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A Canadian Space Odyssey: Canada, the Great Space Powers, and the Space Power Dilemma

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A Canadian Space Odyssey:

Canada, the Great Space Powers, and the Space Power Dilemma

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Abstract

Canada, despite being the third country to launch an artificial satellite, was unable to develop into a space power commanding a long-term strategic presence in outer space during the Cold War. Whereas the "great space powers" of the period, the United States and Soviet Union, held a dominant position in the space environment, Canada's space power influence declined over the years. By analyzing declassified strategic documents and the strategic literature on space power, and by interviewing members of Canada's national space organizations, this thesis will compare the strategic, political and economic variables that make a space power to determine why Canada did not maintain space supremacy when compared with the United States and Soviet Union from 1957 to 1991. This thesis concludes that Canada did not develop into a space power during the Cold War because, opposite the great space powers, the country did not have a comprehensive space strategy, political leadership and support, or the economic resources that would allow for the development of a long-term satellite presence.

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List of Abbreviations

Symbol	Definition
ABM	Anti-Ballistic Missile
AIAC	Aerospace Industries Association of Canada
ASAT	Anti-Satellite Weapon
CAC	Canadian Astronaut Corps
CIA	Central Intelligence Agency
COPUOS	United Nations Committee on the Peaceful Uses of Outer Space
COSPAR	Committee on Space Research
CRS	Chief of Review Services
CSA	Canadian Space Agency
DG	Director-General
DND	Department of National Defence
DRB	Defence Research Board
FOBS	Fractional Orbital Bombardment System
GCCSS	Global Commercial Communication Satellite System
GDP	Gross Domestic Product
GEO	Geosynchronous Orbit
GPS	Global Positioning System
ICS	Interdepartmental Committee on Space
ISS	International Space Station
LEO	Low-Earth Orbit
MAD	Mutually Assured Destruction
MEO	Medium-Earth Orbit
NORAD	North American Aerospace Defense Command
NRC	National Research Council
NSDD	National Security Decision Directive
NSDM	National Security Decision Memorandum
OST	Outer Space Treaty
PMO	Office of the Prime Minster
PTBT	Partial Test Ban Treaty
RCAF	Royal Canadian Air Force
RMA	Revolution in Military Affairs
SDI	Strategic Defense Initiative
SDWG	Space Defence Working Group
SRMS	Shuttle Remote Manipulator System
SSA	Space Situational Awareness
UN	United Nations
USAF	United States Air Force

Chapter 1: In the Aftermath of Alouette: Re-evaluating Canada's Strategic Space Policy during the Cold War

1.1 Introduction

The ultimate high ground, that is, the celestial dominion of outer space, waits for no one. Although the dream of reaching space has teased the imaginations of humankind since the days of classical civilization, it was only during the twentieth century that the knowledge and technology needed to turn this dream into reality became available. The advent of atmospheric rocketry enabled humankind to extend beyond the telluric confines of our atmosphere and, following centuries of technological innovation and progress, made a primitive species of primates into a people capable of interstellar space flight. The future of human exploration in space, as explored by an assortment of popular media ranging from books to films, became thematically linked to the countries of the world putting aside their ideological, economic, and political differences and converging their national interests in outer space toward a single, common good[1]. In other words, "things look[ed] bright" for a world reeling from the devastation of the Second World War as if, overnight, the previous stigmas of anarchy, competition, and self-interest – which had thrown the world into war throughout the early twentieth century – had all but dissipated from the collective consciousness of humankind as they looked to their future in the stars[2]. Unfortunately, humankind's foray into space was not as utopic as previously hoped.

The "Space Age", the period of time that signified humankind's progressively accumulative propensity to conduct regular space activities, began with the launch of a single

[1] Chris Gainor, *Canada in Space: The People & Stories behind Canada's Role in the Exploration of Space* (Edmonton, AB: Folklore Publishing, 2006), 10-11: Perhaps no article of media better illustrates this theme of a "single, common good" than Gene Roddenberry's *Star Trek*, where Captain James T. Kirk (played by Canadian, William Shatner) explains that humankind has put aside its differences to "boldly go where no man has gone before".
[2] Tony Osman, *Space History* (New York, NY: St. Martin's Press, 1983), 36; Frank H. Winter, *Rockets Into Space* (Cambridge, MA: Harvard University Press, 1990), 56-57.

artificial satellite at a time during the Cold War that was marked by egoism and hostility, not of cooperation and peace. On the morning of October 5, 1957, the world awoke to the news that the impossible had been accomplished. Earlier that morning, the Soviet Union (U.S.S.R.) had launched the first man-made object into outer space: an aluminium 22-inch sphere with four spring-loaded whip antennae weighing only 183 pounds[3]. In the highly symbolic world of the Cold War, the international response to Sputnik I was immediate and extremely negative. Still recovering from the Second World War, Western Europe became concerned about a potential threat originating from outer space and the United States (U.S.) became instantaneously fixated on "leveling the playing field" by "bridging the military and scientific gap" with the Soviet Union[4]. Highlighting the magnitude of the situation in the U.S., Wisconsin Republican Senator Joseph McCarthy attested that the launch of the Soviet's first satellite had created a "devastating blow to the prestige of the United States as the leader in the scientific and technological free world"[5]. Immediate action in outer space was, therefore, not only warranted, but necessary to address the growing influence of the U.S.S.R. in a formerly immaculate environment. Fuelled by a robust cocktail of politics, fear, propaganda, and prestige, the two superpowers would consequently engage in a progressively challenging and expensive contest of innovation above the Earth that, according to several commentators, "changed the very nature of the Cold War itself and ultimately defined a new era of human civilization"[6].

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[3] Roger D. Launius, "Sputnik and the Origins of the Space Age," *National Aeronautics and Space Administration (NASA)*, February 2005.

[4] James Clay Moltz, *The Politics of Space Security: Strategic Restraint and Pursuit of National Interests* (Stanford, CA: Stanford University Press, 2011), 92; Nayef R. F. Al-Rodhan, *Meta-Geopolitics of Outer Space: An Analysis of Space Power, Security and Governance* (Oxford, U.K.: Palgrave-MacMillian, 2012), 6.

[5] Zuoyue Wang, *In Sputnik's Shadow: The President's Science Advisory Committee and Cold War America* (New Brunswick, NJ: Rutgers University Press, 2009), 72.

[6] Andrew Chaikin, *A Man on the Moon* (New York, NY: Penguin Book, 1994), 3; Asif A. Siddiqui, *Challenge to Apollo: The Soviet Union and the Space Race, 1945-1974* (Washington, D.C.: National Aeronautics and Space Administration (NASA), 2000), 121.

From the competition and conflict that had provoked humankind's first excursion into outer space emerged a new avenue that nation-states could exploit to better influence the activities of other actual and potential rivals. With the opening of the space environment, "spacefaring states" (countries that had achieved a level of scientific and technological proficiency which allowed for national space activities) were presented with a unique opportunity to impact the activities of other states directly[7]. Similar to other schools of strategic thought – like land power, sea power, and air power – that had developed around the premeditated exploitation of a specific geography-related medium, those states that could efficiently install their influence and prestige in space became known as "space powers". Through a combination of unifying strategic policies, high-risk spontaneous space ventures, and a technological mastery of astrodynamics, the United States and Soviet Union emerged as the undisputed space powers of the Cold War; thus exhibiting a complete mastery of the final frontier as its undisputed conquerors[8]. As internationally-recognized "great space powers", superpowers were successfully guaranteed their national influence and prestige within the upper atmospheres without even firing a shot.

Like a handful of other states, Canada became an active participant during the early stages of the Cold War's Space Race. Much like the rest of the world, the Canadian reaction to Sputnik I was characterized by a dual sense of surprise and unease. A column published in the October 7, 1957 edition of the *Toronto Globe and Mail* summarized the subsequent attitude in Canada: "[i]t's happened…[the Soviet Union has] beat us to the heavens"[9]. Moreover, the column would confer what many households across the country were contemplating regarding Canada's future role in

[7] James E. Oberg (U.S. Air Force), *Space Power Theory* (Colorado Springs, CO: U.S. Air Force Academy, 1999), 118; Norman Friedman, *Seapower and Space* (London, U.K.: Chatham Publishing, 2000), 297.
[8] Joan Johnson-Freese, *Space as a Strategic Asset* (New York, NY: Columbia University Press, 2007), 29; James Clay Moltz, op. cit., 91-92.
[9] The Canadian Press, "Russia launches First Satellite," *Toronto Globe and Mail*, October 1957, 2.

the space environment: "Canada [must] become an active participant in outer space"[10]. Perhaps because of this public outcry, Canada would famously become the third country to launch an artificial satellite into the terrestrial orbits when, on September 29, 1962, it launched a single ionospheric-measurement satellite above the Earth. The Alouette I – aptly named after the skylark named in the popular French-Canadian children's song – became, as if overnight, a national symbol for the prospective aptitude of Canada's limited, yet incredibly specialized ability to place sophisticated technologies into space. In the twilight of humankind's first foray into outer space, Canada began to position itself to enter the Space Age.

As the Space Age began, Canada's national space organizations started to distinguish themselves globally in a manner suiting one of the most technologically-advanced states in the world. According to the Government of Canada's *Satellites: The Canadian Experience* document published in 1984, Canada's greatest contribution to outer space activities at the beginning of the Space Age was in the field of telecommunication. The sheer geographic volume of the second-largest country warranted the development of "the most efficient domestic satellite communications system…and one of the best networks for radio, television, telephone, date and facsimile transmission"[11]. With the launch of a handful of telecommunication satellites in the early 1960s, Canadians in the most remote corners of the country were provided access to a level of interconnectedness enjoyed by very few countries. In the aftermath of these telecommunication satellite launches, the Financial Times reported that "Canadians [stood] in awe of the accomplishments of [their] politicians and scientists[12]. Furthermore, if Canadians wished to continue to benefit from these space technologies, the Federal Government of Canada would need

[10] The Canadian Press, "Russia launches First Satellite," op. cit., 3.
[11] Ministry of External Affairs, "Satellites: the Canadian experience," *Government of Canada*, April 1984, 2.
[12] Uncredited, "A view of space," *Financial Times of Canada*, November 1968, 14-1.

to "[actively] ensure that Canadian efforts [were] not wasted through divided jurisdictions, interagency competition or neglect of private initiative"[13].

In May 1966, the Federal Government would make good on this suggestion by taking the first steps in creating a formative strategic space policy to better coordinate and support Canada's future national space activities and growth into a space power. Championed by Dr. John H. Chapman, the technological architect behind the successful Alouette I launch, the Science Secretariat of the Prime Minister's Office (PMO) would commission the *National Space Study* also known as the "Chapman Report" in May 1966 with the objective of empowering Canada to become "a significant space nation"[14]. To match "tit-for-tat" the growing number of space accomplishments implemented by the great space powers during the early Space Age (which included, during the period, more expensive and symbolic missions like the American Apollo Program and the innumerable Soviet manned lunar attempts), the report would advance an indigenous space-launch capability for Canada[15]. Focused on a strategic space policy that would encourage the launch of multiple communication, scientific, and reconnaissance satellites into the upper atmospheres, the report directed Canada to secure its influence in space through the placement of Canadian satellites into the high-earth orbits. This, it was intended, would have two effects on Canada's maturation into a space power: first, it would allow Canada to be counted among the great space powers as a state that occupied "desirable orbits in the upper atmosphere", which would allow the country to continue to provide space-based services to its populations from these regions and to deny these orbits to emerging spacefaring actors; second, it would allow Canada to continue to develop and deploy space technologies (like telecommunication satellites)

[13] Uncredited, "A view from space," op. cit., 14-1.
[14] J. H. Chapman, P. A. Forsyth, P. A. Lapp, and G. N. Patterson, "Upper Atmosphere and Space Programs in Canada, Special Study 1#," *Science Secretariat Privy Council Office*, February 1967, 101.
[15] Ibid, 111.

that it "had become accustomed to producing" in the early Space Age[16]. The publication of the Chapman Report thus illustrated a significant public assurance during the period by Canadian policy-makers to the Canadian public that a new strategic space policy would be adhered to and implemented throughout Canada's national space organizations in an effort to direct the nation's scientific and technological resources towards supporting multiple satellite launches[17]. Akin to the United States and Soviet Union at the beginning of the Space Age, the future of Canada as a space power appeared connected to the creation, disposition, and maintenance of a long-term satellite presence in the upper atmospheres[18].

1.2 The Space Power Dilemma and Canada's Modern Space Assets

Despite its promising start employing telecommunication satellites and publishing the forward-looking *National Space Study* for developing a national space strategy, outer space has remained, in the popular vernacular, "the final frontier" in the area of operations especially where Canada's modern national space activities are concerned[19]. In spite of the Chapman Report of 1966 providing a clear roadmap for Canadian policy-makers on how to guarantee strategic interests in the upper atmospheres using domestic space resources, Canada's strategic space policy to this day remains stagnant. The country's strategic space policy has been largely indifferent to the space power recommendations outlined by the Dr. John H. Chapman and his contemporaries because of a combination of issues that at present afflict Canada's modern national space activities and the ability of the country to guarantee a lasting strategic influence within the space environment:

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[16] Jeanne Sauve (Minister of State for Science and Technology), "A Canadian Policy for Space," *file 4145-09-1*, 1974, Library and Archives (LAC), Ottawa, Ontario, 1-4.
[17] Christian DeBresson, "Have Canadians Failed to Innovate? The Brown Thesis Revisited," *History of Science and Technology* 6.1 (1982): 20; Richard A. Jarrell, *The Cold Light of Dawn: A History of Canadian Astronomy* (Toronto, ON: University of Toronto Press, 1988), 33.
[18] Jeanne Sauve, op. cit., 1-4.
[19] *Star Trek*, "Amok Time", Directed by Josey Pevney, Written by Gene Roddenberry and Theodore Sturgeon, National Broadcasting Company (NBC), September 15, 1967.

Even though Canada remains one of the most scientifically and technologically advanced states ever to have existed in human history, its modern national space activities – managed by two separate governmental organizations with separate space resources, the Canadian Space Agency (CSA) and Department of National Defence (DND) – are restricted to an uninterrupted "freeze-frame" in history defined by a lack of operational satellites in the orbits. Canada continues to operate and own only a handful of telecommunication satellites for civilian applications, despite being absolutely reliant on satellites for everyday activities. Many of these satellites are technological relics that are well beyond their operational lifespans and whose capabilities are archaic in comparison to modern communication and imagery technologies owned by other states[20]. Canada's astronaut program also demonstrates a similar lack of resources. Although Canada continues to consider astronauts an "invaluable component of its national space operations", the number of astronaut recruitment campaigns has steadily decreased since the 1990s, thereby yielding fewer national and international space flights conducted over the decades by the Canadian Astronaut Corps (CAC)[21]. Moreover, the Canadian Armed Forces (CAF) has ignored a crucial high-tech revolution in military affairs (RMA) that would have enabled the country to make use of a strategic advantage of possessing the "ultimate high ground"[22]. Although Canada boasts one of the most high-tech armed forces and industrial research and development branches in the world, it owns a small military space capability compared with other countries

[20] James Fergusson and David S. McDonough, "WMD Proliferation, Missile Defence, and Outer Space: A Canadian Perspective," in *Canada's National Security in the Post-9/11 World: Strategy, Interests, and Threats*, ed. By David S. McDonough (Toronto, ON: University of Toronto Press, 2012), 262.

[21] Lydia Dotto, *Canada in Space* (Toronto, ON: Irwin Publishing, 1987), 43; Chris Gainor, op. cit., 140-141; Canadian Space Agency, "History of the Canadian astronauts corps," *Government of Canada*, November 2016: It should be noted that the first astronaut recruitment campaign (1983) produced six astronauts, the second campaign (1992) produced four, and third campaign (2008) produced two.

[22] Joshua Kutryk (Royal Canadian Air Force), "To Earth Orbit and Beyond: Discussion Points for a Strengthened Canadian Defence Strategy in Outer Space," *The Royal Air Force Journal* 4.4 (2015): 6.

(including allies and potential adversaries)[23]. Although the CAF's lone owned and operated satellite, the "Sapphire" Space Situational Awareness (SSA) satellite, provides one of the most "detailed and speedy" transmissions of space reconnaissance in the world, former Brigadier-General Rick Pitre – the Director-General (DG) of Space at DND at the time of Sapphire's launch in 2013 – opines that "the capability it not enough…[as] more systems like Sapphire are required " to preserve a long-term strategic presence for Canada in space[24]. As of February 2017, several anonymous military sources have further confirmed reports that Sapphire may be deorbited by the 2020s, thereby making way for a "new military, more advanced Space Situational Awareness capability" which has yet to be communicated to the public[25]. If this is true, the country will be losing a key national space asset that has been in space for less than a decade with no real technological substitute to buttress Canada's lack of operational satellites.

The inadequacy of Canada's modern satellite capabilities are compounded by the ambivalence of government agencies in translating, over the last decade, years of space-related expertise by Canadian space experts into a comprehensive space strategy to direct national space activities. In spite of maintaining a highly talented workforce consisting of career policy-analysts, military experts, scientists, engineers, and civilian consultants, a comprehensive space strategy that outlines how Canada will conduct national space activities – and, by association, what technological resources, launch capabilities, even core strategic objectives that a Canadian satellite presence in the orbits should achieve – remains unrealised[26]. As several interviewees who have worked in Canada's space organizations over the last decade can confirm, a modern-day space

[23] James Fergusson and David S. McDonough, op. cit., 262; Joshua Kutryk, op. cit., 6.
[24] Rick Pitre (Royal Canadian Air Force, Ret'd), Interviewed by Kiernan McClelland, *Research Interview*, September 29, 2016.
[25] Anonymous (Department of National Defence Employee), Interviewed by Kiernan McClelland, *Research Interview*, September 25, 2016.
[26] Joshua Kutryk, op. cit., 6.

strategy for Canada is further complicated by recent articles of civilian and military space legislation which are vacuous of any clear direction for guaranteeing Canada's strategic interests in space[27]. Undeniably, the most recent attempt to direct national space activities comes from the CSA's "Space Policy Framework" published in 2014[28]. The document, which serves to outline a "comprehensive approach to Canada's future in space" leading into the 21st century, presents no clear outline for how national space activities are to be fulfilled in the next decades[29]. Instead, the document stresses a broad umbrella of strategic space policy-making centered on "five core principles" that restate several truisms associated to all spacefaring states: such as a commitment to "[n]ational sovereignty, security and prosperity…[serving as] the key drivers of Canada's activities in space" and that national space activities should "motivate…young Canadians"[30]. If one also considers the latest *Defence Policy Review Public Consultation Document* published in 2016, DND is still determining how best to protect not just Canada's military space assets but those civilian satellites that, if neutralized, would result in the country experiencing a catastrophic disruption to everyday life[31].

In view of these particulars, the strategic space policy that Canada has advanced in the 21st century security environment has impacted the capacity of the country to become a space power. Indeed, the primary problem with the country's strategic space policy is that it differs so markedly from the space power recommendations advanced in the past by the Chapman Report of 1966.

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[27] Anonymous (Canadian Space Agency Employee), Interviewed by Kiernan McClelland, *Research Interview*, September 25, 2016; Blaise Frawley (Royal Canadian Air Force), Interview by Kiernan McClelland, *Research Interview*, November 14, 2016; Walter Natynczyk (Former Canadian Space Agency President), Interviewed by Kiernan McClelland, *Research Interview*, February 11, 2017.
[28] Canadian Space Agency, "Canada's Space Policy Framework: Launching The Next Generation," *Government of Canada*, February 2014.
[29] Ibid, 3.
[30] Ibid, 9-10.
[31] Department of National Defence, "Defence Policy Review: Public Consolation Document 2016," *Government of Canada*, April 2016, 21.

Rather than maintaining a wide set of mulit-faceted national satellite capabilities (consisting of multiple communication, scientific, and reconnaissance satellites), as would be expected from the nation if committed to the Chapman Report, Canada's modern space capabilities include a number of over-specialized scientific and technological capabilities such as the Shuttle Remote Manipulator System (SRMS), the CAP, and DND's Sapphire. Quality has outplayed quantity in the nation's strategic space policy, resulting in less national satellites being launched.

Canada's strategic space policy has thus changed drastically from the strategic space policy that was originally envisaged by the Chapman Report's space power recommendations forwarded in the wake of the launch of Alouette I in 1962. Whereas Dr. Chapman and his colleagues had supported Canada's development into a space power through the deployment of more serviceable satellites into the orbits, Canada now maintains a handful of space assets that are more "flavour than practical"[32]. Despite retaining a strong scientific and technological capability whilst operating alongside the great space powers during the early Space Age, Canada was unable to reach its potential as a space power commanding a long-term presence in outer space during the formative years of the early Space Age.

1.3 Research Question and Hypothesis

It is the objective of this thesis to address the question regarding why Canada's modern strategic space policy in the 21st century is so markedly different from the strategic space policy forwarded in the 20th century through the *National Space Study* of May 1966. To answer this question, the thesis will answer the question: *Why was Canada, despite its promising start employing telecommunication satellites and publishing a forward-looking national space strategy*

[32] Rick Pitre (Royal Canadian Air Force, Ret'd), Interviewed by Kiernan McClelland, *Research Interview*, September 29, 2016.

early in the Space Age, unsuccessful in developing into a space power with a long-term artificial satellite presence in the upper atmospheres during the remainder of the Cold War?

To answer this question, the thesis will hypothesize that Canada, despite holding the honour as the third country ever to enter the space environment, was unable to develop into a space power in the same way as the United States and Soviet Union because it lacked certain strategic, political, and economic space power factors that would have enabled it to better manage and support more satellites activities. The absence of a common space strategy, political leadership and support, and economic resources for national space activities impacted Canada's ability to launch numerous satellites and maintain a long-term material presence in space during the Cold World. As a consequence, Canada's strategic space policy became estranged from the strategic recommendations that had previously been advanced during the early Space Age through the Chapman Report. Conversely, the United States and Soviet Union were able to increase their space-based capabilities in a manner which permitted both counties to remain active in the space environment because they shared strategic, political, and economic factors (variables) which were the antithesis of those exemplified by Canada during the relatively same period. By analyzing the factors that had the greatest effect on influencing the national space activities of the great space powers and Canada during the Cold War, this thesis will add to the understanding of what the United States and Soviet Union 'did right' to guarantee their power in space and what Canada 'did wrong' during the transformative years of early human space operations.

1.4 Research Methodology and Operationalization

Prior to analyzing the first three spacefaring states that emerged during the Cold War, it is important to outline an exact definition for what space power is. The conceptualization of space power used in this thesis will denote *a spacefaring state that increases its artificial satellite*

launches over a number of years as a means of proportionally increasing its share of national power from within the space environment while sustaining this satellite capability. As Chapter 2 will elaborate in further detail, this conceptualization of space power is supported by a number of variables that have affected the study within the field of strategic studies, including the theoretical background of space power theory, the topographical environmental features of space, and the technological limitations of satellite technologies. In this thesis, it is affirmed that space power is linked to the capacity of spacefaring states to conduct and sustain satellite operations over a period of time. Henceforth, more satellites in space yields more power for a spacefaring state in space.

The hypothesis, that Canada was unable to develop into a space power in the same way as the United States and Soviet Union during the Cold War, will therefore assess three important strategic factors which, when studied together, recognize those spacefaring states that can be considered space powers. First, for a state to be considered a space power, it must possess a clear strategic direction that guides its national space activities towards a common strategic objective. If a state has a straightforward strategic direction for outer space, it is more likely to launch more space technologies because it understands that its strategic objectives in the region can only be guaranteed, at this point in human history, through satellite technologies[33]. Second, for a state to be considered a space power it is required to have strong political leadership that can direct all relevant civilian, industry, and military space organizations toward a common direction in its national space exploitation. By possessing strong political leadership that is passionate about space operations, a state can more effectively direct domestic and international space activities and more efficiently distribute national space resources toward a common strategic objective which

[33] David E. Lupton (U.S. Air Force), *On Space Warfare: A Space Power Doctrine* (Maxwell Air Force Base, AL: Air University Press, 1988), 14.

maintains a long-term satellite presence[34]. Third, for a state to be considered a space power it is expected that it has the economic resources needed to sustain a sizable satellite presence. If a state does not have the resources needed to launch multiple satellites at frequent intervals, its influence and prestige in space will dwindle[35]. To summarise, for a state to be considered a space power, it must exemplify all of these three space power factors and variables. A spacefaring state that exhibits these three factors will demonstrate the qualities needed to conduct and maintain its power in outer space by means of a long-term satellite presence, thus becoming a true space power.

A set of three variables including strategic, political, and economic factors that make a space power will be examined in this thesis as dependent variables to assess the space strategy, political leadership and support, and economic resources of the United States, Soviet Union, and Canada during the Cold War. By analyzing these variables, this thesis will be better able to examine the aptitude of a spacefaring state to conduct and sustain multiple satellites in orbit.

