveness, shareholder value, and reliability describe values associated with the performance of NASA itself. The shift in public values may be subtle with significant overlap, but it is important in the understanding of how space policy has shifted broadly over time. Today, NASA exists not as a proxy for a broader,

existential war against an enemy but rather as a large federal agency committed (though not always successful) to its scientific and technological missions.

Finally, a consideration of the public values across the eras appears to track the trend towards an open system for space policy. Each successive era yields public values that signify the shift towards the open market, commercial applications, and other indicia of open systems. The relationship between open systems and public values for the three eras is best displayed on the PVM grid, found in Figure 9 below.

Table 6. Summary of public values across three eras of space policy.

Early Space	**Moon and Back**	**Space, Inc.**
Regime Stability	Responsiveness/ accountability	Accountability
Balancing of interests	Listening to public opinion	Competitiveness - Cooperativeness
Innovation	Regime stability	Stakeholder/shareholder value
Secrecy	Innovation	Reliability
Political Loyalty	Timeliness	Innovation

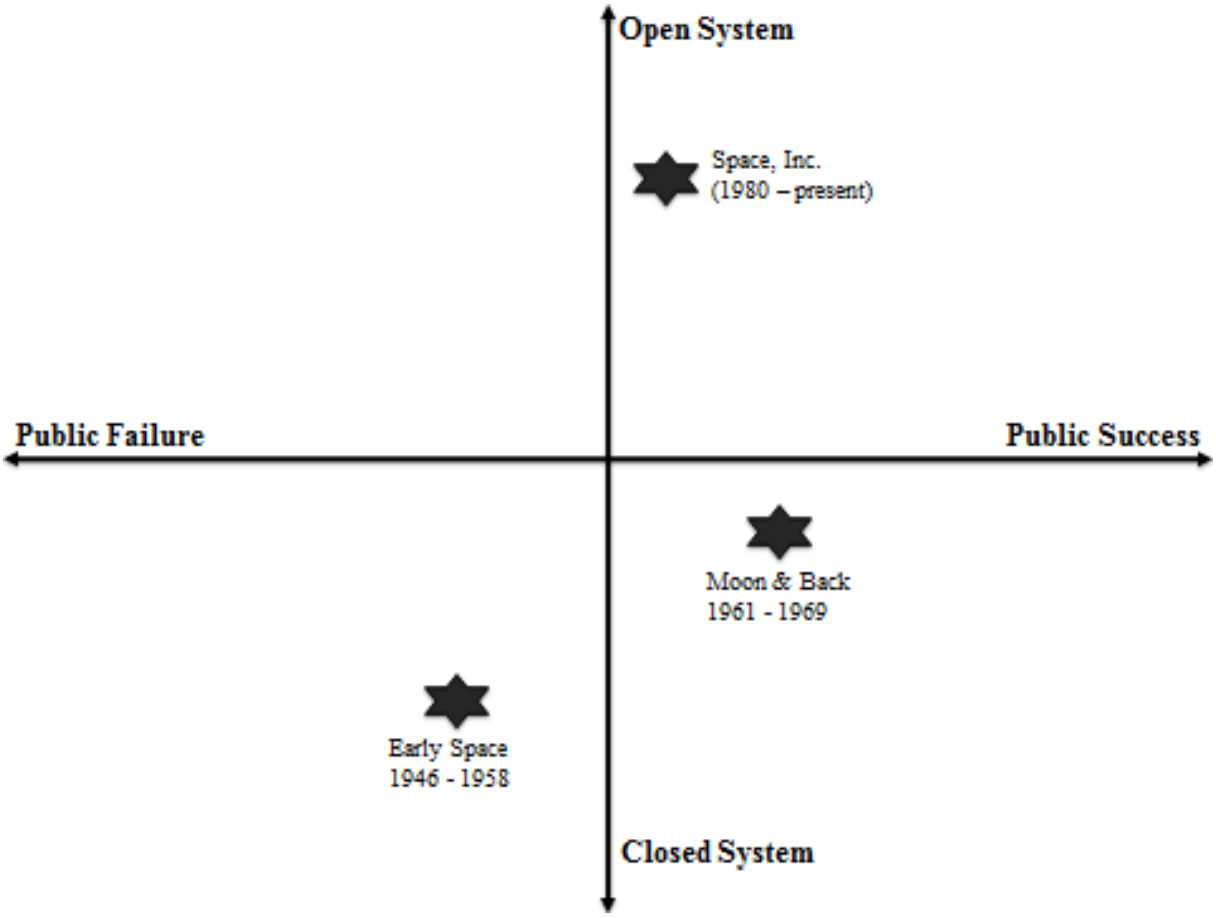

Figure 9. Summary PVM grid for three eras of space policy.

Figure 9 shows the three eras' PVM positions relative to one another. The first insight is that space policy has neither been a runaway public failure or success throughout its existence. This may run counter to some narratives that have the eras in starker contrast to one another, but after the PVM analysis and placement on the grid, it is simply not the case. However, as Bozeman and Sarewitz note, placement on the PVM grid does not equate to gospel. There is room for debate, which is indeed the authors' intent. The public values continuum also offers insight into the power of the presidency to push forward space programs. Four presidents discussed in this paper—Eisenhower, Kennedy, Johnson, and Reagan—exerted their influence in ways that altered the direction of space policy. However, other presidents have either generally

ignored space (Carter, Clinton) or have announced ambitious programs (Bush, Bush) that were never followed through on. It seems that presidential ambition is a necessary, but not sufficient ingredient in successfully shaping space policy.