For the purpose of this thesis, the 'space strategy' of space power that will be used as the strategic variable to analyze the United States, Soviet Union, and Canada during the Cold War will be measured by the number and context of declassified strategic space documents created by the central governments. Although an average state may publish one or two strategic space documents once in a generation, a state that can publish one or more articles of strategy regarding space over a decade illustrates a clear engagement with conducting multiple national space activities[36]. It can be surmised that a space power will deploy a number of government space documents to efficiently manage national space activities among the civilian, industry, and military organizations with a common objective. More strategic space documents published over a period of time, in the context

[34] David E. Lupton (U.S. Air Force), op. cit., 30.
[35] M. V. Smith, *Ten Propositions Regarding Space Power* (Maxwell Air Force Base, AB: Air University Press, 2006), 14-15.
[36] David E. Lupton (U.S. Air Force), op. cit., 14; Nayef R. F. Al-Rodhan, op. cit. 22.

of this thesis, will equate a greater capacity of a country to conduct frequent space operations; insofar as more government direction is provided by national authorities on what exact national interests its space organizations are expected to guarantee. In addition, more documents will signal a greater understanding by a country of the strategic objectives that it wishes to achieve through engagement with the space domain[37]. As a space power wishes to maintain an influence in space, its strategic objectives as articulated through its published space documents should remain consistent in their messaging.

The 'strategic variable' of space power will also encompass the diversity and number space-based capabilities owned by the spacefaring states of the United States, Soviet Union, and Canada. More space-based capabilities – ranging from communication, imagery, intelligence, meteorological, reconnaissance and offensive proficiencies – implies two suppositions for assessing space power. First, having more space-based capabilities in the orbits amounts to a state owning more operational satellites in space (as satellites from the beginning of the Space Age to the end of the Cold War could only accommodate one on-board capability at any one time). Second, more space-based capabilities owned by a state demonstrates an acceptance by a spacefaring state's government of specific technologies (for example, if a state only advocates the use of satellites to gather weather measurements, it would presumably not have offensive or reconnaissance satellites). Considering these two points, a spacefaring state which is considered a space power would opt to own a range of space-based capabilities rather than a select few capabilities when accommodating its influence and power in the upper atmospheres[38]. While a state with a passing interest in space may possess one or two space-based capabilities, a space

[37] Nayef R. F. Al-Rodhan, op. cit., 22.
[38] David E. Lupton (U.S. Air Force), op. cit., 14.

power, whose influence and prestige in the orbits is derived from a strong technological presence in the region, is likely to possess a multi-faceted space-based capability[39].

The 'political variable' of space power that will be examined in this thesis will include an appraisal of the positions articulated by political leaders of a spacefaring state and their consideration of outer space to be a mandated issue in their government's platform. It may be argued that this variable, for the purposes of this thesis, could also be considered a strategic, rather than a political, variable. For a political leader who does not consider space to be a mandated political issue, he/she is less likely to have an interest in approving national space activities during their tenure[40]. Whether in domestic or international institutions (like in North American Aerospace Defense Command (NORAD) or the United Nations (UN)), a political leader who does not see the space environment as a mandated issue will not seek to make advances in space legislation or negotiate a stronger position for his/her country in the upper atmospheres[41]. Instead, political interest (and, by association, government resources), will be allocated toward political issues that they feel more personable addressing[42]. Furthermore, if political leaders continually disregard space as a mandate issue, it is more likely that a state will become detached politically from conducting future space operations[43]. For a spacefaring state to be considered a space power, political leaders must have a consistent and ongoing political interest in exploiting space per their country's national interest. In the context of this thesis, if a political leader of a spacefaring state communicated an explicit political interest in utilizing space, it would be more likely that their

[39] Jon Sumida, "Old Thoughts, New Problems: Mahan and the Consideration of Spacepower," in *Towards a Theory of Space Power: Selected Essay*, ed. By Charles D. Lutes and Peter L. Hays (Washington, D.C.: Institute for National Strategic Studies, 2003), 12.
[40] Robie I. Samanta Roy, "Political challenges of space strategy," in *Space Strategy in the 21st Century: Theory and Policy*, ed. By Eligar Sadeh (New York, NY: Routledge, 2013), 40-41.
[41] Ibid, 41.
[42] Ibid.
[43] Jon Sumida, op. cit., 12.

state would develop into a space power that was committed to conducting more national space activities.

Lastly, the 'economic variable' that will be used in this thesis to assess space power will be attributed to the number of successful satellite launches and the total dollars allocated to a spacefaring state's space budget. These two measurements will be employed to analyze space power of the United States, Soviet Union and Canada for a number of reasons. While the total space budget of a state may demonstrate a state's competency to conduct frequent national space activities over a period of time, a state just as easily can keep its space program inactive or divert funds toward developing ground-based technologies (such as like astronomical observatories or planetariums) or toward organizational logistics (such as facilities, maintenance, personnel etc.).

Table 1.1: Synopsis of Strategic, Political, and Economic Factors and Variables of Space Power

Factors of Space Power	**Variables of Space Power**
Strategic Factor of Space Power ➢ Does spacefaring state have a strategic direction for conducting national space activities in space?	Strategic Variables of Space Power ➢ Number and content of declassified strategic space documents created by government. ➢ Quantity of space-based capabilities owned by a spacefaring state. ➢ Political leaders who considered outer space a mandated issue' during their term(s).
Political Factor of Space Power ➢ Does spacefaring state have political leadership that guides all relevant civilian, industry, and military space organizations and space operations?	Political Variables of Space Power ➢ Political leaders who considered outer space a 'mandated issue' during their terms(s). ➢ Consistency and content of domestic or international space legislation created.
Economic Factor of Space Power ➢ Does spacefaring state have economic resources to support national space activities?	Economic Variables of Space Power ➢ Number of national satellite launches. ➢ Total space budget per year.

Alternatively, a state may, over a period of time, launch multiple satellites but, without a sufficient annual space budget, will not be able to maintain the frequency of launches expected of a space power. One or two satellites launched over a decade does not delineate a space power[44].

[44] David E. Lupton, op. cit., 16.

For instance, North Korea's 2016 Kwangmyŏngsŏng-4 has been qualified as the final satellite to be launched by the embargo-stricken nation for at least the next decade, hence North Korea cannot be considered a space power because its material presence in the region will be gone in the next few years[45]. To summarise, a larger space budget coupled with more satellite launches exemplifies the ability of a space power to conduct and maintain multiple satellite in orbit, and, in the process, guarantees a lengthier technological presence in the upper atmospheres.

Using the strategic, political, and economic space power variables to identify a space power, the thesis will analyze these variables with respect to the United States, Soviet Union, and Canada from the late 1950s to the early 1990s. In the context of this thesis, the United States and the Soviet Union/Russia from 1957 to 1991 will be identified as the "great space powers". This time period has been identified because these – from the launch of Sputnik I on October 4, 1957 that beckoned the beginning of the Space Age to the collapse of the Soviet Union which signalled the end of the Cold War – mark when the United States and Soviet Union both held the "incontestable…[and] unchallengeable space superiority" within the terrestrial orbits over all other terrestrial actors[46]. Indeed, the reality of the Cold War resulted in these two superpowers continually competing against one another for national prestige and influence within the space environment. As Everett C. Dolman eloquently describes, "[t]he Heavens [became] dominated by two global titans…fighting for absolute control of the orbits"[47]. The relationship of this competition between these two spacefaring states also resulted in a level of "orbital domination" which made exploitation of space "difficult or near impossible" for other states wishing to enter

[45] David Wright, "North Korea is launching a rocket soon: what do we know about it?" *Union of Concerned Scientists*, February 2016; Joan Jonson-Freese, *Space Warfare in the 21st Century: Arming the Heavens* (New York, NY: Routledge, 2017), 47.
[46] James Clay Moltz, op. cit., 86.
[47] Everett C. Dolman, *Astropolitik: Classical Geopolitics in the Space Age* (New York, NY: Routledge, 2001), 18.

the domain[48]. Indeed, the unprecedented dominance of the United States and Soviet Union in space – coupled with the exclusivity these states shared as the sole proprietors of the space environment – have delineated the two states as the "original space powers"[49]. Following the end of the Cold War, these states came to represent the indisputable great space powers of the 20th century, thereby setting the theoretical precedent for understanding how other emerging spacefaring states can themselves become space powers.

This thesis will also examine the Canadian context from September 28, 1962 to January 16, 1991. This period is imperative in evaluating Canada's strategic space policy as it extends to two separate chronological events that seemingly revolutionized the nature of Canadian national space operations: the initial launch of Alouette I into the ionosphere and the commencement of "Operation Friction" during the 1991 Persian Gulf War[50]. With the launch of Alouette I, Canada became the third nation to launch a satellite into the upper atmosphere; thus allowing Canada the option to develop into an influential space power. Likewise, it was following Operation Friction that Canadian "defence…and political leadership [noticed] CAF's near outright dependency on space assets" – resulting in the initiation of procedures that would seek to "modernize" Canada's national space activities[51]. Operation Friction was also significant for Canada's national space operations as it was recognized by those working on the mission that the country had "a problem" prior to 1991 that had afflicted the management of national space activities[52]. A comparative analysis of this period, which spans several decades of Canadian interests in the space domain,

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[48] Everett C. Dolman, op. cit., 19.
[49] Andrew B. Godefroy, op. cit., November 1999, 1; M. V. Smith, op. cit., 15.
[50] Rob Huebert, "Canada and Commercial Satellite Imagery: Technology in Search of a Foreign Policy," in *Commercial Satellite Imagery and United Nations Peacekeeping: A View From Above*, ed. By James F. Keeley and Rob Huebert (Aldershot, U.K.: Ashgate Publishing Company, 2004), 195; Andrew B. Godefroy, op. cit., 7; Joshua Kutryk, op. cit., 5.
[51] Joshua Kutryk, op. cit., 5-6.
[52] Anonymous (Department of National Defence Employee), Interviewed by Kiernan McClelland, *Research Interview*, September 25, 2016.

with the national space activities of great space powers will enable a better examination for what was lack in Canada's approach to space and how it impacted Canada's progression into a space power during the Cold War.

To further test the hypothesis that Canada was unable to develop into a space power in the same way as the United States and Soviet Union during the Cold War, this thesis will examine the space power variables of strategic, political, and economic factors by analyzing government documents of the first three spacefaring states (United States, Soviet Union, and Canada). These sources will include declassified government space policy documents, government memos, and political memorandums from the United States, Soviet Union/Russia, and Canada. The information detailing the national space activities of the United States and (to a lesser extent) the Soviet Union/Russia are more available and accessible to the public. The information that this thesis will consider, which details the great space powers' national space activities from the beginning of the Space Age to the end of the Cold War, has been published and verified over the decades by several highly respected texts[53]. Finding declassified information on Canada's national space activities is more difficult. The lack of available literature coupled with the restricted access to government space documents makes researching civilian and military space operations a struggle, even for a Canadian living in Canada. Noting these difficulties, the author has examined documents from Libraries and Archives Canada and the Department of National Defence library. Ranging from scientific briefings on ionospheric satellites to national space security documents on communication satellites, the research conducted in Ottawa has provided invaluable insights into the overlooked history of Canada's strategic ambitions within the space environment.

[53] Walter A. McDougall, *...the Heavens and the Earth: A Political History of the Space Age* (New York, NY: Basic Books, 1985); Benjamin S. Lambeth, *Mastering the Ultimate High Ground: Next Steps in the Military Uses of Space* (Santa Monica, CA: RAND, 2003); Bert Chapman, *Space Warfare and Defense: A Historical Encyclopedia and Reference Guide* (Santa Barbara, CA: ABC-Clio, 2008).

This thesis also makes extensive use of interviews with members of the Canadian Space Agency, Departments of National Defence, Transportation, and Innovation, Science, and Economic Development who were either involved with Canada's national space activities during the Cold War or who have a firm understanding of what had happened during that period. Having received accreditation from the University of Calgary's Conjoint Faculties Research Ethics Board (CFREB), interview participants were asked to voluntarily discuss their experiences and knowledge of Canadian national space activities from 1962 to 1991. The interview participants were also asked to elaborate on the likelihood of Canada becoming a space power in the 21st century and to discuss and elaborate on challenges that Canada's civilian and military space organizations have faced in the past. As several interview participants included members currently employed by the Federal Government, participants were provided with the option to invoke the "Chatham House Rule"; whereby the information from their interviews would be used in the thesis on the condition that they remained anonymous or were given a pseudonym. While their departments were revealed, their positions remained unidentified. Moreover, interview participants were informed that this thesis would not use information subject to classification rules and, in the event that sensitive information was inadvertently shared, that any information deemed potentially classified would be stricken from the interviewer's written record.

1.5 Why Study Canada's Strategic Space Policy during the Cold War

Although the immediate answer to why the study of Canada's space strategy is needed may seem to be "because space is cool", a comprehensive evaluation of Canada's strategic space policy during the Cold War is needed for a number of reasons. First and foremost, there are few theoretical additions that contemplate the relationship between Canada and its strategic application of space power during the Cold War. At the time of writing, only four academic books exist that group

theoretical considerations of space power with the implementation of Canada's national space activities since the beginning of the Space Age[54]. These books either present the space power relationship through the lens of a particular aerospace technology or through a much broader theoretical scope that considers space power to be secondary to the more developed theories of military and national power. None of these books analyzes the great space powers and asks why they were successful in developing into space powers whereas Canada, despite first entering space around the same time, was not. For example, Fergusson's academic contributions to the literature (considered to be Canada's leading "space expert") is comprised of contextual debate surrounding the employment of a unique offensive space technology, space-based ballistic missile defences, whose impact on the strategic application of space is small given the scope of Canadian space operations during the Cold War. Alternatively, Sloan presents space power in the theoretical context through a much broader lens without looking explicitly at the development of Canada as a space power. Last but not least, Godefroy and Huebert both provide an informative overview of national civilian and military space activities but refrain from devolving more into the theoretical limitations of Canada as a space power among spacefaring states. While these texts provide important additions to space power literature, they do not serve to answer the questions surrounding why Canada was unsuccessful in implementing its space power strategy following the 1966 Chapman Report despite the United States and Soviet Union being successful in their efforts to develop into space powers during the Cold War. By means of using variables of space power to analyze the similarities and differences between Canada and the great space powers from the 1950s

[54] Elinor C. Sloan, *The Revolution in Military Affairs* (Kingston, ON: McGill-Queen's University Press, 2002); James F. Keeley and Rob Huebert, *Commercial Satellite Imagery and United Nations Peacekeeping: A View From Above* (Aldershot, U.K.: Ashgate Publishing Company, 2004); James G. Fergusson, *Canada and Ballistic Missile Defence, 1954-2009: Déjà vu All Over Again* (Vancouver, BC: UBC Press, 2010); Andrew B. Godefroy, *Defence and Discovery: Canada's Military Space Program*, 1945-74 (Vancouver, BC: UBC Press, 2011).

to early 1990s, this thesis will do what no other academic work has examined before it: to determine what happened to Canada's strategic space policy that made it ineffective during the formative years of the Space Age.

By better understanding Canada's strategic space policy during the Cold War, this thesis will also provide an important addition to the growing academic literature that considers the strategic application of outer space by spacefaring states. Within academia, this is not only a question of 'why' a state may wish to become a space power but also explains 'how' a state may become a space power and maintain its influence among other states within the space environment. This thesis will provide a solid contribution to space power theory that discusses the various challenges that face middle powers who seek to become space powers within the international system through an analysis of the strategic, political, and economic variables affecting the development as a space power. Correspondingly, by analyzing why the United States and Soviet Union developed into space powers – and, conversely, why Canada was unable to do the same – this thesis will concentrate on the empirical evidence currently published on space power and will add new information that elaborates on why some of the most technologically-advanced states in the world continue to have a limited presence within one of the most important areas of operations humankind has ever occupied.

As Canada has entered the 21st century with a narrow policy-making framework for national space activities, this thesis will provide a suitable analytical reference for policy-makers wishing to understand the historical caveats that have impacted Canada's strategic space policy in the past. By assessing what the great space powers 'did right' when conducting space operations during the Cold War – and, alternatively, assess what Canada 'did not do' during the period – the thesis will be able to highlight certain factors that have impacted the ability of the country to

maintain a long-term presence in space and, in the process, become a space power. This thesis will also address the question of the Canadian Forces' expanded role in outer space presented in the *Defence Policy Review Public Consultation Document*: that "[i]n light of the importance of – and threats to – outer space, should Canada develop the means to protect its satellites and space capabilities…from attack?"[55]. Supplementing a lack of public government documents currently published on space-based threats against Canadian satellites, this thesis will outline a possible direction that will allow Canada to better protect its space assets from the deluge of terrestrial and space-based threats that now exist within the 21st century security environment. The conclusions reached in this thesis may therefore furnish Canadian policymakers with a greater understanding of the strategic, political, and economic complexities surrounding the administration of national space activities and suggest a means of better directing successful space operations in the future.

1.6 Chapter Summary

This thesis will be divided into five chapters (in addition to the ongoing first chapter) in order to determine why Canada has the strategic space policy it does in the 21st century despite being among the first countries to enter outer space at the beginning of the Space Age. The remaining chapters are concerned with providing the reader with a comprehensive understanding of theoretical space power and how space power is gauged, and an analysis of the strategic, political, and economic space power variables that impacted the United States, Soviet Union, and Canada during the Cold War.

The second chapter will examine the strategic thought on space power. It will present an overview of the theoretical background of space power theory, the topographical factors of the outer space, and the technological characteristics of artificial satellites. In closing, the chapter will

[55] Department of National Defence, op. cit., 22.

provide a clear review of what characteristics a spacefaring state considered to be a space power is likely to demonstrate. The core objective of this chapter will be to provide a rationalization for selecting the theory of space power used in this thesis. The chapter will further reinforce the use of the strategic, political, and economic space power variables delineating space power to analyze the ability of the United States, Soviet Union, and Canada to effectively and efficiently install and maintain multiples satellites during the Cold War.

The third chapter will evaluate the major strategic, political, and economic factors that enabled the United States and Soviet Union/Russia to become great space powers in the 20th century space environment. This chapter will present a comprehensive analysis of the national space policies and strategies, the international and multilateral space agreements, and the financial resources dedicated to space projects sustained by each superpower between 1957 and 1991. Following this analysis, the chapter will compare and discuss the space power variable similarities shared between the great space powers which enabled them to progressively increase and sustain a long-term satellite presence in outer space.

In the fourth chapter, the major strategic, political, and economic factors that affected Canada's national space activities following the launch of Alouette I in September 29, 1962 will be analyzed. This chapter will present a comprehensive analysis of Canada's national space policies and strategies, membership in international and multilateral space agreements, and financial resources dedicated to space projects between September 29, 1962 and January 16, 1991. Like the previous chapter, the fourth chapter will present the strategic, political, and economic factors that influenced the capacity of the nation to commit to national space activities following the launch of Alouette I. This chapter will conclude that, considering the space power variables manifested by the country between 1962 and 1991, Canada was never in a position to sustain the

launch of multiple artificial satellites as a means of increasing its national power and prestige in space. By presenting the framework for understanding Canada's strategic, political, and economic space power variables during the Cold War, this thesis will now have the analytical resources needed to compare the space power variables of Canada with the space power variables of the great space powers.

The fifth chapter will produce a comparative assessment of the space power variables manifested by Canada and the United States and Soviet Union from the start of the Space Age to the end of the Cold War. Specifically, the chapter will highlight explicit strategic, political, and economic variables – such as the number and content of strategic space documents and space-based capabilities, political support, and total space budget resources and operational satellites – that differ between Canada and the great space powers. By analyzing and elaborating on these differences, this chapter will explain why Canada does not follow the space power variables exemplified by the United States and Soviet Union during the Cold War. In the context of this thesis, Chapter 5 will forward what the great space powers 'did right' in their quest to install a long-standing satellite presence in space and, more pointy, what Canada 'did wrong' or 'did not do' during the Cold War which impacted its capability to launch multiple satellites into the upper atmospheres. Given the 1966 Chapman Report's strategic recommendations that emphasized a national space launch capability committed to frequent national space activities, the chapter will identify the sources that effected Canada's strategic space policy, from the successful launch of Alouette I in 1962 to the end of the Cold War in 1991.

The sixth chapter will provide a comprehensive summary of the core findings of this thesis. Furthermore, Chapter 6 will elaborate on the potential domestic and international ramifications of this study and potential avenues for future research looking at Canada and space power.

Chapter 2: Power in Space: Intellectualizing National Outer Space Activities through Space Power

2.1 Introduction

While the notion of the boundaries of outer space has existed since man has contemplated the heavens, there have been numerous attempts in the modern era to conceptualize a single comprehensive theory of space power following the launch into outer space of Sputnik I in 1957[56]. While past commentators assumed the overall strategic utility of outer space, they often disagreed with how space could be exploited for a state's national interest[57]. Indeed, as Colin S. Gray notes, space power had been "approached as [everything from] science, as science fiction, as engineering, [and] as human drama"[58]. Without a doubt, the definitive irony of the theoretical study of space power is that it has been approached "as almost everything except what it is most truly: the military exploitation of a new geographical medium, a medium that needs to be understood on its own technical, tactical, and operational terms"[59]. The long-standing result of this misinterpretation of space power theory has evidently subdued the professional literature published on topics regarding the strategic application of outer space and, correspondingly, has resulted in the academic literature on space power remaining in a state of underdeveloped infancy.

The primary explanation for why space power has lagged behind other theories of military power is because of the absence of a clear "founding father or mother": that is, an individual whose contributions to the theoretical study of space power has had a lasting influence on all subsequent space power theories. As Elinor C. Sloan remarks, "[space power] has no big personality [who]

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[56] Paul B. Stares, *The Militarization of Space: U.S. Policy, 1945-1984* (Ithaca, NY: Cornell University Press, 1985), 63-64; Rip Bulkeley and Graham Spinardi, *Space Weapons: Deterrence or Delusion* (Cambridge, U.K.: Polity Press, 1986), 11; Nayef R. F. Al-Rodhan, *Meta-Geopolitics of Outer Space: An Analysis of Space Power, Security and Governance* (Oxford, U.K.: Palgrave-MacMillian, 2012), 20.
[57] Elinor C. Sloan, *Modern Military Strategy: An Introduction* (New York, NY: Routledge, 2012), 118.
[58] Colin Gray, *Modern Strategy* (Oxford, U.K.: Oxford University Press, 1999), 254.
[59] Ibid, 254-255.

directed the development of a common space power theory…like a Clausewitz, or a Mahan, or a Douhet for their respective fields"[60]. Moreover, unlike strategic thinkers focusing on theories of the other, more developed traditional military powers, space power theorists have often disagreed on the core descriptive characteristics that quantify not just why a state may wish to become a space power but how a state guarantees its national interests within the space environment. Some space power theorists, like James E. Oberg and Norman Friedman, forward space power as an flexible concept that states "choose to participate within" but fundamentally "[is not] necessarily needed for the allocation of national influence and prestige."[61]. Alternatively, other space theorists, such as Benjamin S. Lambeth, have argued that only those states who "actively participate in the militarization of outer space" can successfully guarantee their strategic interests within the terrestrial orbits[62]. Worse yet, the attachment between the space environment and science fiction media has often debased the theoretical interpretation of space power as something more fantastical than it really is (most famously, the allegation that the Galactic Empire's "Death Star" from the *Star Wars: A New Hope* is the zenith of space power)[63]. The result of these varying opinions, compounded by the absence of any theoretical touchstone for the discipline and the little empirical evidence available to aspiring theorists, has left the study of space power in a state of constant debilitating change[64].

This chapter examines the strategic thought on space power. It begins by discussing the theoretical background of space power theory by underlining the academic contributions of a

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[60] Elinor C. Sloan, Interview by Kiernan McClelland, *Research Interview*, September 29, 2016.
[61] James E. Oberg (U.S. Air Force), *Space Power Theory* (Colorado Springs, CO: U.S. Air Force Academy, 1999), 118; Norman Friedman, *Seapower and Space* (London, U.K.: Chatham Publishing, 2000), 298.
[62] Benjamin S. Lambeth, *Mastering the Ultimate High Ground: Next Steps in Military Uses of Space* (Santa Monica, CA: RAND, 2003), 98.
[63] Paul Schrodt, "A NASA engineer explains how you would build a Death Star in real life," *Business Insider*, December 2015: A prime case of space power being conceptualized in terms of science fiction was NASA's attempt to determine the logistics of building an operational "Death Star".
[64] Elinor C. Sloan, op. cit. (2012), 111.

number of key theorists such as Dr. Wernher von Braun, Klaus Knorr, and the space doctrine schools of strategic thought that emerged following the 1983 announcement of the American Strategic Defense Initiative (SDI). All explain why and how states would seek to use national space activities to guarantee their national interests within outer space. This chapter then outlines the unique topographical features of the terrestrial orbits and characteristics of satellite technologies which influence the capacity of states to project power within the upper atmospheres. The chapter concludes by providing a clear review of what space power is and what characteristics a spacefaring state which is considered a space power is likely to demonstrate in its continuous pursuit to enter and exploit outer space.

In the first chapter, the author presented a conceptualization of space power which described the theory as the ability of a state to efficiently install and preserve its influence and prestige in the space environment. For a state to develop into a space power, it was forwarded that it had to be capable of manipulating the upper atmospheres, in accordance to its national will, through the application of a lasting material presence in the upper atmospheres. Only by controlling vast swaths of orbital space via the use of satellites could a state guarantee that its national interests would be preserved in the region. The three strategic, political, and economic space power variables presented in the first chapter to analyze the national space activities of the United States, Russia, and Canada during the 20th century – which would, in turn, allow a country the strategic direction, political support, and economic resources needed to commit to multiple space excursions – reaffirms this line of thinking regarding the conceptualization of space power. But why is this conceptualization of space power utilized in the thesis despite the empirical issues connected to understanding the concept? In a way, the theoretical background of space power theory, compounded by the topographical characteristics of space and the technological

characteristics of satellites, supports the interpretation that space power is the ability of spacefaring states to use their space assets to frequently enter and inhabit vast regions of space. As such, the core objective of this chapter in the context of the thesis is to present the factual rationalization for developing the three space power variables to assess the strategic space policies of Canada and the great space powers from the beginning of the Space Age to the end of the Cold War period.

2.2 The Theoretical Background of Space Power

Serious discussions surrounding the strategic applications of outer space began to be considered by the academic community following the publication of Dr. Wernher von Braun's "Crossing the Last Frontier" article published in the "Space Flight" issue of *Collier's* magazine in 1952[65]. As one of the Nazi Germany's foremost rocket scientists responsible for the development of the V-2 ballistic rockets, von Braun captivated both the American public and military by discussing the utility of developing an orbital space station and bomb platform capable of launching "[s]mall winged rocket missiles with atomic warheads" onto "any spot on earth"[66]. Supplementing this capability, von Braun's space station was labelled as possessing "telescopic eyes and cameras", making it "almost impossible for any nation to hide warlike preparations for any length of time"[67]. As a "watch dog for peace", von Braun asserted that his system would provide constant surveillance from "above the heavens" and respond to any "threat to peace" with a pre-emptive orbital strike.

As the abstract progenitor of space power, the "Crossing the Last Frontier" article is influential insofar as it established for the first time the original concept of what a space power should be and do. As von Braun alleged, if a state wishes to become a space power it is paramount

[65] Wernher von Braun, "Crossing the Last Frontier," *Collier's*, March 1952.
[66] Ibid, 2.
[67] Ibid, 3.

that it control space, unchallenged. The ability to disrupt and destroy "with absolute certainty…any enemy spacecraft prior to its launching...[and] any ground forces" became a vital characteristic of this early interpretation of space power[68]. The importance of utilizing artificial technologies capable of guaranteeing "the complete subjugation…domination, and freedom of action" in space was also considered, for the first time, as an inherent characteristic of a space power[69]. Yet, it is important to note that this characteristic, according to von Braun's interpretation of the space power, didn't necessarily mean the proliferation of space weapons. If a state was capable of deploying even one satellite, it was considered a space power. For the purpose of this discussion, von Braun's interpretation had the long-lasting effect on the origins of space power by firmly grounding the study on a hard power ethos; states characteristically had to dominate and pursue aggressive strategies centered on directly combating rival states in space with limited space technologies if it were to guarantee its national objectives in the domain.

Despite its promising qualities, the primary weakness of von Braun's interpretation of space power was that it was very idealistic insofar as it was formulated during a period when national space activities were still a few decades from being actualized. The reality of 1954 was that rocket propulsion had not reached the quality that would be needed to place technologies into outer space[70]. Von Braun presented his interpretation of space power knowing these limitations. Written from the perspective of one hypothesizing the future of space, von Braun took many liberties in presenting his theory of space power. Having willingly joined the Nationalist Socialist Party to pursue his research in 1937, von Braun's space power theory was influenced heavily by

[68] Wernher von Braun, op. cit., 3.
[69] Ibid.
[70] Douglas Aircraft Company Inc., "Preliminary Design of an Experiment World Circling Spaceship," *Abstract SM-11827*, May 1946.

his "expectations [during] the Second World War"[71]. During the Second World War, von Braun had been entrusted to develop a weapon that would have been capable of bombing the Allied Powers into submission[72]. It is appropriate, then, that von Braun's conceptualization of space power reflected an emphasis on utilizing artificial technologies for purely offensive actions against targets located on the ground and in the space environment, similar in many respects to the function of the V-2. Moreover, von Braun's faith in a "Wunderwaffe" to win the Second World War drove his affirmation that only a single space station should ever be deployed by a spacefaring state[73]. Fundamentally, von Braun's interpretation of space power was not grounded on any definite evidence of state decorum within space; it was ultimately constructed on a set of wartime assumptions when space technology development was at its early inception. Nonetheless, von Braun's contribution to space power was important as it created an original reference for measuring future interpretations of theoretical space power as articulated throughout the 20th century space environment. A space power, according to the von Braun interpretation, could be any spacefaring state with the ability to occupy and hold sectors of the terrestrial orbits with national space technologies whilst actively denying the use of space to rival states. The stronger, technologically-advanced state would therefore dominate the space environment, whereas the weaker, technologically-advanced state would simply remain an observer of space activities from Earth.

With the beginning of the Space Age, von Braun's interpretation of a space power built on a hard power ethos was gradually replaced as a reputable concept of strategic thought. The aftermath of Sputnik I confirmed the difficulties in developing and deploying complex space technologies on the scale of von Braun's space station. There was also a sudden international

[71] Wayne Biddle, *Dark Side of the Moon: Wernher von Braun, the Third Reich, and the Space Race* (New York, NY: W. W. Norton & Company, 2009), 22.
[72] Michael J. Neufeld, "Wernher von Braun's ultimate weapon," *Bulletin of the Atomic Scientists* 63.4 (2007), 51.
[73] Rip Bulkeley and Graham Spinardi, op. cit., 12; Ibid.

epiphany about the inherent dangers of a militarized space environment in the volatile reality of the Cold War[74]. As then Senator Lyndon B. Johnson declared, there were inherent "challenges to global security…in going to space" despite the realization that "whoever controls space controls the world"[75]. For example, if a state opted to combat rival states in space, as von Braun advised, there could be severe consequences which could damage the "international reputation of the [spacefaring] state" or "the ability of the [state] to operate in [the upper atmospheres]"[76]. In the context of the Cold War, there were serious anxieties on both sides of the Iron Curtain over the escalation to a nuclear conflict over the destruction of the superpower's satellites[77]. This resulted in two political influences that effectively delegitimized von Braun's theoretical interpretation of space power: the implementation of President Eisenhower's "New Look Strategy" in 1953 and the ratification of the Outer Space Treaty (OST) in 1967. In brief, Eisenhower's "New Look Strategy" disregarded the allocation of complex offensive space technologies – as forwarded by von Braun's space power theory – and instead emphasized the need to develop cheaper technologies that would not provoke tensions to gain strategic benefits in space[78]. The answer would be the development of non-offensive systems that could occupy and deny orbital space without risking the purposeful destruction of opposing satellites[79]. Correspondingly, the OST, particularly Article IV (2) of the "No Bomb in Orbit" provision of the treaty, successfully outlawed von Braun's space station and established space as a domain that should be used "for peaceful purposes"[80]. The passage of the

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[74] Rip Bulkeley and Graham Spinardi, op. cit., 11-12.
[75] British Broadcast Corporation (BBC), "Q&A: Sputnik", *BBC*, October 2007; Michael J. Neufeld, op. cit., 56; Nayef R. F. Al-Rodhan, op. cit., 20.
[76] Wayne Biddle, op. cit., 75.
[77] Matt Bille and Erika Lishock, *The First Space Race: Launching the World's First Satellites* (College Station, TX: Texas A&M University Press, 2004), 13.
[78] Michael J. Neufeld, op. cit., 57; Yanek Mieczkowski, *Eisenhower's Sputnik Moment: The Race for Space and World Prestige* (Ithaca, NY: Cornell University Press, 2013), 27.
[79] Yanek Mieczkowski, op. cit., 28.
[80] Ogunsola O. Ogunbanwo, *International Law and Outer Space Activities* (The Hague, Netherlands: Martinus Nijhoff, 1975), 91-92.

treaty further enforced the expenditure of non-offensive systems over offensive systems and a commitment to "mutual toleration" in space[81]. It may be concluded, then, that the legacy of these political influences had a lasting effect on space power, as von Braun's hard power interpretation was slowly disregarded from all future strategic discussions of the concept.

Around the same time that von Braun's interpretation of space power began to lose favour as a viable policy option with the Eisenhower Administration following the ratification of the OST, the principal characteristics of a space power theory were to again being theorized within academic circles. After the OST, aspiring space power theorists were left with a contextual dilemma – *what would space power look like in a world where the denial of space operations by rival states was extremely unlikely because of the likelihood of a nuclear confrontation?* The answer was to develop space power theory away from states using offensive space technologies, as advocated by von Braun's space station (which, at the time, was a project deemed science fiction), to the development and utilization of multiple non-offensive space technologies as a measure of potential space power[82]. This development is credited to Klaus Knorr's 1964 "On the International Implications of Outer Space" lecture in which Knorr suggested that space – as "an area of…strategic importance" – must be exploited by artificial technologies in order to guarantee national interest and prestige[83] According to Knorr's interpretation of space power, a state that wished to become a space power had to hold "absolute control" in orbit in order to guarantee its national power[84]. In this respect, Knorr summarized the basic theoretical explanation for why a state may wish to become a space power. Similar to the theoretical interpretation of space power

[81] Michael E. O'Hanlon, op. cit., 2.
[82] Nayef R. F. Al-Rodhan, op. cit., 20-21
[83] Michael Sheen, *The International Politics of Space* (Oxford, U.K.: Routledge, 2007), 113-134: The lecture, including Klaus Knorr's first mention of space power in his academic presentation, are recounted in Sheen's book.
[84] Ibid.

presented by von Braun in the early 1950s, Knorr's interpretation had established the overall theoretical characteristics that space powers were fundamentally concerned with the geopolitical region of space because outer space was demarcated by an overall sense of national interest which could greatly benefit any state. In addition, Knorr's interpretation was important for the development of theoretical space power because it diverged from von Braun's theory on several key points. First and foremost, Knorr's space power theory established not just the fundamental motivation of space powers, but the external conditions which defined the behaviour of states within the international system that sought to become space powers. The political influences of the "New Look Strategy" and OST, when matched with Knorr's interpretation, contributed to space power becoming considered in terms of "soft power": a method of guaranteeing national power through passive, noncoercive action within a "peaceful, nonconfrontational" space environment[85]. As commentators have suggested, the acceptance of Knorr's interpretation influenced the theoretical correlation between space power and the deployment of non-combative technologies such as commercial satellites, space shuttles, and scientific probes[86]. As articulated in Knorr's lecture, the deployment of non-combative technologies allowed states to promote a nonconfrontational space environment while providing for the maintenance of their "strategic nuclear stability and… national strategic influence in outer space"[87]. As these factors supported the "peaceful principles" outlined in the "New Look Strategy" and OST, they were almost immediately implemented into the study of space power. As space powers gathered national

[85] Albert D. Wheelon, "The Civilian Uses of Space," in *Seeking Stability in Space: Anti-Satellite Weapons And The Evolving Space Regime*, ed. By Joseph S. Nye, Jr. and James A. Schear (Lanham, MA: University Press of America, 1987), 141; James E. Oberg, (U.S. Air Force), op. cit., 136; James Clay Moltz, *The Politics of Space Security: Strategic Restraint and the Pursuit of National Interests* (Stanford, CA: Stanford University Press, 2011) , 25.
[86] Albert D. Wheelon, op. cit., 141-142; Michael Gleason and John M. Logsdon, "The Civil Sector," in *Space and Defense Policy*, ed. By Damon Coletta and Frances T. Pilch (New York, NY: Routledge, 2009), 255.
[87] Walter A. McDougall, *…the Heavens and the Earth: A Political History of the Space Age* (New York, NY: Basic Books, 1985), 12; John J. Klein, op. cit., 35.

interests but developed an aversion to the weaponization of space, the conceptualization of space power by von Braun became interchangeable with the strategy of launching the most satellites into the orbits. Translating from Knorr, the theoretical study of space power has therefore come to assume that a space power will balance its national power against its rivals through the utilization of soft power strategies, including the launching of multiple satellites into outer space.

With the announcement of the Strategic Defense Initiative (SDI) on March 23, 1983, the academic understanding of the theoretical application of space power was again altered. Whereas the academic discussion surrounding the strategic application of space power fluctuated during the years following the launch of Sputnik I, the single greatest influence leading to space power theory becoming a legitimate concept started with Reagan's deliberate commitment to the use of alternative, non-nuclear technologies in balancing the Soviet Union[88]. With the SDI, Reagan effectively recommitted the national space security strategy of the U.S – which had longed been characterized by "Mutually Assured Destruction" (MAD) – to a strategy that was firmly committed to the deployment of alternative technologies that would solidify a political disregard for MAD and would render nuclear weapons "impotent and obsolete"[89]. Supplementing this strategy, the proposal saw the renewed influence of offensive-over-defensive technologies in guaranteeing strategic objectives in space[90]. Although the use of ground-based anti-ballistic missile (ABM) defense has been cited as the objective of the SDI, the "Star Wars" announcement also suggested the use of space as a "battleground" that could guarantee "total dominance [for

[88] Frances Fitzgerald, *Way out there in the Blue: Reagan, Star Wars and the End of the Cold* War (New York, NY: Simon and Schuster, 2000), 157-159.
[89] Sidney D. Drell, Phillip J. Farley, and David Holloway, *The Reagan Strategic Defense Initiative: A Technical, Political, and Arms Control Assessment* (Cambridge, MA: Harper and Row Publishers, 1985), 101.
[90] Ibid, 39.

achieving]…strategic superiority" over the U.S.S.R[91]. All things considered, the governmental understanding of the strategic utility of space again shifted back to an explanation which was characteristic of von Braun's interpretation of the concept. Yet, contrasting the Eisenhower Administration's reaction to von Braun's concept in 1952, offensive space technologies coupled with a hard power ethos to space power were fundamentally supported by the Reagan Administration[92].

While the SDI consolidated the importance of space power, the definition of the term was again debated in academic communities. This debate effectively resulted in a clash between the two previously recognized interpretations of space power – between von Braun's hard power interpretation and Knorr's soft power interpretation. Nevertheless, the changing political atmosphere and technological advancements of satellites culminated in additional conceptions of space power being discussed[93]. During the years succeeding the announcement of the SDI, no less than four separate "schools of doctrinal thought" surrounding the theoretical application of space power were conceived: presented as the sanctuary, survivability, high-ground, and control schools respectively[94]. The academic literature from this period, as well as the literature published following the end of the Cold War and the 20th century, came to be grouped in one of these four broad categories.

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[91] Aspen Strategy Group (U.S.), *The Strategic Defense Initiative And American Security* (Lanham, MD: University Press of America, 1987), 18-19; Bhupendra Jasani, *Space Weapons and International Security* (New York, NY: Oxford University Press, 1987), 22.
[92] P. Edward Haley and Jack Merritt, "Introduction: Strategic Defense, Nuclear Deterrence, and Arms," in *Strategic Defense Initiative: Folly or Future?*, ed. By P. Edward Haley and Jack Merritt (Boulder, CO: Westview Press, 1986), 9; McGeorge Bundy, George F. Kennan, Robert S. McNamara, and Gerard Smith, "The President's Choice: Star Wars or Arms Control," in *Strategic Defense Initiative: Folly or Future?*, ed. By P. Edward Haley and Jack Merritt (Boulder, CO: Westview Press, 1986), 66-67.
[93] Nayef R. F. Al-Rodhan, op. cit., 20-21.
[94] Ibid, 29; Elinor C. Sloan, op. cit., 118.

Beginning with the "sanctuary school", it had been asserted by commentators that space power was exclusively concerned with the ability of a state to "see" within the "boundaries of sovereign states"[95]. For Robert Futrell, a space power was defined by the capacity of a state to use "space systems" to abide by future treaties, as "overflight through space" was and continues to be legal and, consequently, a means of acquiring strategic interest in space[96]. Other observers, like Albert D. Wheelon and Bhupendra Jasani, expanded on Futrell's argument by asserting that space power was guaranteed not just through the deployment of non-combative reconnaissance and surveillance satellites but also through the deployment of civilian satellites[97]. Through this commitment to non-combative technologies, the sanctuary school conceptualized space power in terms of preserving space as an environment that is (and should be) free of "war and weapons"[98].

Instead of relying on the legality of space systems to contribute a "sanctuary of all mankind", the "survivability school" was formulated to present the inherent vulnerability of satellites in space[99]. The survivability school of space power was founded on three assumptions: space systems were more vulnerable to "long-range weapon effects", satellite technologies could not rely on maneuverability to increase their survivability, and states didn't consider space intrinsic to national interest[100]. Rather, as Colin S. Gray presents, space power was complementary to national interest[101]. As such, the survivability school maintained that while space systems might exhibit some clear strategic advantages, they shouldn't be relied on too much given their apparent

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[95] David E. Lupton (U.S. Air Force), *On Space Warfare: A Space Power Doctrine* (Maxwell Air Force Base, AL: Air University Press, 1988), 30.
[96] Robert Frank Futrell, *Ideas, Concepts, Doctrine: Basic Thinking in the United States Air Force 1907-1960* (Maxwell Air Force Base, AL: Air University Press, 1989), 277-279.
[97] Bhupendra Jasani, op. cit., 54; Albert D. Wheelon, op. cit., 141.
[98] Walter A. McDougall, op. cit., 127.
[99] David E. Lupton (U.S. Air Force), op. cit., 30; Colin S. Gray, "The Influence of Space Power upon History," *Comparative Strategy* 15.4 (1996): 296; James E. Oberg, op. cit., 128-129.
[100] David E. Lupton (U.S. Air Force), op. cit., 30-31.
[101] Colin S. Gray, op. cit., 296.

weaknesses. Instead, a space power was created through a state's technological capacity to enter space. Joseph E. Graetch best summarizes this school of space power by stating that "the dependency placed on space systems is constrained by their survivability"[102].

Originating from the old axiom that the high ground dominates the battlespace, the "high ground school" was popularized following the SDI and became a defining influence of space power literature. The high ground school holds that the strategic superiority of space allows a state to impose its national interests across the world through the use of offensive space technologies. As reiterated by a majority of commentators, the "global-presence characteristic" of space coupled with "an offensive weapons capability" allows a space power the ability to delineate and deter "an adversary's aggressive actions" posed against it[103]. It is, therefore, essential that space powers develop and deploy offensive military technologies in space if they are wanting to guarantee their influence in orbit[104]. Considering this point, the high ground school holds that a state may only become a space power if it possesses the technological ability to produce a space weapon that challenges space-based or terrestrial targets.

The final school of doctrinal thought, the "control school", is unique as a theoretical interpretation because it formulated the value of space power "using air power and sea power analogies"[105]. Space power was thereby conceptualized as coequal to the characteristics of the terrestrial forms of power[106]. This is to argue, as General Thomas A. White asserts, that "[w]hoever has the capacity to control the air is in a position to exert control over the land and seas beneath [similar to] whoever has the capacity to control space will likewise possess the capacity to exert

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[102] Joseph E. Graetch, "Doctrine with a Legacy," *The Great Frontier* 2:292 (1985): 33.
[103] David E. Lupton (U.S. Air Force), op. cit., 31; John J Klein, *Space Warfare: Strategy, Principles, and Policy* (New York, NY: Routledge, 2006), 22.
[104] John J. Klein, op. cit., 22.
[105] Colin S. Gray, op. cit., 298.
[106] Colin S. Gray, op. cit., 301; James E. Oberg, op. cit., 135.

control over the surfaces of earth"[107]. Henceforth, the control school asserted that for a state to be considered a space power, it must be in control of space in addition to developing and deploying enough space technologies to hold the environment.

There are severe limitations associated with applying any one of these particular doctrinal schools to the theoretical study of space power. While all of the doctrinal schools have stimulated an academic discussion surrounding the theoretical application of space power, no one school establishes the exact characteristics that create a space power. Although technological capability is cited as a prerequisite of space power, the schools do not agree on how a state becomes and maintains its influence in orbit. This complication arises because of the importance of the past interpretations of space power on the formulation of the schools of thought. For example, the sanctuary school and the survivability school share the same emphasis on soft power stratagems as Knorr's strategy of launching non-combative, civilian satellites into space. Alternatively, the high ground and control schools support von Braun's hard power interpretation by accentuating the need to "fight for…[and] hold outer space" through deployment of offensive space technologies[108]. As John J. Klein asserts, this categorization of the schools has limited the utility of the definition of space power, as "each of these approaches [fail] to provide anything close to a strategic framework for dealing with the many broad and diverse concerns surrounding national interests in space"[109]. Spurred by the need to create an all-inclusive theory, but influenced by the categorization of the schools, the subsequent characterizations of space power published around

[107] Robert Frank Futrell, op. cit., 277-279: This passage originates from a speech given by Gen. Thomas A. White at a National Press Club meeting on November 29, 1957.
[108] David C. Hardesty (U.S. Navy), "Space-Based Weapons: Long-Term Strategic Implications and Alternatives," *Naval War College Review* 58.2 (2005): 46-47.
[109] John J. Klein, op. cit., 18.

the end of the century became too broad in scope[110]. Indeed, the attempts to create an all-inclusive theory had led to the greatest limitation of using these schools of thought to evaluate and measure space power. Because of the broadness of the strategic utility of space, the schools continuously disagreed on the factors that would determine whether a state was an influential space power or just another member of the spacefaring community.

Over the last decade, a growing number of space power theorists have advanced former United States Air Force (USAF) Lt. Col. David E. Lupton's *On Space Warfare* as the first substantive work on competing space power to be promulgated[111]. Not appearing "until the closing days of the Cold War", Lupton sought to calculate "whether space power should have the same military connotation as air power and sea power, and if there should be such things as space forces"[112]. In the process, Lupton provided a framework for measuring a state's capacity to become a space power that would be "designed for readers who belong[ed] to neither…of [the two] professions" that [would normally] preoccupy themselves with discussions of doctrine: the military and clergy"[113]. For Lupton, a space power was therefore enumerated as "a nation [with the ability] to exploit the space environment in pursuit of [its] national goals and purposes and includes the entire astronautical capabilities of the nation"[114]. As he would elaborate further in *On Space Warfare*, for a state to be considered a space power within the 20th century space environment, it would need to retain a "sizable technology capacity" capable of launching multiple non-offensive artificial satellites into the upper atmospheres "every couple of months" or so[115]. To

[110] Conversely, the "best-known" definition of space power published around the end of the century was offered in the 1998 *US Air Force Doctrine Document*: "[Space power is the] capability to employ space forces to achieve national security objectives".
[111] David E. Lupton, op. cit., 14.
[112] Ibid, 11; Charles D. Lutes, *Toward a Theory of Spacepower* (Washington, D.C.: National Defense University Press, 2011), xv; Elinor C. Sloan, op. cit., 118.
[113] David E. Lupton (U.S. Air Force), op. cit., 11-12.
[114] Ibid, 14.
[115] Ibid, 15.

summarize, an increase in space technology launches was theorized by Lupton to equate to greater power and prestige for a state in the space domain (illustrating both a material presence that could occupy contested regions of orbit and the ability of a nation to launch satellites freely without interruption) as well as a maintaining a long-lasting influence in the region through the operation of newer systems to replace older satellites[116]. For Lupton, a state which was considered a space power would have to steadily increase its artificial satellite launches as a means of "proportionally increasing [its share] of national power" while maintaining space as a nonconfrontational environment through the "non-proliferation…of offensive military technologies" in space[117].

Where Lupton's interpretation shines as a theoretical touchstone of space power is in its ability to incorporate the basic logic entrenched across the schools of doctrinal thought while dissociating itself with the schools' more unconventional assertions. Highlighting the commonality across the schools that satellites need to be protected at all costs, Lupton correspondingly declares that any rational space power must maintain outer space as a nonconfrontational environment in order to implement national space activities. "[The] protection of space forces should remain the [primary] objective of a space power…[as] without space forces, a country cannot hope to accomplish anything [in the space environment]"[118]. Supplementing this, Lupton incorporated principles from both hard and soft power interpretations of space power – on one hand suggesting that states need to actively guarantee their possession of space, while on the other advising that states deploy non-offensive space technologies. By combining several key facets that had previously been conferred by past scientific and strategic thinkers, Lupton provided an interpretation of space power that is grounded on the rich history of human space activities.

[116] David E. Lupton (U.S. Air Force), op. cit., 14.
[117] Ibid.
[118] Ibid, 16.

Like any good mortar, it may be concluded that Lupton's interpretation introduced a solid theoretical foundation for building up all successive theories of space power.

Although the theoretical background of space power has been affected by an assortment of civilian, military, and scientific intellectuals, some key themes have emerged over the generations that explain how states guarantee national interests in outer space. First and foremost, a majority of the key space power theorists avow that power is attained in the space environment through national space activities that conserve a presence in the domain using space technology. To recap, von Braun advanced that a space power would launch offensive space technologies while Knorr argued that a space power would use of non-offensive space technologies to install a strategic presence in the terrestrial orbits. The doctrinal schools of space power forwarded a similar role for space technology in the region, stressing the strategic potential of maintaining space-based systems and the necessity of protecting national space assets operating in orbital space. In this respect, space power is similar to other, more conventional military theories of power. Just as the number of soldiers in an army can be considered the primary unit for evaluating a country's potential land power or the number of ships is an indicator of its sea power, the number of operational space-based technologies – technological material that are capable of entering and remaining in the upper atmospheres for a period of time – are considered absolutely crucial to past space power theorists for evaluating how effective a spacefaring state is in guaranteeing its national interests in space. Even contemporary space power theorists, the most notable being Colin S. Gray and Everett C. Dolman, advance an interpretation of space power grounded on the "ability [of states] to use space and to deny such use to its foe"[119]. In essence, the theoretical background of space power holds that a spacefaring state can only be considered a space power if it a) possesses a sizable space force

[119] Colin S. Gray, op. cit., 244; Everett C. Dolman, *Astropolitik: Classical Geopolitics in the Space Age* (New York, NY: Routledge, 2001), 6.

and b) it can maintain the permanency of its strategic presence in the orbits through the application of space-based technologies.