The inclusion of an open systems framework on the opposing axis to public values increases the novelty of the debate as well. More research is needed, but it appears as though the space system has become more open, perhaps due to maturing infrastructure, technology, and markets in the field.

It is difficult to aggregate the public values and indicators in such a way that makes their placement on the PVM grid satisfactory. This analysis attempts a small step towards a more quantitative analytical method that blends public values identification, open systems analysis, and public value mapping. Why do we continue to explore space? Because there is a public value to be gained by public expenditure in the space program. Although NASA isn't the smashing success it was once thought to be, it is likely that it never reached these mythic heights even in its Golden Age. What is becoming more clear is that the space program has continually become a more open system and the public values expressed in the most recent era suggest that there is a growing private market in space. Space is an example of a government program that has evolved throughout the decades to (mostly) meet the needs of policymakers, the public, and, increasingly, the private market.

This leads back to the central question of this paper: what lessons from the space case studies can be applied to current and future "big" government programs in science, technology, and elsewhere? One is that external moments such as the launch of *Sputnik* can be important catalysts for policy change. NASA was created just months after the Soviet satellite and Eisenhower's years of urging measured steps in space exploration were cast into doubt in the

crisis that followed. Other times, external forces can act to create a political window within which leaders, often presidents, can usher sweeping change. Kennedy and Reagan both capitalized on these political environments to implement their space policy changes.

There is also a need to be aware of changing political and other forces that can affect the viability of a current policy regime. Eisenhower underestimated the psychological, existential impact that spaceflight would have on the American and world consciousness. In contrast, President Johnson toned down his early 1960s rhetoric on the threat posed by a Soviet space program as the issue lost political salience as the 1960s progressed. He had been an early champion of both NASA itself and of the *Apollo* mission, but there is strong evidence that his support was primarily due to the political gain that being a strong advocate would result in. Finally, President Reagan supported an ideology of a limited federal government and he was able to set the space policy course for decades to come by embracing the emerging commercial sector of space. It follows then that champions of large governmental initiatives may be well served by waiting for a political window to open, preferably via a powerful external force, to have the best chance of advocating for a position successfully. Once the window opens, it is crucial, as the space examples can attest, to have powerful leadership to guide it through; presidents are a necessary, but not sufficient component of these types of success.

As a counterbalance to the previous point, policymakers cannot sit back and wait for a perfect alignment of political and public support before calling others to action. Despite popular accounts, President Kennedy did not announce the lunar mission while riding a wave of public support—he did it despite early warnings and doubts about the size and necessity of the program and the warnings only grew louder as the years went on. This may seem to run counter to the previous paragraph's message, but it can be distilled in a few words: be patient, find a champion,

take advantage of the situation, be mindful of shifting political landscapes, and be nimble in the reaction.

Policymakers can use PVM analysis to assess prospects of current and future policy ideas. The method is envisioned as an additional tool policymakers can use in addition to traditional research methodology like economic analysis. It would be less suited for a legislator or someone with limited time, however, given the need to understand and appreciate the nuances of the analysis. The method would be better suited for a mid-level policymaker who is designing recommendations and alternatives because PVM can fit into this somewhat slower method of decision making.

In closing, the story of U.S. space policy began in dramatic fashion, in little more than a decade, a massive industry was created and a federal agency sent humans to the moon and return them safely. Perhaps more impressive is that despite some public setbacks in recent decades, NASA enjoys broad support and is valued not for their spectacular accomplishments, but for the ongoing work of discovery and science the agency engages in. This is a sign that NASA is fulfilling public values by learning new things about the way the universe works. The ultimate lesson for advocates of large government initiatives may be to do big things, not because they are hard, but because they fulfill public values.

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APPENDIX

Table from Jorgensen and Bozeman (2007)

Value Category	**Value Set**
Public sector's contribution to society	Common good
	Public interest
	Social cohesion
	Altruism
	Human dignity
	Sustainability
	Voice of the future
	Regime dignity
	Regime stability
Transformation of interests to decisions	Majority rule
	Democracy
	Will of the people
	Collective choice
	User democracy
	Local governance
	Citizen involvement

	Protection of minorities
	Protection of individual rights
Relationship between public administrators and politicians	Political loyalty
	Accountability
	Responsiveness
Relationship between public administrators and their environment	Openness-secrecy
	Responsiveness
	Listening to public opinion
	Advocacy-neutrality
	Compromise
	Balancing of interests
	Competitiveness-cooperativeness
	Stakeholder of shareholder value
Intraorganizational aspects of public administration	Robustness
	Adaptability
	Stability
	Reliability
	Timeliness
	Innovation
	Enthusiasm
	Risk readiness
	Productivity
	Effectiveness
	Parsimony
	Business-like approach
	Self-development of employees
	Good working environment
Behavior of public-sector employees	Accountability
	Professionalism
	Honesty
	Moral standards
	Ethical consciousness
	Integrity
Relationship between public administration and the citizens	Legality
	Protection of rights of the individual
	Equal treatment
	Rule of law
	Justice
	Equity
	Reasonableness
	Fairness
	Professionalism
	Dialogue
	Responsiveness
	User democracy
	Citizen involvement
	Citizen’s self-development
	User orientation
	Timeliness

	Friendliness