2.3 Satellite Orbits and the Topography of Outer Space

Although outer space may seem like a vast expanse of black nothingness, the topographical features exemplified in the region make space power exceptional when compared to with other, more conventional theories of military power. By accounting for an astonishing array of variability that rivals the geographic traits present within the terrestrial environments, space demonstrates physical characteristics that uniquely influence the study of space power. As Everett C. Dolman describes, "[the space environment] is in fact a rich vista of gravitational mountains and valleys, oceans and rivers of resources and energy alternately dispersed and concentrated, broadly strewn danger zones of deadly radiation, and precisely placed peculiarities of astrodynamics"[120]. As a result of the laws of physics, space is as "demarcated and bounded a domain as are the land and sea environments by [E]arth's geographic features"[121]. Highlighting these particular attributes unique to the space environment will clarify the impact its use has on the capacity of a state to guarantee its influence and prestige within the upper atmosphere.

Since the beginning of the Space Age, understanding space power has been predicated on a comprehension of astrophysics and the atmospheric orbits of Earth[122]. The space environment is regarded as being made up of four main terrestrial orbits that surround Earth at distances ranging from an altitude of 100 km (at the Kármán Line) to an altitude of approximately 36,000 km (extending up to the beginning of the exosphere). These orbits, depending on their altitude and

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[120] Everett C. Dolman, "Geostrategic in the Space Age: An Astopolitical Analysis," in *Geopolitics, Geography and Strategy*, ed. By. Colin S. Gray and Geoffrey Sloan (Portland, OR: Frank Cass Publishers, 1999), 84.
[121] Alan C. Tribble, *The Space Environment: Implications for Spacecraft Design* (Princeton, NJ: Princeton University Press, 2003), 3; Elinor C. Sloan, op. cit., 118.
[122] Mark E. Harter (U.S. Air Force, "Ten Propositions Regarding Space Power," *Air & Space Journal* 13.1 (2006), 13.

mission utility, are categorized as Low-Earth, Medium-Earth, Geosynchronous, and Molniya orbits. Low-Earth orbit (LEO) begins just above the Kármán Line at an altitude of 150 km and extends to around 800 km. In LEO, the atmospheric concentration of air molecules is still very dense, compared with other orbits, which contributes to a significant amount of atmospheric drag. Due to its close proximity to the "safe embrace" of Earth, LEO is particularly useful for earth-observation satellites and manned space missions, foremost being the annual international scientific expeditions to the International Space Station (ISS)[123]. LEO is also the most contested and congested of the orbits because of its close proximity to Earth, equating approximately 1,100 operating satellites in the one orbit, yet it remains the most accessible orbit to launch into[124].

Medium-Earth (MEO) extends between 800 km to 35,000 km and accommodates an air density that is slightly lower than LEO. At this intermediate area in the upper atmosphere, the most common altitude used by satellites is at approximately 20,000 km where gravitational forces are most stable for artificial satellites operating in the region. Over the decades, this altitude of approximately 20,000 km has been utilized primarily for navigational satellites, like the Global Positioning System (GPS), because of the intermediate speeds and periods of revolution that space objects in MEO exhibit[125]. Atmospheric stability, whereby satellites operating in the region are less likely to be compromised by environmental fluctuations in the other terrestrial orbits, is the primary strategic advantage for utilizing MEO[126].

Geosynchronous orbit (GEO), the outermost of the four main terrestrial orbits, surrounds Earth at 35, 888 km above the equator. For a satellite to be considered geosynchronous, it must

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[123] Ashton B. Carter, "Satellites and Anti-Satellites: The Limits of the Possible," *International Security*, 10.4 (1986): 50-51.
[124] Elinor C. Sloan, op. cit., 118.
[125] Ashton B. Carter, op. cit., 50.
[126] Michael E. O'Hanlon, *Neither Star Wars Nor Sanctuary: Constraining the Military Uses of Space* (Washington, D.C.: Brookings Institution Press, 2004), 30

demonstrate a similar orbital period as Earth's (at a height of just under 36, 000 km) from a stable atmospheric point either 70 degrees north or 70 degrees south from the equator[127]. This enables a satellite to remain "fixed" at a single point in the orbit as it rotates with Earth[128].When matched with a low concentration of air molecules, a satellite's orbit around Earth in GEO takes exactly twenty-four hours (analogous to a single axial rotation for Earth). As a result, GEO is the preferred altitude for civilian and military communication satellites to provide 24/7 services, as well as electronic surveillance and missile warning systems[129].

Finally, the Molniya orbit is a highly elliptical orbit that does not have a set atmospheric altitude; rather, space objects in the orbit travel from approximately 250 km to as far out as 40, 000 km[130]. Molniya orbit is also unique insofar as it is extends through all orbits at various intervals during a single axial rotation[131]. The inherent "unpredictability" of satellites travelling in the orbit and the risk of atmospheric collisions between space objects means that spacefaring states tend to avoid its use when possible[132]. Nevertheless, Molniya orbit contains several communication and missile warning satellites exclusively operated and owned originally by the Soviet Union and then the Russian Federation[133].

It is also important to note when presenting the topographic features of the terrestrial orbits that, per the laws of atmospheric physics, the lower a satellite is at a particular altitude, the faster that satellite moves in relation to Earth. For example, a satellite in LEO will travel around Earth between 14 to 16 times per day whereas a satellite in MEO will travel between 2 to 14 times[134].

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[127] Everett C. Dolman, op. cit., 103.
[128] Elinor C. Sloan, op. cit., 118.
[129] Michael E. O'Hanlon, op. cit., 30.
[130] Ibid, 30.
[131] Mark E. Holdridge, "Space Mission Operations," in *Fundamentals of Space Systems*, ed. By Vincent L. Pisacane (Oxford, U.K.: Oxford University Press, 2005), 764.
[132] Mark E. Holdridge, op. cit., 764.
[133] Michael E. O'Hanlon, op. cit., 31.
[134] Alan C. Tribble, op. cit., 4; Elinor C. Sloan, op. cit., 118.

As stated, satellites in GEO take a single axial rotation and travel at their same spot above the Earth's equator continuously. In contrast, because of the irregular angle of the orbit, satellites in Molniya orbit normally travel around the Earth twice a day by lingering over the Northern Hemisphere for eleven hours and then "sweeping low and fast" over the Southern Hemisphere during 45 to 60 minute passes[135]. In the context of theoretical space power, every terrestrial orbit, by all accounts, has a unique mission utility that corresponds to its proximity to Earth and the time it takes for a satellite to complete one full atmospheric rotation.

Despite their different atmospheric characteristics and mission utility, the four main terrestrial orbits are further differentiated in relation to how the Earth's gravity influences the topography of their areas. Gravity is the most important factor in the topography of space as it dictates both the movement and strategic position of satellites within the orbits. For instance, while "[the] gravitational pull for satellites in [LEO] is stronger compared with the satellites in [GEO], less propulsive energy is required for a satellite to be placed in [LEO] because of [the orbit's] lower altitude"[136]. It is easier for spacefaring states to launch satellites into lower altitudes. As Michael E. O'Hanlon notes, "[e]ven though satellites in GEO end up moving much more slowly than satellites in LEO, satellites must be accelerated to greater initial speeds…[b]ecause they lose a great deal of speed fighting Earth's gravity as they move"[137]. Satellites in LEO are also bound by more concentrated gravitational forces than satellites in GEO which, when coupled with the greater atmospheric concentration of air molecules typical of the lower orbits, result in satellites in lower altitudes slowing down faster over time. On average, satellites in lower altitudes move at approximately 8 km per second and de-orbit sooner than satellites at higher altitudes travelling at

[135] Mark E. Holdridge, op. cit., 764-765.
[136] Malcolm D. Shuster and Wayne F. Dellinger, "Spacecraft Attitude Determination and Control," in *Fundamentals of Space Systems*, ed. By Vincent L. Pisacane (Oxford, U.K.: Oxford University Press, 2005), 282.
[137] Michael E. O'Hanlon, op. cit., 33.

3 km per second[138]. Likewise, more energy (and, by association, on-board fuel) is required to keep a satellite stabilized within LEO and MEO than is required within GEO. In practical terms, LEO and MEO are great for spacefaring states that yearn for a short-term presence in a relatively crowded orbit, while GEO is reserved exclusively for those wishing to exploit a lasting position within the space environment.

Besides manipulating the movement of satellites, the gravitational forces of Earth also influence the topography of outer space by creating "common pathways" between the terrestrial orbits. In theory, these pathways located at specific coordinates around the Earth allow space objects to successfully navigate smoothly from one orbit to another at a higher altitude by intersecting distinctive "transfer orbits" (known as "Hohmann Transfer Orbits")[139]. Although paraded as the "common heritage of humankind" by international law and legislation, these common pathways of space are difficult to enter and require incredible technological expertise and total velocity effort to achieve successfully[140].

It should also be highlighted that the propulsive energy needed to conduct a forced transfer between orbits is moderately equal going down (to a lower altitude) and going up (to a higher altitude); despite both forced transfers requiring more energy than simply letting a satellite "fall out of the sky" on its own[141].

Lastly, the Earth's surface has a profound impact on the topography of outer space and, since the beginning of human space activities, the ability of a spacefaring state to access the upper atmospheres. Where a satellite is launched on Earth has a profound impact on its likelihood to

[138] Michael E. O'Hanlon, op. cit., 35.
[139] Everett C. Dolman, op. cit., 95-96.
[140] Everett C. Dolman, op. cit., 96; John J. Klein, op. cit., 22.
[141] Malcolm D. Shuster and Wayne F. Dellinger, op. cit., 293.

enter space intact. As the Earth rotates west to east, satellites launched upward in an eastward direction sustain a “boost” which assists on-board propulsion in transitioning the Kármán Line[142].

The geographic latitude of a launch also contributes to its likelihood of entering the orbits. For example, a country which possesses territory near the equator has a decisive advantage in launching satellites into higher altitudes because the speed of Earth’s rotation peaks at the equator. As Elinor Sloan records, “[t]wice the payload for the same energy can be launched into geostationary orbit from [French Guiana, near the equator,] as from Kazakhstan"[143]. Despite making on-board propulsion of launch technologies more efficient, the location of a state may also determine what terrestrial orbits may be accessed. The closer a spacefaring state is to the equator, the more likely a satellite launch will successfully enter the more distant orbits (like GEO or Molniya Orbit). As such, launch facilities located nearer to equator, such as Kourou, French Guiana and Alcantara, Brazil, allow easier access to terrestrial orbits compared to Plesetsk, Russia or San Marko, Kenya[144]. For a spacefaring state wishing to become a space power, the closer it is to the equator or whether it has access to territory around the region makes a world of difference when launching multiple satellites into the upper atmospheres.

It should therefore be understood that outer space is a unique environment possessing many inimitable topographical features. Just as previous military theorists like Alfred Thayer Mahan and Julian Corbett had affirmed that the sea environment possessed a unique set of geographic characteristics which made sea power markedly different from land power, or how Giulio Douhet made a similar argument for the air, so too must the topographical features of outer space be considered exceptional to further elaborate on the distinctiveness of space power. Space power

[142] Everett C. Dolman, op. cit., 100.
[143] Elinor C. Sloan, op. cit., 119.
[144] Everett C. Dolman, op. cit., 100.

takes note of this exceptionalism by highlighting the scientific and technological difficulties associated with conducting national space activities in the upper atmospheres. Unique atmospheric characteristics – like the four terrestrial orbits, gravitational forces, and different launch latitudes relative to the equator – make national space activities problematic or impossible for most countries. Whether because financial or technological ability or geographic location, some countries are genuinely more proficient in entering space than others[145]. As Brigadier-General Blaise Frawley flatly put it, the likelihood of countries "like Togo or Tuvalu" spacefaring is "ridiculous" given the current constraints afflicting the countries' current scientific and technological activities[146]. Indeed, a certain level of high-tech proficiency is required by a state in order to overcome the environmental challenges prevalent within the lower regions of the space environment. A state that does not surmount these challenges does not go to outer space and, correspondingly, does not become a space power[147].

Yet the topographical features that continuously afflict the space environment must also be repeatedly overcome by a spacefaring state to preserve its strategic presence in space and, in the process, become a bonafied space power. As discussed, the atmospheric and gravitational drag experienced by all objects in the terrestrial orbits means that operational space technologies, and the strategic presence they afford through their occupation in the space domain, are finite as, at some point, "they will come down sooner or later after about twenty-five years"[148]. This is why space power considers the ability of a state to launch and maintain multiple satellites as

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[145] M. V. Smith, *Ten Propositions Regarding Space Power* (Maxwell Air Force Base, AB: Air University Press, 2006), 15.
[146] Blaise Frawley (Royal Canadian Air Force), Interview by Kiernan McClelland, *Research Interview*, November 14, 2016: Lt. Gen. Frawley did add that with proper space policies and financial support, any country could hypothetically become a significant contributor to the international space-faring community.
[147] James E. Oberg, (U.S. Air Force), op. cit., 22.
[148] Rick Pitre (Royal Canadian Air Force, Ret'd), Interviewed by Kiernan McClelland, *Research Interview*, September 29, 2016.

indispensable to its study. Unsurprisingly, inserting multiple artificial space technologies into space and keeping them operational inside an orbital rotation is extremely demanding, requiring significant strategic direction, political support, and economic resources to accomplish[149]. If a spacefaring state cannot keep its space assets, as the old aerospace axiom goes, from "falling out of the sky", it cannot secure the influence, prestige, or power that these technologies would have otherwise provided. As a military theory of power that rationalizes the conduct of national space activities, the aptitude of topographical features of space to manipulate the ability of states to both deploy their satellites and maintain the altitude of these space technologies in the upper atmosphere is imperative to its ability to project power in the region.

2.4 General Characteristics of Satellite Technologies

It should come as no surprise that the artificial satellite is one of the greatest inventions ever conceived by humankind. Since the launch of Sputnik I, the advent of more complex and sophisticated man-made satellites has revolutionized the manner in which humankind conducts the drudgery of everyday life. From operating our televisions and cell phones to regulating communication in the global economy and environmental monitoring, the practical benefits of states employing satellites to provide services for their populations [is] obvious[150]. Without a doubt, satellites have made the world more interconnected through its dissemination of information across continents. Yet, despite modern society's absolute dependence on satellites, the ultimate irony of the technology is that their most valuable usage remains their innate ability to operate in the cold, oxygen-deprived void of outer space.

[149] M. V. Smith, op. cit., 15; Nayef R. F. Al-Rodhan, op. cit., 20.
[150] Nayef R. F. Al-Rodhan, op. cit., 2-3; Dan Stillman, "What Is a Satellite?," *National Aeronautics Space Administration (NASA)*, September 2015.

The important function that satellite technology serves in influencing space power goes beyond the multifaceted on-board capabilities that the systems can provide for populations. As affirmed by John V. Grange, all technology, regardless of its specific intention, are "action-directed…[and] concerned with doing things, solving problems…or in the sense that they fill the perceived needs of nations as a whole"[151]. By this description, "satellite technology" is created with the objective of assisting spacefaring states in guaranteeing their national interests in the space environment to the degree that they see acceptable. In the context of theoretical space power, the satellite itself is acknowledged as a valuable unit for policy-making in an unconventional environment and whose occupation of the domain is more significant than the specific amenities it provides for a population. Moreover, regardless of its overarching purpose, any satellite deployed into the orbits should demonstrate the "same characteristic features warranting of a unique technology that operates in outer space"[152]. For that reason, any space power theory that seeks to cultivate a strong understanding of the strategic dimensions of space must successively consider the distinctive technological characteristics that all satellite technologies share.

Space power is exceptional among other theories of strategic thought insofar as it considers the satellite as a unique piece of hardware that exhibits no discernible peer to any other form of terrestrial technology. Just as the characteristics of air forces – such as range, speed, and maneuverability – are used to dictate contemporary air power theory, the characteristics of space forces should also be used to underscore the distinctiveness of a space power theory. Several space power theorists, including Lupton and Oberg, extend this conceptual breakdown of space power to include a list of macrolevel characteristics "on the same order of detail as range, speed and

[151] John V. Grange, *Technology and International Relations* (San Francisco CA: W. H. Freeman and Company, 1979), 2-3.
[152] David E. Lupton (U.S. Air Force), op. cit., 20.

maneuverability used to describe the attributes of air forces" to pronounce the satellite as the "primary tool of all space forces"[153]. Consequently, there are four general technological characteristics of satellite technologies – two characteristics influenced by atmospheric physics and two by logistically-influenced characteristics – which space power reflects.

The first environmental-influenced characteristic of satellite technologies, associated with the laws of atmospheric physics and the topography of the space environment, has been termed by erstwhile space power theorists as "global presence". Satellites, unlike any other form of terrestrial technology, retain access to a "high-altitude vantage" above Earth, thereby affording "line-of-sight view of large portions of [E]arth"[154] As discussed, the ability of these technologies to sustain their global presence is also guaranteed once they are placed in a terrestrial orbit. While the periodic release of on-board fuel is required to maintain orbital stability, the momentum generated from a satellite's movement allows it "see" enormous areas of Earth with little to no use of fuel to stay "on target"[155]. Furthermore, the global presence characteristic of satellites begets the capacity for global access: described by Elinor C. Sloan as the capacity of a space-based technology to "be observed from the ground and accessed for information [by ground stations] throughout large portions of the day"[156].

Second, satellites are characterized as moving naturally through a linear plane of motion, despite maintaining the ability to move in three-dimensional space. As a "quasi-positional" object, satellites placed in the terrestrial orbits move at high velocities in a single continual direction that encompasses the circumference of a particular orbit[157]. Moreover, once in an orbit, a satellite

[153] Ibid, 20; James E. Oberg (U.S. Air Force), op. cit., 22.
[154] Mark E. Holdridge, op. cit., 764.
[155] Colin Gray, op. cit., 244.
[156] Elinor C. Sloan, op. cit., 120.
[157] Ibid, 120-121.

cannot "maneuver, stop, or reverse course in the manner of terrestrial objects"[158]. This contributes to one of the major vulnerabilities specific to satellite technology: they are predicable. As Col. Robert M. Kronebusch concluded, given a satellite's "current position and velocity…trackers can accurately predict its position and velocity for days into the future using the laws of physics"[159]. Similar to Julian Corbett's belief that "[t]he fertile areas where the terminals of departure and destination [would]…always attract the strongest [likelihood of] attack", a satellite is always vulnerable because its location is always known.

Accompanying these environmentally-influenced characteristics, a satellite is also unique insofar as it displays two logistically-influenced characteristics that reflect the operational difficulties in reaching the upper atmospheres. The first of these characteristics, as several commentators have pointed out, is that satellite technologies are largely inaccessible following their deployment into the terrestrial orbits[160]. As Everett C. Dolman repeatedly affirms, it is a given that "[n]one of the other environments is as difficult to reach [as space]"[161]. Unlike more conventional terrestrial technologies – like aircraft and watercraft – that, if ever damaged, can be recalled from active service and promptly repaired, an inherent likelihood of a damaged satellite is that it will most likely never be repaired and will be either deorbited or forgotten. As such, satellites demonstrate the remarkable aptitude of being "lost in space". The second of these comparable logistically-influenced characteristics is that satellites are primarily unmanned. In an interview, astrobiologist Ian A. Crawford described the costs and dangers of the space environment as only increasing following humankind's "gradual push to explore the stars"[162]. Given the

[158] Colin Gray, op. cit., 244-245; Ibid.
[159] Robert M. Kronebusch (U.S. Air Force), "USAF's Roles in Space Surveillance," *Proceedings of the Sixteenth Space Congress*, April 1979.
[160] Julian S. Corbett, *Some Principles of Maritime Strategy* (London, U.K.: Brassey's Defence Publishers, 1988), 158.
[161] Everett C. Dolman, op. cit., 99-100.
[162] Ian A. Crawford, "Dispelling the myth of robotic efficiency: why human space exploration will tell us more about the Solar System than will robotic exploration alone," *Astronomy and Geophysics* 53.1 (2012): 1-2.

significant resources that are needed to produce a space shuttle crew, matched with the grave risks associated with human space flight, the launch of an unmanned satellite is often the cheaper, safer, and more profitable means of situating a temporary presence in the orbits.

On the whole, these four characteristics of satellites maintain that all national space forces, regardless of their purpose, are vulnerable to the same collection of environmental and logistical challenges. It would appear that the apparent differences between a commercial television satellite streaming a hockey game across a country and a highly-encrypted military photoreconnaissance satellite transmitting sensitive data is negligible to the emotionless vacuum of outer space. One anonymous source from the Canadian Space Agency (CSA) said it bluntly: "extending beyond the semantics of specific on-board systems, a satellite remains just a collection of circuits and wires". The strategic study of space power highlights this supposition by asserting that a spacefaring state that wishes to become a space power does not consider the type of technology being launched into outer space[163]. As long as a state can maintain a satellite presence in the space environment, and in the process can occupy a section of uncontested real-estate in any one of the terrestrial orbits, it is satisfactorily content.

2.5 Conclusion

Space power is similar to and different from other forms of military and national power. Although space power has many different facets depending on one's perspective and objectives of the concept, one common argument shared with the more conventional theories of power is the argument that preserving a major, long-standing presence in a unique operational environment allows a state to better guarantee its strategic objectives in the region. More artificial satellites – which, as a space technology, can remain in space longer than most other objects – equates a

[163] Anonymous (CSA Employee), Interviewed by Kiernan McClelland, *Research Interview*, September 25, 2016.

greater presence in the space environment, which in turn yields a greater ability to operate in the orbits[164]. This notion has been supported over the years by the academic contributions from the key space power theorists, including the interpretations of space power as imagined by Dr. Wernher von Braun, Klaus Knorr, and the budding schools of doctrinal thought that emerged following the introduction of President Ronald Reagan's Strategic Defense Initiative. Space power can further be defined as the ability to use an operational environment while denying its use to potential rivals. The key space power theorists supported this assertion, while the atmospheric features of the terrestrial orbits and the technological characteristics of satellites (which reemphasize the difficulties in conducting national space activities) make the preservation of functioning satellites important to the overall strategic objects of a state. Yet, space power is unique among other theories of power insofar as it is connected to other forms of national power, including measures of economic, scientific, and international leadership.

Therefore, for a spacefaring state – that is, a country that has the scientific and technological resources to place space-based technologies within the upper atmospheres – to be considered a space power, it is must be able to maintain its influence, prestige, and power in outer space through the development of multiple artificial satellites. Given the difficulties in preserving a long-term strategic presence in the region, a space power is further differentiated as a state that can conduct frequent artificial satellite launches. As space power theory highlights, being able to launch more space technologies at frequent intervals in time allows a state the means to continuously illustrate its dominance over the space environment to the international community while denying swaths of orbital space to potential rivals who would wish to enter the region. Given the vulnerabilities that satellites exhibit while operating in space (such as being inaccessible and

[164] M. V. Smith, op. cit., 4-6.

quasi-positional), a space power will also seek to protect its space assets through the upkeep of outer space as a nonconfrontational environment. Understanding that less threats in space translate to satellites surviving longer in the region, a space power will therefore offer to use its influence among other spacefaring states to preserve the space environment as a peaceful sanctuary and, in the process, assure the permanency of its space dominance.

Although strategic thought on space power is relatively new compared to other theories of power, a number of theoretical conclusions have been determined. Having surveyed the history of space power theory, the topographical features of the atmospheric orbits, and the technological characteristics of artificial satellites, a few key themes have emerged that will better allow for the assessment of spacefaring states – such as the United States, Soviet Union, and Canada during the Cold War – as potential space powers. Having presented the theoretical benchmark for understanding the strategic application of national space activities within the discipline of strategic studies, the subsequent chapters of this thesis will be better able to articulate the strategic, political, and economic factors of states that seek to don the honourific mantle of space power.

Chapter 3: To Infinity and Beyond: Identifying the Underlying Descriptive Characteristics of Great Space Powers in the 20th Century Security Environment

3.1 Introduction

As the first signs of the Cold War emerged in the aftermath of the Second World War, the two superpowers that now dominated the planet tried to envision the likelihood of future conflicts and the weapons that they would need to fight them. Having brought down Nazi Germany after half a decade of bloody conflict, the United States (U.S.) and Soviet Union (U.S.S.R.) prepared for the "age of weapons of mass destruction" and the accompanying political brinkmanship that would come to define the Cold War[165]. Having witnessed the destructive potential of the German V-2 (or "Vengeance Weapon 2") medium-range rockets, both American and Russian experts realized only months before the war's end that Nazi Germany had done more than simply lay the groundwork for a powerful new class of weapon[166]. The technological qualification of the V-2 to breach the lower boundaries of outer space provided straightforward access to a new environment that permitted decisive strategic advantages for whatever country could control it[167]. Understanding this, both the U.S. and U.S.S.R. leadership introduced programs that sought to capture German rocket scientists and knowledge and bring them back to their countries to develop national space programs. Under Operation Paperclip, which began in May of 1945, and the formation of TsKB-1 (designated Central Design Bureau 1) shortly thereafter, the immediate post-war superpowers began the race in space by first guaranteeing the basic human resources that

[165] Annie Jacobsen, *Operation Paperclip: The Secret Intelligence Program That Brought Nazi Scientists To America* (New York, NY: Little, Brown and Company, 2014), 2.
[166] Deborah Cadbury, *Space Race: The Epic Battle between America and the Soviet Union for Dominion of Space*, (New York, NY: HarperCollins Books, 2006), 5.
[167] Wilson W. S. Wong and James Fergusson, *Military Space Power: A Guide To The Issues* (Santa Barbara, CA: Praeger, 2010), 5-6.

would be needed to conduct sophisticated space-based operations[168]. For those other states – both allies and former enemies – staggering from the Second World War, they could only watch in frustrated admiration as the U.S. and U.S.S.R. proceeded to enter the Space Age alone and unchallenged[169].

Although outer space was to be legislated in several international organizations as a "province of all mankind", the reality of the Space Age saw two global superpowers become the first space powers to operate within the final frontier[170]. Although Operation Paperclip can be considered the chronological beginning of the superpower's aspiration towards national space activities and the exploitation of the terrestrial orbits, it was by no means the end. From 1957 to 1991, the United States and the Soviet Union held absolute control within outer space. Yet, as various commentators have presented, the reality of the Cold War saw these two space powers continually competing against one other for national prestige, influence, and power within the space environment[171]. As Deborah Cadbury exposes, "[t]he development of missiles and rockets went hand in hand with…control of space"[172]. In this respect, the first space race was not only a struggle for strategic interests in the orbits, but an open contest between the political ideologies of capitalism and communism. The U.S. and U.S.S.R. leadership both saw space activities not just as a matter of pride, but of national security and global order. The result, as Everett Dolman presents, was that "[t]he Heavens [became] dominated by two global titans…fighting for absolute control

[168] Matt Bille and Erika Lishock, *The First Space Race: Launching the World's First Satellites* (College Station, TX: Texas A&M University Press, 2004), 23; Wayne Biddle, *Dark Side of the Moon: Wernher von Braun, the Third Reich, and the Space Race* (New York, NY: W. W. Norton & Company, 2009), 129.
[169] Matt Bille and Erika Lishock, op. cit., 131-132.
[170] Yanek Mieczkowski, *Eisenhower's Sputnik Moment: The Race for Space and World Prestige* (Ithaca, NY: Cornell University Press, 2013), 4.
[171] D. A. Turner and J. Vedda, "Foreign space developments and US policy," in *Space and Defense Policy*, ed. By Damon Coletta and Frances T. Pilch (New York, NY: Routledge, 2009), 312; Yanek Mieczkowski, op. cit., 4.
[172] Deborah Cadbury, op. cit., ix.

of [outer space]" launching the beginning of the Space Age[173]. The relationship of this competition between the two space powers resulted in a level of "unchallenged space superiority" within the space environment which made the exploitation of space "difficult or near impossible" for other states wishing to enter the orbits[174]. Indeed, the unprecedented dominance of the United States and Soviet Union in space – coupled with the exclusivity these states shared in the space environment – have denoted the two states as the "original" space powers[175]. Following the end of the Cold War, these states have also come to be considered as the great space powers of the 20th century, thereby setting the theoretical precedent for understanding modern space powers.

This chapter will evaluate the major strategic, political, and economic factors that allowed the United States and Soviet Union/Russia to become great space powers in the context of the late 20th century security environment. To conduct this evaluation, the chapter will present a comprehensive analysis of the national space policies and strategies, the international and multilateral space agreements, and the financial resources dedicated to space projects sustained by each superpower from the assessment period between 1957 and 1991. Following this analysis, the chapter will then compare and discuss the strategic, political, and economic similarities shared between the great space powers which enabled them to progressively increase and sustain a presence in the space environment. Defined by the global superpower competition of the Cold War and the emergent opportunities presented from the initial opening of the space environment, the chapter will conclude that the U.S. and U.S.S.R. both exhibited similar features that enabled them to exploit the upper atmospheres with multiple artificial satellites whilst maintaining the environment as a peaceful sanctuary.

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[173] Everett C. Dolman, *Astropolitik: Classical Geopolitics in the Space Age* (New York, NY: Routledge, 2001), 18.
[174] Everett C. Dolman, op. cit., 19.
[175] Nayef R. F. Al-Rodhan, *Meta-Geopolitics of Outer Space: An Analysis of Space Power, Security and Governance* (Oxford, U.K.: Palgrave-MacMillian, 2012), 20.

3.2 The United States as a 20th Century Space Power

As the nation responsible for the scientific progression of space exploration, the United States has held a definitive role as the major space power of the 20th century. While not the first country to enter space, the United States had, during the Cold War, developed an aptitude for utilizing space technologies that, in turn, facilitated the maximization of the state's national interest in the orbits. Correspondingly, the strategic documents and political legislation supported by the United States – together with financial capabilities of the state – represent the archetypical historical measure of how a state may become a space power and how it may retain its influence in the orbits.

Throughout the Cold War, the United States published multiple security documents detailing the strategic application of outer space. Prior to the launch of Sputnik I in the years following the Second World War, these documents did not assert that there was a strategic position to be achieved in outer space. As the 1948 *Research and Development Service's Studies* concluded, there was no strategic utility in outer space because "the technical feasibility of earth satellites [had yet] to be clearly established"[176]. Moreover, the *U.S. Air Force PROJECT RAND Special Memorandum of 1954* argued that the incorporation of artificial satellites into space would be seen as "too expensive to match…[the] military utility of the systems"[177]. As James Clay Moltz has postulated, the primacy of this position to space may have originated from the realization that the United States had yet to achieve the technological capabilities necessary to enter outer space[178].

[176] Arthur J. Downey, *The Emerging Role of the US Army in Space* (Washington, D.C.: A National Security Affairs Monograph, 1985), 3.
[177] Bruno W. Augenstein, *Evolution of the U.S. Military Space Program*, 1945-*1960: Some Key Events In Study, Planning, and Program Development* (Santa Monica, CA: RAND, 1982), 5.
[178] James Clay Moltz, *The Politics of Space Security: Strategic Restraint and the Pursuit of National Interests* (Stanford, CA: Stanford University Press, 2011), 142.

Given this position, the application of artificial satellites was not originally considered a viable security strategy in guaranteeing the national interests of the United States.

The election of President Dwight D. Eisenhower in 1953 served to re-valuate the strategic importance of outer space for the national interests of the United States. Increasingly concerned with the possibility of a Soviet military threat in space, the Eisenhower Administration produced a national vision regarding space and established, among other things, a commitment to the strategic importance of the space environment[179]. Opposite previous documents, space was beginning to become accessible to the United States as the costs of satellite technology were starting to decrease by the year[180]. When matched with Eisenhower's personal outlook of a militarized space leading "to the destruction of all mankind", the national space documents of the United States began to emphasize a national commitment to two central tenets: "freedom in space" and "space for peaceful purposes"[181]. Whereas Eisenhower understood that the deployment of offensive military technologies in space would lead to an "aggressive response from the Soviet Union", the exploitation of space was seen as requiring a civilian component in order to legitimize all space activities as public, rather than military, endeavours[182]. As issued in the United States National Security Council (NSC) *Directive 5520* in 1955, it was recommended that the first U.S. satellite be deployed using civilian launch vehicles in order to promote a peaceful image of America internationally[183]. Following the launch of Sputnik I, the U.S. remained committed to peaceful uses of space through the use of greater civilian space capabilities. This is not to argue that the strategic aspect was absent from subsequent documents. With the issuance of *NSC 5814/1*,

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[179] Par Steven Lambakis, *On the Edge of Earth: The Future of American Space Power* (Lexington, KY: University Press of Kentucky, 2001), 218.
[180] Ibid.
[181] Air Command and Staff College, *AU-18 Space Prime* (Maxwell Air Force Base, AB: Air University Press, 2009), 39.
[182] Arthur J. Downey, op. cit., 3.
[183] Arthur J. Downey, op. cit., 4; Par Steven Lambakis, op. cit., 218.

the Eisenhower Administration concluded that there existed a "psychological impact of outer space activities which is of broad significance to [the] national prestige" of the U.S[184]. The document further elaborated as far as stating that U.S. space capabilities had been surpassed by the U.S.S.R.[185]. As Par Steven Lambakis affirms, this statement allowed the Eisenhower Administration to assert that the continued space dominance by the U.S.S.R. would result in the "space superiority [of]…U.S. prestige" being undermined[186]. The remedy to this problem therefore relied on the development and deployment of more space technologies and a commitment to "scientific exploration and use of outer space"[187]. Eisenhower's strategic commitment to this new policy eventually lead to the creation of the 1958 *National Aeronautics and Space Act*; considered by many as the first U.S. space policy document. The document asserted many of the strategic principles that had previously been supported by the Eisenhower Administration: a commitment to the peaceful uses of outer space, the belief of space as a geographic area of national importance for "the general welfare and security of the [U.S.]", and a commitment to deploying multiple space technologies (both civilian and military reconnaissance) into the space environment[188].

Following the end of Eisenhower's term, the national space strategies of the United States remained unchanged for upwards of around 30 years. During this period, the government administrations of several U.S. Presidents re-adopted the space policy framework created by Eisenhower when guiding the strategic application of outer space. For example, President John F. Kennedy sought to continue Eisenhower's space strategy by guaranteeing U.S. national prestige by "[taking] a clearly leading role in space achievement" while maintaining outer space as an "area

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[184] National Security Council, *NSC 5814/1* (Washington, D.C.: Dwight D. Eisenhower Presidential Library and Museum, 1958), 5.
[185] National Security Council, op. cit., 15.
[186] Par Steven Lambakis, op. cit., 219.
[187] Ibid.
[188] The National Aeronautics and Space Administration (NASA), *National Aeronautics and Space Act of 1958, As Amended* (Washington, D.C.: NASA, 2008), 4-5.

of peace"[189]. This commitment by the Kennedy Administration resulted in the "single greatest achievement of mankind" – the first manned Moon landing on July 20, 1969. Without firing a single shot in space, Kennedy had effectively guaranteed the national prestige and international recognition of the United States while maintaining space as a peaceful sanctuary through the launch of a non-offensive civilian space technology. Following the immediate aftermath of the landing, the Kennedy Administration also committed to the deployment of multiple reconnaissance and communication satellites in order to "[exploit] the sudden opening in space [produced] by…the successful lunar mission"[190]. Like Kennedy, President Lyndon B. Johnson continued the administrative support for the deployment of non-offensive space technologies – comprising reconnaissance, communications, meteorology, and navigation satellites – into the orbits. Even the subsequent Republican Administrations of President Nixon and President Ford supported a national commitment to maintaining the space strategy outlined by Eisenhower. Under Nixon, the military and civilian space programs matured with additional deployments of non-aggressive technologies into space, while Ford devised the *National Security Decision Memorandum (NSDM) 333* which commented on the apparent dangers of offensive military satellites and the need for "increasing [the] exploitation of space…[with] strategic and tactical reconnaissance, warning, communications, and navigation satellites"[191].

The strategic principles of the United States national space strategy were summarily re-valuated following the appointment by President Jimmy Carter of Presidential Directive (PD) 37 on May 11, 1978. The declassified transcript of PD-37 outlines several strategic principles that

[189] Par Steven Lambakis, op. cit., 220-221: From the May 25, 1961 Congressional address by President John F. Kennedy to the American people on committing to NASA's Apollo program.
[190] Ibid, 221; Bert Chapman, *Space Warfare and Defense: A Historical Encyclopedia and Reference Guide* (Santa Barbara, CA: ABC-Clio, 2008), 343.
[191] National Security Council, *National Security Decision Memorandum 333* (Washington, D.C.: NSC, 1976), 1.

were tantamount to Eisenhower's space strategy. These strategic principles included an emphasis on the importance of space for the "national well-being" of the U.S., a confidence in the peaceful sanctuary of space, and an overall commitment to the deploying non-offensive military and civilian space technologies[192]. However, PD-37 outlines an important amendment which had yet to be codified in the previous national space strategy of the U.S.: "[t]he United States will pursue activities in space in support of its right of self-defence"[193]. While this directive did not set a course for the application and integration of offensive military space technologies, it did expand the national vison of the U.S. space strategy by recognizing the potential for outer space to become a future combat medium[194]. While Eisenhower had emphasised space as retaining the potential to become militarized, the Carter Administration reconceptualised the possibility of space as a volatile geopolitical region that would eventually experience hostilities. Despite this concern of "inevitable space war", the national space strategy of the U.S. remained committed to the "peaceful uses of outer space" – primarily through the application of non-aggressive military and intelligence functions. For Carter, this was a more practical space strategy to protect national interests through the continued exploitation of reconnaissance satellites and civilian space projects than the development of alternative defensive satellite technologies, such as development of an anti-satellite weapon (ASAT).

Remaining unchanged for decades, the Administration of President Ronald Reagan revolutionized the national space strategy of the United States. First presented in the 1982 *National Security Decision Directive (NSDD) 42*, the Reagan Administration recommitted the national objectives and strategies of outer space. With NSDD 42, Reagan again promoted Eisenhower's

[192] National Security Council, *Presidential Directive/NSC-37, National Space Policy* (Washington, D.C.: NSC, 1978), 1.
[193] Ibid.
[194] Par Steven Lambakis, op. cit., 226.

principle that the "use of space by all nations [be used] for peaceful purposes"[195]. Unlike Eisenhower, Reagan established that the U.S. space strategy would stress the commitment to activities "in support of its right of self-defence"[196]. Considering this, the Reagan administration reoriented the U.S. national space strategy to "detect and react to threats to United States space systems"[197]. With the announcement of the Strategic Defense Initiative (SDI) on March 23, 1983, the Reagan Administration further repositioned its strategic commitments toward the protection of U.S. space technologies: supporting the development of alternative, non-nuclear technologies that would also assist in the balancing of the Soviet Union[198]. Although the use of ground-based anti-ballistic missile (ABM) defense has been cited as the primary objective of the SDI, the "Star Wars" announcement also suggested the use of space as a "battleground" for space technologies that could guarantee "total dominance [for achieving]…strategic superiority" over the U.S.S.R.[199].

Although Reagan's approach to outer space has been considered by modern commentators to have been too "militarily oriented" and "overtly aggressive" for the international security of the Cold War, the U.S. national space strategy succeeding the SDI was very similar to its past counterpart. Like Eisenhower's original strategy, the maintenance of space as a peaceful sanctuary was seen as essential for the allocation of national interest in the region. By clarifying the differences between "peaceful uses" and "peaceful purpose" – being considered as "nonaggressive" and "non-military" respectively – the Reagan Administration recommitted a space strategy that imposed a strategic obligation to pursuing peaceful activities in the orbits.

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[195] National Security Council, *National Security Decision Directive Number 42* (Washington, D.C.: The White House, 1982, 1-2.
[196] Ibid.
[197] Ibid. 4
[198] Frances Fitzgerald, *Way out there in the Blue: Reagan, Star Wars and the End of the Cold War* (New York, NY: Simon and Schuster, 2000), 157-159.
[199] Aspen Strategy Group (U.S.), *The Strategic Defense Initiative And American Security* (Lanham, MD: University Press of America, 1987), 18-19; Bhupendra Jansani, *Space Weapons and International Security* (New York, NY: Oxford University Press, 1987), 22.

Although Reagan's space strategy presents a commitment to defending the space environment against potential aggressors, it suggests a non-offensive strategy for protecting civilian satellites through the deployment of defensive military space technologies[200]. As Colin S. Gray agrees, while Reagan's space strategy supported the continued use of multiple artificial satellites as a means of acquiring national interest, its main benefit was that it added strategic safeguards for protecting space technologies[201]. As such, the historical strategic factors of the United States' national space security policies had remained, for several decades, conscious of the advantages of applying space-based technologies when exploiting national interests in the upper atmospheres.

Supplementing the strategic factors, the United States maintained its dominance in outer space throughout the Cold War by creating and supporting political legislation that governed the activities that would occur in outer space. Believing that "Outer Space should be used for peaceful – that is, non-aggressive and beneficial – purposes", the U.S. devised various multilateral treatises that sought to limit the military activities in space[202]. The most successful of these treaties was the 1967 *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies* (OST). Negotiated by the United States and Soviet Union within the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS), the OST provided for the right of free passage to all states operating in space and, supplementing this amendment, successfully categorized satellites as national property[203]. As stated in the preamble, the OST retrenched the commitment of the signatory states to "[t]he exploration and use of outer space, including the moon and other celestial bodies...for the benefit

[200] P. Edward Haley and Jack Merritt, "Introduction: Strategic Defense, Nuclear Deterrence, and Arms," in *Strategic Defense Initiative: Folly or Future?*, ed. By P. Edward Haley and Jack Merritt (Boulder, CO: Westview Press, 1986), 11.
[201] Colin S. Gray, op. cit., 82.
[202] Bert Chapman, op. cit., 229.
[203] Ogunsola O. Ogunbanwo, op. cit., 90; Wilson W. S. Wong and James Fergusson, *Military Space Power: A Guide To The Issues* (Santa Barbara, CA: ABC-Clio, 2010), 7.

and in the interests of all countries…[as a] province of all mankind"[204]. The OST provided an international precedent by which the U.S. could legitimize its strategic commitment to the maintenance of outer space as a peaceful region, thereby guaranteeing that its artificial satellites would remain secure. Coupled with Article IV (2) of the "No Bomb in Orbit" provision of the treaty, the OST allowed the U.S. to exhibit a considerable level of political legitimacy in exploiting the space environment within non-offensive space technologies while allowing for the continued dominance of U.S. space technologies in the orbits[205]. As concluded by John J. Klein, the subsequent international precedent set by the OST created legal restrictions on the military activities of space but did not, in any way, inhibit the national space strategies of the United States[206]. In retrospect, the OST is a testament to the absolute political dominance and control that the United States enjoyed as the preeminent space power of the era.

Although the OST provided the most influential article of international law for outer space during the Cold War, various other treaties were formulated after 1967 which also served to the influence the United States' national space strategy. Adding to the principles established in the OST, other multilateral treaties ratified by the U.S. included the 1968 *Agreement on the Rescue of Astronauts*, the 1972 *Conventions on Liability*, and the 1975 *Conventions on Registration*[207]. These treaties further supported a U.S. commitment to the peaceful application of outer space and the condemnation of "[a]cts done with the intent to cause damage on the part of a…state in outer space"[208]. Interestingly, this universal principle of the treatise also established the "reasonable

[204] Ogunsola O. Ogunbanwo, op. cit., 91.
[205] Ibid, 92.
[206] John J. Klein, *Space Warfare: Strategy, Principles, and Policy* (New York, NY: Routledge, 2006), 11-12-; 63.
[207] Nathan C. Goldman, *American Space Law: International and Domestic* (Ames, IA: Iowa State University Press, 1996), 1-4.
[208] RAND Corporation, *Space Weapons, Earth Wars* (Santa Monica, CA: RAND, 2002), 19; Bert Chapman, op. cit., 229.

claim [to] the right of self-defence in the protection of space assets"[209]. Amended by the United States, this addition to the treaties allowed for the legitimization of defensive action in space and, by association, the protection of U.S. national interests and space superiority in the space environment. A number of bilateral arms control treaties – sanctioned by the U.S. and U.S.S.R. – would also promote the sanctity of outer space through an agreement to "not interfere with the operations of each other's satellites"[210]. These treaties included the 1972 Anti-Ballistic Missile Treaty, the 1974 Threshold Test Ban Treaty, and the 1979 SALT II Treaty. Even though these international treatises were created for the betterment of humankind, the principles of the treatise were directly influenced by the United States' strategic commitments.

The final characteristic constituting the United States as a space power in the Cold War is the state's proven financial engagement toward space-related programs. Prior to the launch of Sputnik I, the total national budget allocated towards space was nominal compared to the national funding allocated for other military and civilian projects[211]. As the strategic utility of space was not accepted by the military and public of the United States, the funding was drastically decreased. However, succeeding the launch of Sputnik I and the implementation of the NASA act in 1958, the national space budget for both military and civilian institutions steadily increased. As Tamar A. Mehuron has calculated, the total U.S. government spending on space technologies from the fiscal years of 1952-1957 was $4.4 billion, while the 1959 fiscal year equated a total space budget of $4.0 billion[212]. The U.S. government spending on space is seen to progressively increase up to 1991, with a steady progression from $4.4 billion in 1959 to a budgetary high of $39.1 billion in

[209] Bert Chapman, op. cit., 229-230.
[210] Michael E. O'Hanlon, *Neither Star Wars Nor Sanctuary: Constraining The Military Uses of Space* (Washington, D.C.: Brookings Institution Press, 2004), 3; John J. Klein, op. cit., 16.
[211] Arthur J. Downey, op. cit., 19.
[212] Tamar A. Mehuron, "2003 Space Almanac," *Air Force Magazine*, August 2003.

1989. This corresponds with the number of satellites deployed by the U.S. into the orbits: four satellites were deployed in the 1950s, five in the 1960s, nineteen in the 1970s, and twenty-one between the 1980s and 1990s[213].

While there are financial breaks in the U.S. space budget during periods of economic recession (such as between 1971-1974 and 1978-1980), the U.S. space budget from 1959 to 1991 still average a total of $23.6 billion per year[214]. Considering this total, it should be emphasized that a majority of U.S. government space funding during the Cold War was allocated towards civilian projects under NASA. Per year, around 70% to 82% of total U.S. government funding was allocated to NASA with the remaining funds being dedicated to the space projects of the Department of Defense and private benefactors[215]. This financial trend would suggest a correlation between the strategic principles outlined in the historical U.S. national space strategy and the monetary support for non-aggressive space technologies – like commercial satellites, space shuttles, and scientific probes – that had been developed under NASA[216]. Indeed, as Hans Mark argues, U.S. government funding for offensive military space technologies was almost non-existent during the Cold War as communication technologies and reconnaissance satellites were considered the more viable option in guaranteeing strategic interests in space. As such, the financial capacity of the U.S. to progressively increase its national space budget in all areas allowed for the protracted exploitation of the space environment using multiple civilian space technologies and artificial satellites.

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[213] Michael E. O'Hanlon, op. cit., 14.
[214] The average was determined by adjusting all national space budgets from 1959-1991 using the 2015 inflation rate (approximately 0.5% of the dollar amount), then divided per the number of years.
[215] Albert W. Wheelon, "The Civilian Uses of Space," in *Seeking Stability in Space: Anti-Satellite Weapons And The Evolving Space Regime*, ed. By Joseph S. Nye, Jr. and James A. Schear (Lanham, MA: University Press of America, 1987), 142; J. A. Giacalone, "Global Trends in the Commercialization of Space*," Journal of Business & Economics Research* 6.8 (2011): 67.
[216] J. A. Giacalone, op. cit., 68.

As the apparent archetype of great space power, the United States during the Cold War exemplifies all of the fundamental characteristics of a spacefaring state that developed into a space power. The long-standing strategic commitment to Eisenhower's national space strategy highlighted in several space policy documents and the legislation of the OST and other bilateral arms control agreements allowed the U.S. to proportionally increase its national power while maintaining space as a nonconfrontational sanctuary. Additionally, the financial commitment to progressively increasing the national space budget and a national commitment to civilian space projects allowed the U.S. to launch multiple artificial satellites at a pace that far outnumbered any other state that sought to exploit the space environment. That is, every other state but the second great space power: the Soviet Union.

3.3 The Soviet Union as a 20th Century Space Power

Although it has since fallen from its superpower status, the former Soviet Union has guaranteed an international legacy as the world's second great space power. As the first state to enter space, the U.S.S.R. had been at the forefront of all deliberations that involved the space environment during the Cold War. Corresponding to the characteristics of the United States during the period, the U.S.S.R exhibited strategic, political, and economic factors that reflect a great space power in the context of the 20th century security environment.

Contrasting the United States, the first national space strategy developed by the Soviet Union had a distinctive military focus that supported the exploitation of outer space for national interest with offensive space-based technologies. Following the end of the Second World War, the U.S.S.R. became fixated on the strategic utility of missile technology, predominantly technologies that would emulate the German V-2 rocket systems[217]. Through the covert actions of TsKB-1

[217] James Clay Moltz, "Russia and China: Strategic choices in space," in *Space and Defense Policy*, ed. By Damon Coletta and Frances T. Pilch (New York, NY: Routledge, 2009), 270.

starting in 1946, German rocket scientists and missile experts would be forcibly removed and transferred to Soviet occupation zones in Eastern Europe to begin work on the stagnant U.S.S.R. rocket programs[218]. Directly resulting in the development of the first intermediate-range ballistic missile system in August 1957 – the liquid-fueled R-7 "Semyorka" – the U.S.S.R. became the first state to own a space launch capability[219]. Initially, this technological milestone crafted a strategic understanding of space as being the "national right of the Soviet Union" and a geographic region that "must be controlled at all costs"[220]. As no other state had yet entered the orbits, the U.S.S.R. considered it to be in their national interest to limit the exploitation of all other states in space, thereby guaranteeing the unchallenged national influence and prestige of the U.S.S.R across the world[221]. This, as Rip Bulkeley and Graham Spinardi assert, contributed to the first national space strategy of the U.S.S.R. becoming centered on the application of multiple space-to-earth weapons[222]. Following the immediate aftermath of Sputnik I, the Soviet space strategy still remained fixated on the application of offensive military technologies in space. Conceptualized in 1952, the U.S.S.R. proceeded to develop the "Fractional Orbital Bombardment" system (FOBS) – a nuclear warhead-equipped launch system that would be deployed in low-earth orbit – to match the strategic demands of the first space policy[223]. By maintaining the "ability to strike with weapons of mass destruction in an extremely short flight time", the U.S.S.R. guaranteed the ability to "flex their muscles" within the space environment, thereby increasing their influence and prestige in outer space at the expense of all terrestrial states[224]. However, several strategic

[218] Matt Bille and Erika Lishock, op. cit., 23.
[219] James Clay Moltz (2009), op. cit., 270-271.
[220] Matthew Mowthorpe, "The Soviet/Russian Approach to Military Space," *The Journal of Slavic Military Studies* 15.3 (2002): 26.
[221] Rip Bulkeley and Graham Spinardi, Space Weapons: Deterrence or Delusion (Cambridge, U.K.: Polity Press, 1986), 16.
[222] Ibid.
[223] Rip Bulkeley and Graham Spinardi, op. cit., 18-19; Elinor C. Sloan, op. cit., 126.
[224] Matthew Mowthorpe, op. cit., 28.

reconsiderations contributed to a sudden re-valuation of Soviet space strategy that culminated in a loss of governmental support for the strategy.

With the rise of the United States technological leadership and national interest in the space environment, the first national space strategy of the Soviet Union was delegitimized. Although the U.S.S.R. had tried to deter space exploitation with four nuclear tests in the low-earth orbit in 1961 and 1962, the U.S. remained committed to deploying non-offensive space technologies. Risking international condemnation (or, worse, a potential nuclear standoff) over combatting these technologies, the U.S.S.R. concluded that the best means of maintaining national prestige in space was through the comparative deployment of similar and better non-offensive space technologies. Attempting to beat the U.S. "at their own game in space", the U.S.S.R. began to develop and deploy photoreconnaissance, ocean surveillance, and meteorological satellites[225]. The U.S.S.R. also began to accomplish a number of space milestones before the U.S. which influenced its international prestige: the first object to the Moon, the first two-man spaceflight, and the first space station, to name a few accomplishments. This culminated in the creation of the quintessential Soviet space strategy during the Cold War. Driven by the Cold War competition, the U.S.S.R. sought to dominate outer space by proportionally increasing the number of space technologies in the orbits in order to contest the growing influence of the U.S. space technologies in the orbits. The fundamental space strategy of the Soviet Union was, therefore, exemplified as a matter of quantity rather than of quality" following the launch of Sputnik I, as the Soviets understood that "more satellites would [most likely] equate more national prestige in the short and long term". Similar to the traditional definition of space power, the deployment of multiple satellites to

[225] Michael E. O'Hanlon, op. cit., 2-3.

populate space was, therefore, seen by the Soviet Union as the best space strategy for guaranteeing national interests above all other states in outer space.

In the days following the Reagan Administration's public announcement of the SDI in 1983, the long-established Soviet space strategy was permanently upset by an unforeseen disturbance that shifted the historical agreement between the United States and Soviet Union in outer space. Although American government authorities began to recommit the defensive posture of U.S. space strategy, the Soviet leadership's response was both "vehement and furious" over the perceived "offensive rearmament of space"[226]. In a statement issued four days after the announcement, General Secretary Yuri Andropov asserted that the strategic defense measures President Reagan spoke of would only seem defensive to "someone not conversant with these matters"[227]. Moreover, Andropov would exemplify the Soviet leadership's response by stating that it was time for the U.S. to "stop devising one option after the other in their search for [the] best ways of unleashing nuclear war in the hope of winning it"[228]. Hence, U.S. recommitment through "defensive space action" through the SDI was "not just irresponsible, it [was] insane"[229].

On this basis, the Soviet Union immediately saw the SDI as a decisive advantage that would allow the United States to achieve military superiority in the Cold War. Not only that but, as the United States would learn from KGB defector Oleg Gordievsky in 1985, the public consensus in the U.S.S.R. was that the SDI "might really work and could pose a fundamental challenge to the Soviet strategic arsenal"[230]. In response, Soviet Defence Minister Dimitri Ustinov was appointed by the Soviet Presidium to chair a commission to evaluate the potential threat posed by the SDI

[226] Matt Bille and Erika Lishock, op. cit., 24; James Clay Moltz (2008), op. cit., 75-76.
[227] Mira Duric, *The Strategic Defence Initiative: US Policy and the Soviet Union* (Surrey, U.K.: Ashgate Publishing, 2003), 41.
[228] Ibid.
[229] Ibid.
[230] Mira Duric, op. cit., 47; James Clay Moltz, op. cit., 221.

and create an immediate response through the implementation of an updated Soviet space strategy[231]. Although the commission's recommendations remain classified to this day, we know that from between 1983 and 1985 the Soviet defense budget was again increased, with an estimated growth of three billion annually allocated to the Soviet space program alone[232]. In addition, Russian scientist Yevgeny Velikhov would assert some years later that the Soviet military leaders, having read the commission's recommendations, called for the "immediate development of a comparable defence system for the Soviet Union" – which included the augmentation of their own space-based capabilities to include multiple artificial satellites to counteract the SDI[233].

Following the death of General Secretary Konstantin Chernenko in March 1985, General Secretary Mikhail Gorbachev assumed leadership of the Soviet Communist Party and the administrative mandate to address the SDI. Like Ustinov and Chernenko, Gorbachev viewed the SDI as a premeditated offensive action that the United States was using to "strategically outmaneuver" the Soviet Union and disturb the long-established understanding shared between both countries regarding sanctity of space[234]. Unlike his predecessors, Gorbachev also understood that competitively matching the space technologies developed under SDI tit-for-tat would result in severe ramifications for an already burdened national economy[235]. As Gorbachev understood it, the SDI would divert the already-minimal financial resources of the Soviet Union to an arms race in the space environment.

As Gorbachev's primary mandate priority upon assuming leadership of the Communist Part of the Soviet Union was to "forward…economic and social development", the SDI was

[231] Bill O'Neill, "Fear and Laughter in the Kremlin," *New Scientist*, March 1993, 36.
[232] Ibid, James Clay Moltz, op. cit., 231.
[233] Mira Duric, op. cit., 42.
[234] Frances Fitzgerald, op. cit., 284.
[235] James Clay Moltz, op. cit., 177.

quickly made the number one target of his diplomatic and public attacks[236]. According to Soviet diplomat Anatoly Dobrynin, Gorbachev's main target always remained the same throughout his term as General Secretary – "to kill or neutralize Star Wars through diplomatic negotiations"[237]. On October 11, 1986, Gorbachev finally got his chance with the Reykjavik Summit. Half way between Moscow and Washington, Gorbachev and Reagan met to discuss bilateral nuclear arms reduction. Although the summit started out promising, the discussion broke down following the introduction by Gorbachev of the SDI. Gorbachev insisted that the SDI research under the Department of National Defense be halted[238]. In response, Reagan assured Gorbachev that the SDI was "being developed not to gain an advantage, but rather to offer safety against accidents or outlaw nations"[239]. Reaching the end of the summit, Gorbachev would present his final terms: an acceptance of the continued development of the SDI, so long as testing was confined to the laboratory for the next ten years. Reagan refused, and the Reykjavik conference ended. As events would soon show, Gorbachev would drop his interest in stopping the SDI and, in the process, any attempt to preserve the acknowledged agreement between the superpowers to preserve space as a peaceful sanctuary safe from offensive space-based action. In reality, Reagan effectively recommitted the U.S. to pursuing peaceful space activities in the interest of national security, whereas the U.S.S.R. near the end of the Cold War made the major error of misreading the SDI as a purely offensive action. Instead of recommitting itself to its principal space strategy, the U.S.S.R. uncoupled itself from participating in national space activities.

Whilst strategic considerations drove the re-examination of the Soviet Union's national space strategy, various other articles of political legislation sustained a Soviet commitment to

[236] Frances Fitzgerald, op. cit., 407; 409.
[237] Mira Duric, op. cit., 46.
[238] Mira Duric, op. cit., 77.
[239] Ibid.

deploying non-offensive space technologies. Amidst growing tensions between the two superpowers, the U.S.S.R. came to the realization the U.S. could, following 1958 U.S. nuclear tests in the low-earth orbit, target and destroy Soviet satellites[240]. Although the U.S.S.R. struggled with the issue of whether to tolerate the U.S. capacity to directly influence the space environment, they ultimately concluded that mutual tolerance would better serve their national interests. The U.S.S.R. began to pursue the legislation of various bilateral arms control agreements with the U.S. with the political objective of limiting the deployment of U.S. space technologies and maintaining the Soviet influence in space. The agreements that helped guarantee the greatest allocation of Soviet interests in space included the Partial Test Ban Treaty (PTBT) in 1963 and the 1972 ABM treaty: two agreements that halted nuclear tests in space and highlighted the inherent right of both superpowers to pursue peaceful action in the orbits. The U.S.S.R. also signed the tentative space treaty – the Outer Space Treaty – which further supported a political commitment to maintaining the peaceful sanctuary of space while protecting the livelihood Soviet space technologies and national interest.

Like the United States, the Soviet Union had also demonstrated a proven record of financial engagement in space-related programs. As the civilian and military space programs were interchangeable, the allocation of the Soviet budget for individual projects was a lot higher than its U.S. equivalent. Indeed, with modern inflation rates, the total Soviet space budget averaged $33.5 billion dollars per year from 1959 to 1991 – 33% more than the U.S. space budget during the period. While the U.S. space budget split the financial resources into separate space projects under NASA and the Department of Defense, the Soviet space program – under the Ministry of General Machine Building – centralized space funding towards projects that possessed both

[240] Michael E. O'Hanlon, op. cit., 3; James Clay Moltz, op. cit., 271.

civilian and military functions[241]. As James Clay Moltz alleges, this enabled the U.S.S.R. to continue a "steady stream of manned and unmanned launches" throughout the Cold War with "little political resistance…[stopping the] resources in the [Soviet] space budget"[242]. The ultimate irony of the Soviet space program – and the cause for the fall of the Soviet Union as a space power – was that the U.S.S.R. began to experience serious financial problems during the latter part of Secretary General Mikhail Gorbachev's rule in the late 1980s[243]. In the 1980s, the U.S.S.R. would experience a serious financial crisis that would limit the available financial resources needed for space activities. It was at this point that the previous space strategy of U.S.S.R., which was centered on deploying multiple space technologies – became unprofitable and even damaging to the economic welfare and political unity of the state. In an almost poetic end for the first state to ever enter the space environment, the financial funds for the Soviet space program simply dried up.

Drawing many parallels with the United States, the Soviet Union also established itself as an archetypical great space power. Throughout the Cold War, the U.S.S.R. remained committed to a space strategy of balancing the interests of America in space through the deployment of multiple artificial satellites and space technologies. In addition, the political ratification of various bilateral arms control agreements, when matched with a support for the OST, would suggest a Soviet engagement to maintain its national influence and prestige through the assurance of space as a peaceful medium. Lastly – as is a testament to the country's standing as an influential spacefaring state – the U.S.S.R. maintained its strategic primacy in the space environment through the allocation of a formidable space budget. Although the Soviet Union was able to maintain its

[241] Matthew Mowthorpe, op. cit., 38; James Clay Moltz, op. cit., 271.
[242] Ibid, 271.
[243] James Clay Moltz, op. cit., 272-273.

position as a space power throughout the Cold War, its eventual political demise contributed to its delegitimization as a viable space power in the 21st century.

3.4 Ascertaining the Common Space Power Factors between the Cold War Superpowers in the 20th Century

Given the context of the Cold War, the two superpowers endured a bilateral relationship that, while centered on an open contest between the political ideologies of capitalism and communism, extended into an outright technological competition to maintain a presence in outer space. In this regard, the space environment represented new opportunities for both countries to "prove their merit in international relations…and by extending their [civilian and military] capabilities" for a future conflict[244]. Although profoundly different in why they sought to dominate the domain, the United States and Soviet Union exemplified common approaches when it came to the implementation of their national objectives in space. Having analysed the U.S. and U.S.S.R. from 1957 to 1991, one can deduce that there are three similar strategic, political, and economic features that both superpowers employed which allowed these great space powers to better guarantee their dominant posture within the space environment.

First, consider the similarities present between the strategic characteristics of the United States' and Soviet Union's national space activities during the Cold War. As is evident from the activities of both superpowers in the Space Race, both countries presented an operational framework for all subsequent national space security strategies that emphasized the peaceful preservation of space and a common memorandum of understanding in which opposing satellites would not be eliminated. As it would appear from the declassified documents on the material, both superpowers and, by association, all relevant space-related government departments and industry were concerned with the probability of escalation to a nuclear conflict over the destruction of a

[244] James Clay Moltz, op. cit., 121.

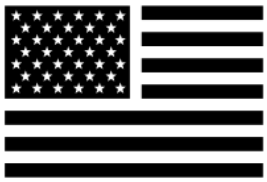
satellite. To address this concern, all subsequent national space security strategies presented by the great space powers from 1957 up until 1991 emphasised two central tenets: a national commitment to freedom in space and the use of space application technologies for peaceful purposes within the upper atmospheres. Yet, because it was still the Cold War, the "superpower competition" still persisted. This led both countries to begin deploying multiple satellites in an effort to, as Michael E. O'Hanlon describes, "one up one another" to acquire the mantle of the "lead space-faring nation in the world"[245]. An attitude shared by both superpowers since the start of the Space Age, this space strategy remained unchanged on both sides for the duration of the Cold War, with satellite launches increasing steadily on both sides up until the Soviet Union's eventual collapse.

Both superpowers also exhibited strong, centralized executive leadership at the upper levels of political decision-making that assisted in administering a common direction for all national space-related activities. As is evident from the previous historical analysis of the United States and Soviet Union from 1957 to 1991, national space-related activities that were successfully completed and launched into the terrestrial orbits required the support of all relevant collaborators, including from civilian, industrial, and military space organizations. Just as the "wonderful trinity" forwarded by Clausewitzian strategic thought combined three forces that theoretically drove the events of war, the triumvirate relationship shared between civilian, industrial, and military space organizations culminated in a cyclical relationship for all parties involved which, in turn, provide an appropriate blueprint for launching satellites into space[246]. National space activities can therefore be conceptualized as exhibiting this linked, interactively-driven relationship: civilians

[245] Michael E. O'Hanlon, op. cit., 46.
[246] Carl von Clausewitz, *On War* (London, U.K.: Penguin Books, 1968), 121: Correspondingly, Clausewitz forwards his theoretical trinity as consisting of "[first] the people, second…the General and his Army [and third] …the government". Through the trinity proper, the conduct of war is sustained by a state. The trinity example utilized above provides a representation of the interconnected nature of space organizations inside great space powers.

provide the legitimacy, industry provides the capabilities, and the military provides the objectives. The U.S. and the U.S.S.R. were more effective and efficient in deploying satellites during the Cold War because both superpowers could concentrate the aforementioned triumvirate space organization relationship towards a single national space strategy. As discussed, President Eisenhower produced a "national vision" that enabled NASA, the DOD, and other American space industries to pursue a common strategy towards space application. Similarly, the Soviet Presidium made compliance to a common space strategy the norm among the nation's relevant space organizations because of the "threat to national security" presented by remaining passive in the orbits. Although differentiated by political ideologies, the U.S. and U.S.S.R. were in the same way able to direct their national space activities only by providing effective leadership that unified all relevant civilian, industry, and military participants toward a single communal approach to space.

Table 3.1: Analysis of Great Space Powers in the 20th Century Security Environment

Great Space Powers (1957 – 1991)	**Strategic Characteristics**	**Political Characteristics**	**Economic Characteristics**
The United States 	• National space security strategy focuses on "freedom in space" and application for "peaceful purposes (NSC 5520 & NSC 5814/1).	• President provides leadership that creates "national space vision". • Creates OST (1967)	• Total average yearly government spending on space tech. from 1957-1991: $23.6 billion.
The Soviet Union 	• Risking international condemnation or potential nuclear standoff, shift strategy towards the proportional deployment of non-offensive space technologies.	• Presidium combines civilian, military, and industry space organizations • Creates OST (1967)	• Total average estimate at $33.5 billion per year from 1959 to 1991.

Besides strong political leadership, both countries also maintained their dominance as great space powers through the creation of international legislation that governed space activities. Undoubtedly, the most evident of these articles which supported the space superiority of the great space powers was the 1967 "Outer Space Treaty". Particularly Article IV (2) of the "No Bomb in Orbit" provision of the treaty, which to this day is used as the primary legal text against attempts to militarize activities in the upper atmospheres, allowed the great space powers to exhibit a considerable level of political legitimacy in exploiting the space environment with non-offensive space technologies while allowing for continued dominance of the region.

Lastly, and it will also come as no surprise, both superpowers shared similar economic characteristics that helped enable the rapid development and deployment of non-offensive space technologies representative of the traditional definition of space power. As discussed, the United States and Soviet Union combined national, civilian, and military space activities together. By emphasizing the dual-use role of satellites to their citizens – that is, the technological utility of artificial satellites in providing both public and military objectives – the budgets were combined thereby allowing the financial pot for space technology procurement to grow more easily. This lead to the second factor, which is simply that both counties could afford to dedicate a considerable sum of their national economy towards space-related activities and research. When joined together, the U.S. and U.S.S.R. illustrate similar economic characteristics that bolster the capacity to deploy multiple space technologies at regular intervals and their great space power status among the pantheon of spacefaring states.

To summarize, as shown in Table 3.1, the United States and Soviet Union/Russia existed as the great space powers of the Cold War because they shared similar strategic, political, and economic characteristics when conducting national space activities. Indeed, between the periods

of 1957 to 1991, the superpowers were able to guarantee and, over the long-term, maintain their presence in the space environment through effective leadership that could amalgamate participation from all relevant civilian, industry, and military space organizations toward a common direction to national space exploration. Compounded by these strategic similarities, both the U.S. and U.S.S.R. could sustain the arrangement of multiple artificial satellites into the upper atmospheres required of a great space power by preserving national interest through international space legislation and by simply having the economic resources needed to sustain expensive ventures into the space environment.

3.5 Conclusion

The brief military alliance enjoyed by the United States and Soviet Union during the Second World War quickly receded into memory at the dawn of humankind's exploration into outer space. As the U.S. consolidated a defensive position in Western Europe and U.S.S.R. solidified its control over Eastern Europe, both superpowers began to shift their attention toward exploiting the space environment for national prestige and interests. Being the first countries to enter the upper atmospheres at the beginning of the Space Age had its unique advantages, as both countries were able to guarantee their national objectives in space fairly quickly through the implementation of multiple national space strategies that accentuated the deployment of multiple satellites at increasingly frequent intervals. In addition, as both superpowers entered the space environment fundamentally unopposed, the U.S. and U.S.S.R. sought to preserve their supremacy in the space environment through a combination of international space legislation that maintained the domain as a peaceful sanctum free from offensive action and through the allocation of a substantial national space budget that could support continued artificial satellite launches.

Although the clash of ambitions between the superpowers was at its core a product of different divergent ideologies, the United States and Soviet Union shared very similar space power features that enabled them to more effectively and efficiently accomplish their national objectives in outer space. Through a combination of complementary national space strategies, effective political leadership, willingness to create and promote international space legislation, and a combined national space budget between civilian, industry, and military space organizations, the superpowers were better able to accomplish their national interests in high-earth orbits.

Within the theoretical brolly of strategic thought accommodated by space power, the United States and Soviet Union, from the periods of 1957 to 1991, together illustrate a clear, empirical example of two countries that began with a limited space capability at the start of the Space Age and who developed over the decades into the most influential members of the spacefaring community by the end of the Cold War. In the subsequent chapters, these descriptive space power features illustrated by the great space powers will provide a suitable measure for assessing what a spacefaring state must do if it is wishing to exploit the space environment the "right way". The absence of these descriptive space power features may also account for the lack of a long-standing presence in space by any other country – for instance, as will be discussed in Chapter Four, Canada's national space activities during the Cold War – that by all other accounts would have possessed the technological motivation to become an influential member of the emerging spacefaring community.

Chapter 4: Too Little, Too Late: Evaluating Canada's National Space Activities during the Cold War and its Impact on Canadian Space Operations in the 20th Century

4.1 Introduction

As the technological competition between the United States and the Soviet Union in outer space began to materialize, Canada was thrust into an advantageous position whereby it would be able to guarantee its own national interests within the space environment. Like a handful of other states, Canada was an active participant in the early Cold War; especially during the twilight of the Space Age[247]. As Andrew B. Godefroy noted, Canada's first foray into outer space was "[b]orn out of scientific curiosity and shaped by technological competence in [outer space] into political, military, and strategic saliency among its larger and more powerful allies". This initiative was somewhat apotheosized following the launch of Canada's first artificial satellite into low-earth orbit: the Alouette I on September 28, 1962[248]. By becoming the third state to enter the space environment, Canada was poised to become an influential space power among the pantheon of space-faring states.

A sense of national pride swelled across the country. Prime Minster John G. Diefenbaker in late 1962 personally congratulated the scientists and rocket technicians behind the Alouette I "[o]n behalf of the Government of Canada and the Canadian people" for their work on the "great scientific achievement of developing a Canadian satellite"[249]. So important was the launch of Alouette I that the Federal Government in May 1966 would commission the *National Space Study* to discuss how best to maintain a strategically dominant position presence in space using similar

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[247] Andrew B. Godefroy, *Defence and Discovery: Canada' Military Space Program, 1945-74* (Vancouver, B.C.: UBC Press, 2011), 1-2.
[248] Rob Huebert, "Canada and Commercial Satellite Imagery: Technology in Search of a Foreign Policy," in *Commercial Satellite Imagery and United Nations Peacekeeping: A View From Above*, ed. By James F. Keeley and Rob Huebert (Aldershot, U.K.: Ashgate Publishing Company, 2004), 195; Joshua Kutryk (Royal Canadian Air Force, "To Earth Orbit and Beyond: Discussion Points for a Strengthened Canadian Defence Strategy in Outer Space," *The Royal Air Force Journal* 4.4 (2015): 5.
[249] Ibid, 7.

artificial satellite technologies employed in 1962[250]. International pundits also took notice of Canada's grand accomplishment in space and the country's potential to become an influential spacefaring state. Indeed, as one group of authors from NASA's Goddard Space Flight Center in 1963 noted, "the most spectacular of [recent] accomplishments to date has been the Canadian swept-frequency topsider sounder, Alouette, which will probably yield more data about the upper atmosphere…than all other programs combined"[251].

Given the largely elated mood of the Canadian public following the immediate aftermath of the launch of Alouette I, the future of Canada's strategic position in outer space appeared too many observers to be an irrefutable constant in the turbulent sea that was the Cold War[252]. For a state like Canada, whose previous technological advancements and innovation had already cemented its status as one of the most scientifically-competent nations in the post-Second World War period, its first artificial satellite launch served to provide a tangible demonstration of self-worth to Canadians (and a clear illustration to the World) that retrenched the lingering impression that Canada had "substantial…skin in the game" that was the superpower-dominated space environment and was "prepared and willing to occupy a [long-term] residence" within the high-earth orbits[253]. Canada, it was hypothesized, would continue to maintain or even increase the regularity of its national space activities into the upper atmospheres and, in the process, establish a lasting influence for the nation in the space environment[254].

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[250] N. Harvey Lithwick, *Canada's Science Policy and the Economy* (Toronto, ON: Methuen, 1969), 41.
[251] Joshua Kutryk, op. cit., 2-3.
[252] Andrew B. Godefroy, op. cit., 2.
[253] "NASA Facts: Alouette – Canada's First Satellite", *file F-12-62*, December 16, 1962, Library and Archives Canada (LAC), Ottawa, Ontario, 6-7.
[254] Uncredited, "A view from space," *Financial Times of Canada*, November 1968, 3; Robert Cohen, "Year of decision for all-Canadian satellite network," *Financial Times of Canada*, January 9, 1967, 7; Chris Gainor, *Canada in Space: The People & Stories behind Canada's Role in the Exploration of Space* (Edmonton, AB: Folklore Publishing, 2006), 32-33.

However, rather than highlight the beginning of a long-term strategic presence in the atmospheric orbits, the Canadian-built and developed Alouette I signalled the apex of national space activities in Canada[255]. Somewhere between Alouette I in 1962, and end of the Cold War in 1991, Canada's national space activities began to fall behind other more-conventional, ground-based scientific and technological programs in terms of government coordination and support, qualified personnel who understood the limitations of space operations, and project funding for space technology[256]. Near the end of the 20th century, Canada's presence in space did not look at all like what by Canadian policy-makers and society had envisaged during the early 1960s. Comprising of a single astronaut from the Canadian Space Agency (CSA), who participated in the multilateral International Space Station (ISS) programme starting in 1998, the Shuttle Remote Manipulator System (SRMS), and a few aging scientific and communication satellites which would become technologically unserviceable by the beginning of the 21st century, Canada's strategic presence in space was marginal by the end of the century[257]. Antagonistic to the optimistic mood forwarded by Canadian policy-makers and society following the launch of Alouette I, the country's national space activities have experienced difficulties in guaranteeing a long-term strategic presence in space in the late 20th century and the early 21st century despite the country being involved in the exploitation of the domain for nearly two generations.

One is left to question why Canada, in spite of the governmental and societal optimism for future space operations that followed after Alouette I, had reduced its scientific and technological potential toward conducting national space activities during the beginning of the Space Age. In

[255] "NASA Facts: Alouette – Canada's First Satellite", *file F-12-62*, December 16, 1962, Library and Archives Canada (LAC), Ottawa, Ontario, 7.
[256] Rick Pitre (Royal Canadian Air Force, Ret'd), Interviewed by Kiernan McClelland, *Research Interview*, September 29, 2016; André Dupuis (Royal Canadian Air Force, Ret'd), Interviewed by Kiernan McClelland, *Research Interview*, November 20, 2016.
[257] Canadian Space Agency, "Mission and Mandate," *Government of Canada*, January 2017.

other words, what happened during the Cold War which swayed Canada from advancing a clear aspiration to enter outer space more frequently using artificial satellites, thereby allowing the country to maintain a long-term presence in the domain, to a country with a limited space capability centered on a few space-based assets within terrestrial orbits?

To determine an answer to this question, this chapter will evaluate the major strategic, political, and economic factors that affected Canada's national space activities during the mid to late 20th century security environment. Similar to the previous examination of the United States and Soviet Union as great space powers, this chapter will present a comprehensive analysis of Canada's national space policies and strategies, membership in international and multilateral space agreements, and financial resources dedicated to space projects from the assessment period of September 28, 1962 to January 16, 1991[258]. Following this analysis, the chapter will then discuss the strategic, political, and economic factors that influenced the capacity of the nation to commit to national space activities in the years following the launch of Alouette I. Despite signifying considerable scientific and technological promise at the beginning of the Space Age, the chapter concludes that a combination of strategic, political, and economic decisions made by several, successive governmental actors restricted the regularity of national space activates that the country could pursue during the Cold War.

4.2 Strategic Factors of Canada's National Space Activities during the Cold War

One should first consider the strategic factors that sustained Canada's national interest toward the exploitation of the space environment immediately following the end of the Second World War. Prior to the launch of Sputnik I and the formal beginning of the Space Age, national

[258] This time period is imperative to examining Canada's national space activities in the Space Age during the late 20th century. It is imperative for the evaluation as it extends two separate chronological events that signalled the beginning and the end of Canada's development as a contemporary spacefaring state. These events are the successful launch of Alouette I on September 28, 1962 and the commencement of "Operation Friction" on January 16, 1991.

space activities remained like other fledging space-faring countries, in the hands of the military. Indeed, Canada's military viewed outer space as a geographic region that was to be a "strategic multiplier for…[a future] military operation" through the utilization of a "winning weapon"[259]. As historian Donald Avery states, "[b]y the summer of 1946 [and beyond], Canadian military planners no longer considered war with the Russians a remote possibility" – climaxing in a universal drive in the military and public services for the development of military technologies that were capable of counteracting the U.S.S.R.[260]. Perhaps because of this perception coupled with a lack of available funds, the Liberal Governments under Prime Ministers William Lyon Mackenzie King and Louis St. Laurent would position Canada's strategic commitments in outer space between 1946 and 1957 to be in line with the commitments of the United States: based on developing "long-range artillery" and "nuclear-delivery" systems including ballistic missile systems[261]. To further support this strategic commitment, the Defence Research Board (DRB) was also founded within the Department of National Defense in 1947[262]. With an initial policy paper that stressed the "need to develop a completely independent defense research capability in Canada…[so as to] focus on long-term research and development" of military space technologies, Canada had publically stated its future ambition to fight alongside its main allies – the Americans and British – in a confrontation that would occur in the celestial orbits[263]. While this aggressive approach to the space environment was normal for most states like the United States or Soviet Union during the period, the Canadian

[259] D. J. Goodspeed, *A History of the Defence Research Board* (Ottawa, ON: Queen's Printer, 1958), 45-46.
[260] J. Starnes, *Closely Guarded: A Life in Canadian Security and Intelligence* (Toronto, ON: University of Toronto Press, 1998), 76-81.
[261] James G. Fergusson, *Canada and Ballistic Missile Defence, 1954-2009: Déjà vu All Over Again* (Vancouver, B.C.: UBC Press, 2010), 16-17.
[262] Andrew B. Godefroy, op. cit., 14-15.
[263] D. J. Goodspeed, op. cit., 50-51; Andrew B. Godefroy, op. cit., 17.

strategic commitment would, for the first and only time, be concentrated on a single objective – on guaranteeing the "ultimate high-ground" for the protection of Canadian national interests[264].

Yet, succeeding the Soviet Union's first expedition into outer space, Canada's governmental and military leadership became conflicted over what exact strategic role the burgeoning Canadian space power was to play at the beginning of the Space Age. At first glance, the launch of Sputnik I had again unified the relevant sections of government and the military – including the "[Federal] Cabinet and the Departments of National Defence, Science and Technology, and Transpiration" – under a common memorandum that espoused "pursuing activities in outer space as symbiotic to attainment of national interests"[265]. However, there was universal disagreement over how the utilization of the orbits was to be achieved through the implementation of a national space security strategy. Indeed, there was a considerable level of infighting that occurred between the three main organizations that controlled Canada's early space activities – Defense Review Board (DRB), the National Research Council (NRC), and the Royal Canadian Air Force (RCAF) – over what would constitute Canada's first space strategy[266]. On one hand, the DRB and RCAF argued that Canada needed to develop a strong independent technological capability in outer space to gain national interests[267]. However, the DRB articulated a "science-oriented agenda" that promoted the deployment of multiple artificial satellites under a newly-formed civilian space agency, whereas RCAF presented a much "more technology-focused agenda" that supported the development of more offensive military space technologies – resulting in a constant clash between the two organizations over "which of them should take priority in

[264] D. J. Goodspeed, op. cit., 52.
[265] Andrew B. Godefroy, op. cit., 72-73.
[266] D. J. Goodspeed, op. cit., 51.
[267] "Air Marshal Hugh Campbell to Air Marshal C. R. Slemon, deputy commander in chief of NORAD", *file 840-105-001.8*, March 28, 1961, Library and Archives Canada (LAC), Ottawa, Ontario; J. Schmookler, *Invention and Economic Growth* (Cambridge, MA: Harvard University Press, 1966), 64.

determining the direction of Canadian space activities"[268]. On the other hand, the NRC forwarded that Canadian national interests in outer space could best be guaranteed through civilian "upper atmospheric research [and] atmospheric seeding experiments" and "increased communication and meteorological [satellite] launches"[269]. While it seems almost trivial, these initial policy divisions would cause these organizations to disagree at the most rudimentary strategic level on all matters related to outer space. As Andrew B. Godefroy would present, it was "[b]y the fall of 1964…that the [intergovernmental] conflict reached its new low…[and] nearly jeopardized an important portion of Canada's national defence cooperation agenda"[270]. Hence, the three main organizations that were charged with guaranteeing Canadian space power had no comprehensive clue of how to create an accepted national space security strategy that would adequately provide for a Canadian influence in the space environments; rather, they were preoccupied with fighting amongst themselves on matters ranging from civilian oversight on space launches to national space budgets.

This troublesome issue associated with the creation of an all-inclusive national space strategy for Canada was further exacerbated by the lack of governmental direction from the Office of the Prime Minister (PMO). While the DRB-NRC-RCAF squabbled about the sorts of space missions that Canada should perform in the aftermath of Sputnik I, the PMO remained remarkably ambivalent to addressing any topic related to the strategic application of outer space. Undeniably, the Prime Minister who would set the fundamental benchmark for this lackadaisical approach to addressing Canadian space strategy was "the chief" himself – Prime Minister Diefenbaker. Having been elected in the 1957 federal election in a landslide victory, Diefenbaker had been successful

[268] D. J. Goodspeed, op. cit., 51; "Statement by Honourable Lucien Cardin Associate Minister of National Defence Press Release Statement / simultaneously released in Washington at 9:30 PM, EST", *file DRB 1-64*, January 13, 1964, Library and Archives Canada (LAC), Ottawa, Ontario.
[269] "Some Factors Affecting Defence Research Policy – A Report to Board Members, October 1957", *file DRBS 173-1*, October 23, 1957, Library and Archives Canada (LAC), Ottawa, Ontario.
[270] Andrew B. Godefroy, op. cit., 87-88.

on a "publicly perceived anti-American platform" that "seemed little interested in outer space or space cooperation with America"[271]. Perhaps because of this, Diefenbaker would routinely "deviate from the facts in his speeches when discussing [Canada's military] space program plan"; opting instead, when questioned, to simply "make a splash" by claiming that Canada had similar space technologies to the U.S.[272].

Even following the launch of Sputnik I in 1957 (which, as presented in the introduction, caused a stir in the Canadian media) and Alouette I in 1962, Prime Minister Diefenbaker would remain noticeably impassive and uninterested in anything to do with the strategic application of outer space. As is unmistakeably demonstrated in the days following the Sputnik I launch, the Government did not articulate any plans for an official response to the launch, nor did it take any steps towards developing a contingency plan to counteracting threats originating from the high-earth orbits[273]. Even when the DRB-NRC-RCAF (in an uncharacteristic show of unity) advised the government to develop a response, the Diefenbaker Government simply ignored them. Instead, Diefenbaker initiated several political reforms that cancelled a number of high-profile national efforts to support the development of sophisticated space-based and terrestrial technological development – including the ill-fated CF-105 Avro Arrow[274]. Correspondingly, the launch of Alouette I spurred a similar limited reaction from Diefenbaker that would suggest a passing interest rather than a strategic commitment toward continuing national space activities. In a statement made on September 29, 1962, Diefenbaker presented the future of Canadian space activities as consisting of "[t]he knowledge gained, which will be used for peaceful purposes, should greatly improve the problem of communication" as well as a personal congratulations to the satellite's

[271] Andrew B. Godefroy, op. cit., 69.
[272] Record Group (RG) 25, *file 12798-4-40*, Library and Achieves Canada (LAC), Ottawa, Ontario.
[273] Andrew B. Godefroy, op. cit., 73.
[274] Peter Stursberg, *Diefenbaker: leadership gained, 1956-62* (Toronto, ON: University of Toronto Press, 1975), 112:

designers "for selecting such a distinctive Canadian name as Alouette"[275]. In fact, spurred by his campaign promises, the end product of Diefenbaker's tenure as Prime Minister indicated a clear ambivalence toward the strategic application of the space environment – a fact that, if anything, would aggravate the already short-fuse tensions shared between the DRB-NRC-RCAF and would prolong the development of a national space security strategy for Canada.

Diefenbaker's general ambivalence toward creating a sovereign national space strategy saw its peak with the appointment of the Royal Commission on Government Organization in 1960 and the Commission's conclusions released throughout the 1960s. Named after its chair John G. Glassco, the Glassco Commission offered a number of science and technology policy, management, and development recommendations for many of Canada's federal departments with the mandate to "inquire into and report upon the organization and methods of operation of the departments and agencies of the Government of Canada and to recommend the changes therein which…would best promote the efficiency, economy and improved service in the dispatch of public business"[276]. Throughout the course of the Commission's proceedings from September 1960 to November 1963, the declassified Glassco Commission reports demonstrate a clear absence of any senior-level policy agenda offered by a dedicated governmental space organization to the Commission during the period. While other smaller, lower-level government groups were able to successfully lobby the Glassco Commission into "fixing" several departments (including the Treasury Board, whose sweeping reorganization was a product of these lower-level groups), the space operation lobby consisting exclusively of DRB-NRC-RCAF often varied in how to define a

[275] NASA Facts: Alouette – Canada's First Satellite", *file F-12-62*, December 16, 1962, Library and Archives Canada (LAC), Ottawa, Ontario, 7.
[276] Privy Council Office, "Report of the Royal Commission on Government Organization, Volume 1", *file Z1-1960/4-1E*, September 12, 1962, Library and Archives Canada (LAC), Ottawa, Ontario, 19.

Canadian role in space[277]. With no real combined attempt to reorganize Canada's space organizations to increase the efficiency or sustainability of national space activities in the early Space Age, the DRB-NRC-RCAF competition over whose strategy would be used to control space remained continually disregarded by the Prime Minister and his Cabinet.

Evidently, the Federal Government looked upon national space activities during the Glassco Commission in much the same way as it looked to technological procurement during the period in general. As Dr. James Fergusson recalls from his research on Canadian ballistic missile defence, the Federal government "ignored [technological] procurement [under Prime Minister Diefenbaker] except when they became necessary…[and] even then only when there was some kind of political purpose rather than a policy goal to be had"[278]. In comparison, because national space activities remained very much a "niche area" during the Glassco Commission, a grand Canadian vision of a national space strategy was deferred by Diefenbaker as more important policy issues took precedence and, consequently, were provided supplementary government and technological resources that could have otherwise been used to develop a restructured space program[279].

Albeit less obvious, this legacy of the PMO would be continued during the tenure of Prime Minister Lester B. Pearson following the federal election in 1963. Like Diefenbaker, Pearson demonstrated little interest in discussing outer space in government policy-making or in mandating a national space security strategy to direct future Canadian national space activities[280]. Indeed, as several commentators have noted, the Pearson Government "turned away from international issues

[277] Andrew B. Godefroy, op. cit., 274.
[278] James Fergusson, Interviewed by Kiernan McClelland, *Research Interview*, November 13, 2016.
[279] Ibid.
[280] Lester B. Pearson, *Mike: The Memoirs of the Rt. Hon. Lester B. Pearson* (Toronto, ON: University of Toronto Press, 1975), 157.

dealing with science and technology [in outer space], as internal government reorganization and professionalization of the civil service became top priorities"[281]. With his retirement from his tenure in 1968, Pearson would leave the Canadian national space strategy as it had been prior to 1963: a dishevelled collection of ideas from various infighting organizations. Hence, the absence of a clearly defined mandate or ministerial advocate during both the Diefenbaker's and Pearson's terms resulted in a "disjointed approach to [the] research and development [of space technologies] as the formation of policy and programs was left up to the discretion and competing agendas of the agencies actively engaged in developing space projects''[282].

Nevertheless, some progress was made during the Pearson Government's tenure that attempted to merge and revaluate the strategic commitments of the DRB-NRC-RCAF towards a single, unified national space strategy. By November 1965, Canada faced a significant impasse that threatened the country's organizational and technological ability to conduct further satellite launches. Through a combination of recent advents to space exploration technology that enabled easier entrance into the upper atmospheres and the ongoing race to the Moon between the superpowers, the Pearson Government determined that a "top-to-bottom" reorganization of Canadian space resources was desperately needed to maintain Canada as a significant space nation[283]. The answer finally came in May 1966, when the Science Secretariat of the PMO commissioned the *National Space Study*[284]. Better known as the "Chapman Report", the final document included input from various civilian and industry stakeholders involved in national

[281] James G. Fergusson (2010), op. cit., 50; Andrew B. Godefroy, op. cit., 71.
[282] Andrew B. Godefroy, op. cit., 71.
[283] N. Harvey Lithwick, op. cit., 41.
[284] Rob Huebert, op. cit., 195.

space activities (although military advocates were unusually limited in their representation) that was collected by the committee through numerous interviews and inquiries across the country[285].

When it was released for public consumption, the Chapman Report highlighted several long-standing issues with Canada's strategic approach to national space activities as well as the historical disagreements over space strategy exhibited between DRB-NRC-RCAF. While the study noted that the successful launch of Alouette I had made Canada a significant "space nation" among the space-faring community, the prospect of Canada becoming a space power was facing multiple challenges. Foremost among these challenges was the assertion that "[t]he absence of a national mission-oriented agency with overall responsibility for upper-atmosphere and space activities in Canada [had] resulted in fragmented programs, divided responsibilities, and serious omissions in planning" which in turn had led to "tragic consequences for Canada in loss of technological opportunity…and in gradual erosion of national control over natural resources"[286]. The study would further advance the argument that the lack of a Canadian national space strategy was a product of a significantly lower "GNP basis [for national space activities] than other industrial nations" and the inability to launch "small...satellites at a rate which will justify supply from Canadian sources"[287].

The study would forward three main strategic recommendations. The first was the need for the immediate creation of a "centralized organization to oversee all space activities in Canada"[288]. Second, was the recommendation for the "development and deployment of more Canadian satellites for domestic telecommunications by 1970 or 1971"[289]. And third was the development

[285] Andrew B. Godefroy, op. cit., 90-91.
[286] J. H. Chapman, P. A. Forsyth, P. A. Lapp, and G. N. Patterson, "Upper Atmosphere and Space Programs in Canada, Special Study 1#," *Science Secretariat Privy Council Office*, February 1967, 91-92; 101.
[287] Ibid, 109-110.
[288] Ibid, 110.
[289] Ibid, 111.

of an "indigenous satellite-launching capability" to support the fulfillment of the second recommendation[290]. Supplementing these recommendations, the Science Council of Canada would publish two subsequent official reports in 1967 that would serve to further buttress the strategic recommendations made by the Chapman Report. First, in January 1967, the *Upper Atmosphere and Space Programs in Canada: Special Study No. 1* would restate several of the conclusions reached in the Chapman Report and argue that "in the interests of survival, [Canada] must define those technologies which are crucial to Canadian aspirations, independence and social justice"[291]. The study would also articulate a very clear description of the role that satellites would serve in guaranteeing Canada's national interests within the space environment: "[s]pace technology is so directly related to the needs of a large, sparsely populated country, that it cannot be ignored…[i[n a free society, it will be used, and the role of the Government is to see that space technology is used in the best interests of Canada…[i]t is therefore an inescapable conclusion that the elements of space technology vital to Canada must be under Canadian control"[292]. This study would be followed in July 1967 by *Report 1: A Space Program for Canada*, which outlined in a broader sense the needed steps toward the "advancement of [the] Canadian capability in the science and technology of the upper atmosphere and space" as necessitating the development and deployment of a greater number of civilian and military satellites into the high-earth orbits[293].

Overall, the Chapman Report provided the most comprehensive and detailed attempt since the beginning of the Space Age to produce a national space strategy for Canada. Notwithstanding the defence-driven agenda of the RCAF being moderately sidelined in favour of the more scientifically-grounded and civilian-controlled agendas of the DRB and NRC, the report provided

[290] J. H. Chapman, P. A. Forsyth, P. A. Lapp, and G. N. Patterson, op. cit., 111.
[291] Ibid, 95.
[292] Ibid, 111.
[293] Science Council of Canada, "Report 1#: A Space Program for Canada," March 1967, Ottawa, Ontario, 5.

a top-down governmental framework that concentrated Canada's civilian and military space organizations and resources toward a clear set of objectives and policies. As Canada was governed by a democratic civilian authority, the report verbalized the decision-making authority of the Federal Government on national issues related to space activities[294]. Consequently, the Chapman Report launched a strategic reposting of existing national goals in space – underscoring the deployment of multiple satellites that had been forwarded by the RCAF since the end of the Second World War and ending the historical disagreement between DRB-NRC-RCAF through the combination of scientific and civilian suggestions. In the aftermath of the report, Canada was poised to re-enter the space environment by progressively increasing its artificial satellite launches with all manner of non-offensive space technologies. Those satellites that had seen particular success, such as the Alouette I, would be continued. The bureaucratic quagmire had been overcome as it appeared that Canada was finally on the path to creating a comprehensive national space strategy needed to guarantee its strategic interests within the high-earth orbits.

As luck would have it, by the end of the 1960s, the initial momentum generated by the Chapman Report was abruptly halted by the 1968 election of Prime Minister Pierre Elliot Trudeau. Contrasting the Governments of Diefenbaker and Pearson, Trudeau assumed office with the clear intention of influencing Canada's space strategy in some capacity. Still, this premeditated intention would do more bad for the overall formulation of Canada's national space strategy than good. Indeed the new agenda for outer space forwarded by the Trudeau Government, with the objective of providing "Canadians with [space projects] with clear short-term political and economic returns", emphasized the discontinuation of national space activities that were deemed "not

[294] Science Council, "Report 1#: A Space Program for Canada," March 1967, Ottawa, Ontario, 7.

beneficial"[295]. Recalling this period, a Standing Committee on Research, Science and Technology statement published in June 1987 would recall that the "Federal Government [during the late 1960s] made a decision to redirect Canada's space activities from purely scientific pursuits (exemplified by the Alouette and ISIS programs) to the applied"[296]. As the statement would further articulate, "[s]pecifically, this meant that Canada's principle objective in space would be the application of technology and science to domestic telecommunications and resource survey problems"[297]. The leading strategic objective in the space environment, following the change in government, suddenly became focused on the creation of a space-based satellite communications capability that would connect the country from coast to coast.

Corresponding to this newfound objective, the Trudeau Government would make two decisions that effectively redirected and reduced Canada's existing space capabilities whilst attempting to create a new satellite communication network. The first decision made by Trudeau and his Cabinet was to redirect the research, development, and production of Canadian space technologies away from its long-established civilian and military components toward limited commercial and industrial applications[298]. Supporting a previous Liberal Party initiative which was half-heartedly accepted by the Pearson Government in the 1968 *White Paper on a Domestic Satellite Communication System for Canada*, Prime Minister Trudeau – who had previously served on the government task force that transcribed the paper – would advocate the establishment of a shared public and private Crown corporation that would bankroll and operate the satellite

[295] John Vardalas, *The Computer Revolution in Canada: Building National Technological Competence* (Cambridge, MA: MIT Press, 2002), 173; Andrew B. Godefroy, op. cit., 174.
[296] Standing Committee on Research, Science and Technology on the Study of Canada's Space Program, "Canada's Space Program: A Voyage to the Future, Report of the Standing Committee on Research, Science and Technology on the Study of Canada's Space Program," June 1987, Ottawa, Ontario, 2.
[297] Standing Committee on Research, Science and Technology on the Study of Canada's Space Program, op. cit., 2.
[298] Rob Hubert, op. cit., 195.

communication network[299]. The second decision was to refocus Canada's existing national space activities away from, what the Trudeau Government would determine warranted military-related applications. As Dr. John Kirton calculates, Canada's national space activities by 1967 continued to be predominantly military-related as "almost 75 per cent of Canadian space expenditures had some degree of military orientation" and a plurality of national space resources and expertise remaining at the Department of National Defence[300]. Nonetheless, rather than create a separate civilian space organization, the Trudeau Government made the decision to transfer national space resources and expertise out of DND (including the DRB and RCAF) and into the NRC and the newly-created Department of Communications, which was given the primary government mandate to oversee the development of a satellite communication network. The decision was also made in late 1970 establish an Interdepartmental Committee on Space (ICS) with the government mandate to "review and coordinate Canadian space activities and resources and to consider plans and policy"[301]. Supporting Trudeau's commitment to civilianizing national space activities, DND was reassigned to the task of "observer work" while public and private space organizations were expected to determine the future direction for Canadian space power[302].

To further impose the sudden strategic reposting of Canada's national space organizations and to cement the permanence of these two decisions, the Trudeau Government would table Canada's first civilian space policy in April 1974. Demonstrating an obvious bias toward industry's role in space operations, the policy would support three key strategic ideas that would

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[299] Charles Mills Drury (Department of Industry), "White Paper on a Domestic Satellite Communication System for Canada," February 1968, Ottawa, Ontario, 11; John Vardalas, op. cit., 175.
[300] John Kirton, "A Renewed Opportunity: The Role of Space in Canadian Security Policy," *in Canada's International Security Policy*, ed. By David Dewitt and David Leyton-Brown (Scarborough, ON: Prentice-Hall, 1995), 111-112.
[301] Terrance Jamieson, "The Canadian Space Research Program – Science and Technology Division," *file BP-121E*, February 15, 1985, Library and Archives (LAC), Ottawa, Ontario, 19.
[302]Elinor C. Sloan, Interviewed by Kiernan McClelland, *Research Interview*, September 29, 2016; James Fergusson, Interviewed by Kiernan McClelland, *Research Interview*, November 13, 2016.

deviate from the Chapman Report's recommendations: an obligation to shift national space activities towards "pure space science" purposes, recommitments, that had previously been articulated in the 1968 White Paper, emphasizing the transition of space technology procurement to industry; and the prerequisite for Canadian satellites be "designed, developed, and constructed" in Canada[303]. Overall, the policy "encouraged joint government-industry endeavours to develop an indigenous productive capability…[which] was aimed at satisfying domestic space system requirements, providing high technology employment opportunities, and enhancing the ability of Canada's aerospace industry to penetrate additional export markets"[304].

In the immediate aftermath of the 1974 civilian space policy being implemented by Upper House of Parliament, the Trudeau Government would essentially provide a strategic repositioning of national space activities that would essentially starve the deep-rooted, defence-oriented space programs of the NRC-RCAF of most governmental funds and resources. As was expected, the lack of government funds toward the NRC and RCAF resulted in the immediate termination or gradual reduction of a historically strong component of national space operations[305]. In addition to funding being cut, the transfer of experienced personnel from the established military space projects of NRC-RCAF to the indeterminate policy mandate of ICS further set Canada back in its ability to guarantee national priorities in space[306]. Recalling the consequences of the transfers, one retired NRC member using the interviewee pseudonym "John Smith" summarized the general sense of the decision: "it was confusing for everyone…[as t]here was no one mandate…every department looked after their own projects". In due course, the "Canadian space capability diminished…[as

[303] Jeanne Sauve (Minister of State for Science and Technology), "A Canadian Policy for Space," *file 4145-09-1*, 1974, Library and Archives (LAC), Ottawa, Ontario, 1-4.
[304] Jeanne Sauve (Minister of State for Science and Technology), op. cit., 3-4.
[305] Andrew B. Godefroy, op. cit., 189.
[306] Ibid.

t]he Trudeau Government's policy was to remove the military component from space issues but no real effort was…made to develop a Canadian equivalent to NASA"[307].

When compared to the strategic recommendations outlined in the Chapman Report, that advanced the development and deployment of a greater number of civilian and military satellites, the Trudeau Government's decision to rely on buttressing the public-private relation in space drove the formation of a Canadian space strategy in flux. Whereas the Chapman Report had advocated a unified approach to space operations centered on the deployment of multiple satellites, the Trudeau-style of government and political agenda degenerated satellite launches to the lower end of national priorities. By 1981, control of a potential Canadian space strategy that utilized satellites had been transferred from the Department of National Defence to the Departments of Communication and Energy, Mines and Resources[308]. These departments were provided with little financial or governmental resources to develop a leadership role for national space activities. To summarize the second strategic idea during the 1970s, "Canadian space efforts were largely a privatized civilian affair with no cohesion or focus, concentrating on niche industries rather than national priorities"[309]. In the context of Canada's national space strategy, the Trudeau-era tentatively quashed most of Canada's space capabilities and silenced a majority of the governmental enthusiasm within the DRB-NRC-RCAF for guaranteeing a more visible presence for Canada in the 20th century space environment.

It was only following the announcement by the Reagan Administration's Strategic Defence Initiative (SDI) on March 23, 1983 that Canada would again become interested in formulating a national space strategy incorporating all civilian and military space organizations. Following

[307] Rob Huebert, op. cit., 197.
[308] Andrew B. Godefroy, "Canada's Strategy for Space, 1985-1999," *The Canadian Institute of Strategic Studies Datalink #82*, November 1999, 1.
[309] Andrew B. Godefroy, op. cit., 1.

President Reagan's famous "Star Wars" speech and the reiteration of the United States' strategic commitment to "peace through…strength", Canada found its closest and most dependable international security partner contemplating the utility of dominating the space environment through advanced space technologies[310]. Following the address, Canadian policy-makers suddenly found that the Trudeau-era had left Canada had with no mechanism with which, even passively, to monitor the issue[311]. While the previous 1981 renewal of the NORAD agreement had indicated a strong emphasis toward the use of space technology for defence and exploration, Canadian policy-makers in the decade-old Liberal Government were generally uninterested in supporting any costly bilateral space venture. Yet, after the election of a new Progressive Conservative Government during the 1984 Federal Election, Prime Minister Brian Mulroney – who was eager to strengthen Canada-U.S. relations – was invited to participate in the SDI by the Reagan Administration. However, the Government again declined. Recollecting his conversation with Prime Minister Mulroney on the topic of SDI, James Fergusson recalls that "the moment Reagan stepped off the plane [to attend the March 1985 "Shamrock Summit"], Mulroney was very clear with a blunt 'no' to [SDI]"[312]. In a public declaration that would, Mulroney understood, calm the fears of many Canadians, Canada's civilian and military space organizations would not pursue the weaponization of outer space[313]. However, in a move that would spark a renewed government and public debate on a national space strategy, the Mulroney Government allowed Canadian scientific and technological companies to participate in the initiative[314].

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[310] Mira Duric, *The Strategic Defence Initiative: US Policy and the Soviet Union* (Surrey, U.K.: Ashgate Publishing, 2003), 166.
[311] Andrew B. Godefroy (1999), op. cit., 2.
[312] James Fergusson, Interviewed by Kiernan McClelland, *Research Interview*, November 13, 2016.
[313] Ibid.
[314] Ministry of External Affairs, "Satellites: the Canadian experience," *Government of Canada*, April 1984, 2; Joel Sokolsky, "The Bilateral Defence Relationship with the United States," *in Canada's International Security Policy*, ed. By David Dewitt and David Leyton-Brown (Scarborough, ON: Prentice-Hall, 1995), 179.

Perhaps because of this allowance to such a sophisticated (and controversial) military program, the Mulroney Government would create several intergovernmental committees consisting of civilian and military organizations that were tasked with reviewing the prospect of creating a national space program for Canada. Through the studies conducted by the 1985 Senate Special Committee on National Defence and the 1986 House of Commons Standing Committee on External Affairs and National Defence, it was recommended that Canada investigate the establishment of a national military space program to compliment and support the space activities of a civilian space organization equivalent[315]. Both studies would also articulate the common requirement for Canada to support the deployment of multiple satellites encompassing a variety of services – including "early warning, surveillance, and communication tasks necessary for the protection of national security"[316]. The final recommendation forwarded by both studies was fairly new to the Canadian case context, supporting the "dual-use [characteristic of space technology to] provide scientific and defence functions for the social and economic benefit of Canadians"[317].

Considering these recurrent recommendations, the Mulroney Government would release its governmental policy paper on outer space in 1986. For the first time since the beginning of the Space Age, the Canadian Federal Government called for a common memorandum between all of the relevant space organizations involved in the management of Canada's space activities. As Rob Huebert notes, the "policy paper was [also] important in that it provided the first real effort to develop a coherent policy on space"[318]. The verdict was made in late 1986 to rejuvenate a national strategy in space by reversing two Trudeau-era policy decisions: to combine civilian space organizations into a single national agency and to revive military space activities.

[315] Andrew B. Godefroy (1999), op. cit., 2.
[316] Ibid.
[317] Andrew B. Godefroy (1999), op. cit., 2.
[318] Rob Hubert, op. cit., 198.

In 1989, Canada would finally create an independent civilian space organization that would successfully combine civilian space organizations and direct national space activities through the Canadian Space Agency (CSA). The *Canadian Space Agency Act* would support the directive of the CSA to "plan, direct, manage and implement programs and projects relating to scientific or industrial space research and development and the application of space technology"[319]. Supporting the provision to increase satellite launches, CSA would "construct, acquire, manage, maintain and operate space research and development vehicles, facilities and systems"[320]. To provide civilian space organizations with the incentive to work with DND on national space activities without government pushback, CSA would, too, be provided with the overarching mandate to "assist departments, boards and agencies of the Government of Canada of use and to market space technology"[321]. Overall, the creation of the CSA provided Canada with a national civilian space organization. First advocated at the initial twilight of human space exploration during the Chapman Report, this organization could direct a space strategy centered on satellite deployments.

Corresponding to the creation of the CSA, the Department of National Defence was also given the go-ahead from government to begin the arduous task of pulling itself from the slump of previous space policy-making decisions. Although military space projects were seen to exist in the "shadow of the publicly unpopular SDI program", DND began to develop a new set of policies that reemphasized the requirements for the non-confrontational role of military satellites while contemplating the need for a dedicated and qualified space personnel section that would advise on military space issues [322]. In 1989, the Chief of Review Services (CRS) of DND concluded a number of recommendations on policy, plans, projects, and management structures that supported these

[319] Government of Canada, "Canadian Space Agency Act," *Government of Canada*, S.C. 1990, c. 13, (2) b.
[320] Government of Canada, "Canadian Space Agency Act," op. cit., (3) a–(3) b.
[321] Rob Huebert, op. cit., 198.
[322] Andrew B. Godefroy (1999), op. cit., 1.

requirements and that were later used to formalize the newly-established Space Defence Working Group (SDWG) document on "strategic space application"[323]. A confidential "military space strategy" based on the SDWG document, supporting the need for greater cooperation between national space organizations and programs and the necessity for Canada to tactfully employ non-offensive satellites to meet national security objectives, was approved within the department and implemented shortly thereafter on July 3, 1990[324].

Of the three important strategic developments that signalled a sudden repositioning by the Federal Government of Canada's national space security strategies and civilian space polices, the period from 1983 to 1990 was unique insofar as it advocated the absolute necessity of a unified government approach toward national space application. Whereas the Chapman Report had supported limited consensus between civilian space organizations (albeit, still ending the historical DRB-NRC-RCAF disagreement) and the Trudeau-era had driven a clear divide between civilian and defence space programs, the Mulroney Government's revitalization of a Canadian space strategy presumed the necessity of a "single-front approach" when conducting national space activities. This single-front approach to space operations, where civilian and industry would work alongside defence officials and share space technologies, would support an increase in satellite development during the period[325]. In addition, it was cooperation between all relevant civilian and military space organizations that enabled Canada to remain committed to more expensive satellite projects. For example, when the United States and United Kingdom refused to provide a bulk of its funding in the late 1980s, the Canadian Government settled to continue the RADARSAT-1

[323] Department of National Defence, "A Canadian Military Space Strategy," *Government of Canada*, July 1990, 1; James G. Fergusson (2010), op. cit., 189.
[324] Department of National Defence, "A Canadian Military Space Strategy," *Government of Canada*, July 1990, 1.
[325] Elinor C. Sloan, Interviewed by Kiernan McClelland, *Research Interview*, September 29, 2016; Rick Pitre (Royal Canadian Air Force, Ret'd), Interviewed by Kiernan McClelland, *Research Interview*, September 29, 2016; James Fergusson, Interviewed by Kiernan McClelland, *Research Interview*, November 13, 2016.

satellite with financial resources drawn from the civilian and military space budgets, several provincial governments (including Ontario, Saskatchewan and British Columbia), and industrial partners including Space Aerospace, MDA, SED Systems, and CAL Corporations[326]. On the condition of using the satellite's complex imagery technology, all associated parties could use the information gathered from the system as long as the system remained operational[327]. Hence, a unified approach to space operation was again popularized in government following the announcement of SDI.

Despite all the good the SDI did in restarting the government dialogue on strategic space matters in Canada in the 1980s, there were still substantial issues related to the comportment of Canada's national space activities in the final years of the Cold War. A product of the historically disjointed government apathy toward national space activities, these issues included the lack of a single future strategic objective toward space exploitation and a clear governmental consensus on what national interests were to be gained from influencing the region. Although there was finally bureaucratic consensus between all civilian and military space organizations to work together and share space technologies, the strategic agendas of each organization continued to vary widely. For instance, the newly-established CSA performed many of the tasks its government and scientific predecessors had previously executed, including continuing the Canadian Astronaut Corps program and placing substantial resources into fine-tuning the Shuttle Remote Manipulator System (SRMS) or Canadarm series of robotic arms[328]. Reeling from past policy-decisions, the DND – unsure of how to "sell" Canadians on the idea of military satellites and whether another Trudeau-era cut was on the horizon – regressed to a plan of "saying rather than doing" on space-related

[326] Rob Huebert, op. cit., 200.
[327] Rick Pitre (Royal Canadian Air Force, Ret'd), Interviewed by Kiernan McClelland, *Research Interview*, September 29, 2016.
[328] Canadian Space Agency, "Mission and Mandate," *Government of Canada*, January 2017.

matters[329]. This is to say that, notwithstanding civilian and military space organizations working more closely together on satellite development, the launching of satellites into the upper atmospheres remained low. Furthermore, because the Federal Government continued to defer to Canadian space organizations rather than directing national ventures into the space environment, satellite launches had been all but been replaced by more symbolic long-established space ventures (like the CAP and Canadarm) that Canadians were content to support.

Overall, the three aforementioned strategic ideas that emerged throughout the Cold War had limited any credibility associated with the proposition of Canada unwaveringly standing committed to a long-term presence in outer space. A number of conclusions can be drawn regarding the strategic features of Canada's national space activities during the period. If one is to consider the various space policy agendas forwarded by the Diefenbaker, Pearson, Trudeau, and Mulroney Governments, Canadian policy-makers had remained disjointed throughout their terms on how to guarantee the country's strategic objectives in outer space since the start of the Space Age. The decision-making back and forth that transpired over the creation of a national space strategy within the PMO teetered between, on one hand, developing a single intergovernmental approach toward space operations and, on the other hand, reinforcing niche civilian space capabilities and public engagement with domestic space industry. Canada experienced a lack of direct leadership on national space activities leading to its national space organizations becoming unsure of their exact strategic mandate within the high-earth orbits. Misunderstanding lead to inaction.

However, it should also be noted that, since the beginning of the Space Age, no Prime Minister ever developed, prior to being elected, a clear strategic mandate prior to being elected for

[329] Elinor C. Sloan, Interviewed by Kiernan McClelland, *Research Interview*, September 29, 2016.

maintaining the regularity of national space activities. Whereas Diefenbaker and Pearson adapted a strategic space mandate while in office in response to external events that transpired in the upper atmosphere (notably the launch of Sputnik I in 1957 and Alouette I in 1962), Trudeau opted to adjust national space activities on a more ad hoc basis without a proper awareness of the various resources needed to maintain Canada's space operations and space-based technologies. The major consequence of this decision on the part of the Trudeau Government was that enthusiasm in government for national space activities was quelled while space technology development became more specialized and, consequently, less likely to be launched. As such, because of this decision, national space activities in Canada were placed on government hiatus from 1968 to 1983 (following the SDI). To a lesser extent, even Mulroney developed a strategic mandate for space that was less concerned with establishing a long-term presence in the orbits and more focused, in part, because of the Reagan Administration's sudden announcement of the SDI in 1983, with revitalising Canada's civilian and military space organizations by providing the support required to modernize the country's space assets to levels comparable to the superpowers. In spite of this sudden government backing toward space operations, internal complications would disturb Reagan's strategic mandate away from committing frequent space activities to concentrating on the longevity of several space technology projects (the most significant being the diminution of financial support by the United States and United Kingdom for RADARSAT-1). Consequently, by the end of the Cold War, Canada continued to lack a clear strategic direction for its national space programs as it had prior to the launch of Sputnik I. Although Canada's entrance into outer space with Alouette I came before many other countries had even thought to place objects in this environment, any coordinated attempt to formulate a unified space strategy by the Canadian

Federal Government after the satellite launch was disrupted by a sudden institutional repositioning of the country's strategic objectives in the space environment.

4.3 Political Factors of Canada's National Space Activities during the Cold War

Compounded by these strategic aspects that affected national space activities during the Cold War, Canada's participation within the dominant international agreements on outer space also served to exemplify Canada's national space activities since the beginning of the Space Age. Although not as detailed as the strategic aspects, the political aspects of Canada's national space activities served to indicated a limited function for Canada in the drafting of international space legislation that would allow it to preserve its national interests in space by sustaining a space-based presence in the region. Particularly, it may be argued that Canada's involvement in the 1967 Outer Space Treaty, the international agreement that codified the space environment as a "peaceful sanctuary for all mankind", was born from a reluctance to directly pursue its national interests in the upper atmosphere within an international forum. Rather than pursue a multilateral approach to international space diplomacy (where the country would be "one of many equals" in space), Canada instead, in an attempt to remain on greater terms with the United States, opted instead to sign the OST as a "junior partner" of the U.S.[330].

The evidence supporting this political argument may be found beyond the strategic documents published during the early Cold War, and among the efforts of a wide range of Canadian administrators, diplomats, scientists, and engineers. Perhaps propagating the Canadian internationalist stance, Douglas V. LePan – a Science Undersecretary in the Diefenbaker

[330] Andrew B. Godefroy (2011), op. cit., 74; 84; James Fergusson, Interviewed by Kiernan McClelland, *Research Interview*, November 13, 2016: The author participated in a roundtable discussion with Dr. James Fergusson, University of Manitoba, and Dr. Steven Freeland, Western Sydney University, on November 15, 2016 discussing Canada's role in the OST. The consensus reached by all commentators was that Canada had "served as a dependable ally and partner to [the U.S.] in OST negations…[however] the superpowers nullified other proposals which didn't fit with their political agendas".

Government – realized, in the late 1950s, that both the United States and Soviet Union were in a position to dominate space both militarily and commercially[331]. As such, "Canada might soon find its own space interests restricted or even threatened"[332]. Concerned by this prospect, LePan concluded that the best means of protecting Canadian national interests in outer space was "to promote and, if possible, codify an agreement that made space control an international responsibility" under the jurisdiction of the United Nations (UN)[333]. LePan opted to create a proposal for the Diefenbaker Government that emphasized two central suggestions: first, the suggestion that the "international community...declare space a sanctuary" and, second, that "Canada play a lead role" in directing international space efforts and the sharing of space research within the UN[334]. By essentially forcing the two superpowers to relinquish their obvious strategic advantages in dominating outer space and by acting as a champion for third-party interests within an internationally-recognized forum, Canada would be able to guarantee free access to the space environment and substantial prestige to conduct space operations in the future.

In 1959, the proposal was forwarded to A. G. Campbell, a senior diplomat on the Canadian delegation at the United Nations, who subsequently presented it in New York at the UN Headquarters. Unfortunately, the proposal was not accepted by either the United States or the Soviet Union. As Andrew B. Godefroy submits, the LePan proposal "underestimated the acrimonious attitude of the Soviet union toward any space cooperation, while overestimating the amount of influence that Canada could have in forcing the two superpowers to relinquish their obvious advantages in controlling access to outer space"[335]. Although diplomats foresaw the

[331] D.V. LePan, "International Control of Outer Space," *file 12798-4-40*, August 20, 1958, Library and Archives (LAC), Ottawa, Ontario, 1-2.
[332] Ibid, 2.
[333] D. V. LePan, op. cit., 2.
[334] Ibid.
[335] Andrew B. Godefroy (2011), op. cit., 75.

U.S.S.R.'s dismissal, the U.S. deposition of the Canadian proposal came as a general surprise[336]. Indeed, it was the lack of American political support that suppressed the Canadian delegation's urge to follow through with LePan's proposal. As A. G. Campbell would report back to Ottawa, "to give reality to the claim to equal rights in outer space and to gain a position of influence for negotiating international control of space" would have probably "killed [the proposal]"[337]. Moreover, while there was an interest to increase international cooperation, the proposal was seen to jeopardize Canada's own strategic agenda (however ill-defined as that agenda for space strategy was) and the relationship with the U.S.[338]. As a consequence, Canada's national interests centered on leading an international effort in the space environment remained sidelined as a means of preserving its strategic relationship to the U.S.[339].

By the 1960s, Canada's attempts at championing an internationalist approach to space control that would supress the strategic advantages of the superpowers had failed and another option was needed. The Canadian position within the international forum shifted suddenly to "remain…allied to those from whom it could most benefit" within the space environment[340]. Thus, Canada chose to ally itself more closely with the United States on political and security matters pertaining to outer space. Undoubtedly, following the dismissal of LePan's proposal at the United Nations, Canada would position itself to become more dependent on U.S. space technologies as a method of safeguarding its strategic interests within the region. This would include the signing of several bilateral agreements with the United States such as updating the NORAD agreement to include satellite tracking of Canadian aerospace by American-operated assets and the signing of

[336] Andrew B. Godefroy, op. cit., 77.
[337] Record Group (RG) 25, *file 12798-4-40*, Library and Achieves Canada (LAC), Ottawa, Ontario.
[338] "Outer Space – Proposal for Possible Canadian Initiative," *file 12798-4-42*, 1959, Library and Archives Canada (LAC), Ottawa, Ontario, 1.
[339] Andrew B. Godefroy (2011), op. cit., 80.
[340] Andrew B. Godefroy (2011), op. cit., 81.

the 1960 SPACETRACK and the 1963 preliminary agreement of the global commercial communication satellite system (GCCSS) which would later become the INTELSAT geosynchronous communication network. Within international forums, Canada would remain in only two UN-related memberships – which remain active, in some capacity, to this day – that would serve to support American objectives compared to Soviet ambitions rather than buttressing Canadian multilateral interests: the UN General Assembly's Committee on the Peaceful Uses of Outer Space (COPUOS) and the Committee on Space Research (COSPAR). Indeed, when looking at the transcripts of committee meetings from 1963 to 1988, Canadian-sponsored resolutions were virtually non-existent on matters of space activity management, space security, and space research and development[341]. Ultimately, in the context of the Cold War, Canada's voice on matters of international space politics was routinely silenced by Canadian public servants who saw the role of the "yes-man" to American proposals as the easiest means of guaranteeing a political presence at the table of great space powers.

By the same token, international space treatises, like the 1967 Outer Space Treaty and the 1968 "Rescue Agreement", made little difference to Canada's overall strategic interests or agenda as they were "perceived as having no greater magnitude than other diplomatic ventures"[342]. Although the argument can be made that Canada benefitted from Article I of the OST which advanced that "[the] use of outer space…be carried out for the benefit and in the interests of all countries", Canada did not have the technological infrastructure in place to voice any concerns over other provisions detailed in the treaty that were included by the superpowers. This encompassed "[o]uter space…[being] not subject to national appropriation by claim of

[341] United Nations, "Reports of the Committee on the Peaceful Uses of Outer Space," *Office for Outer Space Affairs*, A/5559 (1963) – A/43/20 (1988): Although Canada is noted at being present at all sessions of the sub-committee, the chairman of the sub-committee had, at no time, received any request for general statements from the delegation.
[342] Andrew B. Godefroy (2011), op. cit., 82-83.

sovereignty" covered by Articles II and III or the assignment of the broad definition of "weapons of mass destruction" into celestial bodies[343]. Even as Canada began to develop more sophisticated space technologies throughout the Cold War and as the two superpowers continued to increase national space program activities and satellite deployments, its concerns over updating the OST to preserve the peaceful sanctuary of space remained minimal. Remarkably, it was only when the strategic leveraging of Canada's civilian space organizations by the Trudeau Government had been fully implemented by the early 1980s that Canada's obligation to maintaining space as a peaceful sanctuary began to receive more attention in government and in the public sphere[344]. By the end of the decade, Canada was seen by its population as not just an unassuming advocate of space as a peaceful sanctuary, but as a "founding member of the spacefaring fraternity…[who], through a commitment in principle to peace," which had lobbied and legislated the space environment as a nonconfrontational environment through the OST[345].

It may be argued, then, that the political factors demonstrated by Canada during the Cold War within international forums were not conducive of the country maintaining a long-term influence within the space environment. Although Canada did uphold the proverbial status quo of outer space existing in spirit as a nonconfrontational space environment, it did not actively seek to maintain the peaceful status of the domain even as the superpowers appropriated the treatises to guarantee their own interests in the upper atmosphere. Bilateralism took precedence over multilateralism within international space politics. For Canada, this decision had the adverse effect of muting and, at times, restricting the Canadian voice in international affairs associated to

[343] Ogunsola O. Ogunbanwo, *International Law and Outer Space Activities* (The Hague, Netherlands: Martinus Nijhoff, 1975), 91; Alan Beesley, D. W. Sproule, and Mark Collins, "Canada's Contribution to Outer Space Law and Arms Control in Outer Space," in *Space Strategy: Three Dimensions*, ed. By Brian MacDonald (Toronto, ON: Canadian Institute of Strategic Studies, 1989), 95.
[344] Alan Beesley, D. W. Sproule, and Mark Collins, op. cit., 96.
[345] Chris Gainor, op. cit., 12.

sustaining a truly global article of space legislation that would have supposedly allowed the international community to preserve the peaceful sanctuary of space with greater unanimity. It also had the long-lasting effect of demoting Canada to a "junior partner" of the United States rather than promoting Canada as an equal space power, consequentially limiting the momentum for developing and retaining a lasting presence in domain. Canada's historical commitment to internationalism and being a leader among equals with multiple space assets, first forwarded by the LePan proposal, diminished as Canada's cooperative space endeavours became virtually dependent on the U.S. Consequently, the American relationship trumped all other collaboration efforts in space, including those with close scientific and security allies (e.g. Great Britain, France, and Germany)[346].

4.4 Economic Factors of Canada's National Space Activities during the Cold War

Compounded by these strategic and political features which have influenced Canada's national space activities since the beginning of the Space Age, the country's aptitude to conduct space operations in the upper atmosphere following the launch of Alouette I were influenced by its traditionally poor financial engagement of its space-related programs. In other words, the Canadian national space budget for both civilian and military space programs has customarily been tiny when compared with other government-funded technology projects[347]. Indeed, the total space budget (accounting for both civilian and military space projects) was only $3.4 billion dollars per year from 1962 to 1991[348]. Of this amount, $1.7 billion (exactly 50%) was credited to national space projects that began development between 1984 and 1991[349]. Even at a glance, $3.4 billion

[346] Alan Beesley, D. w. Sproule, and Mark Collins, op. cit., 72.
[347] Colin Franklin, "Canadian Military Requirements in Space," in *Canada's Strategies for Space: A Paradox of Opportunity*, ed. By Brian MacDonald (Toronto, ON: Canadian Institute of Strategic Studies, 1983), 56.
[348] Ibid, 56-57; Alain Simon, "The Economic Impact of Space," in *Space Strategy: Three Dimensions*, ed. By Brian MacDonald (Toronto, ON: Canadian Institute of Strategic Studies, 1989), 5-6.
[349] Ibid.

dollars per year is nowhere near a fraction of the amount needed to sustain a dedicated satellite launch capability or even to maintain the research and development of scientific and defence-related space-based technology during the Space Age. As Alain Simon notes, when a national space budget needs to pay for "administrative and logistical" costs to maintain the personnel and facilities for researching and producing space-based technology, there are often few financial resources left over for producing numerous artificial satellites[350]. Purely by this measure, it could be concluded that Canada did not dedicate the financial resources to its national space organizations for developing and deploying multiple artificial satellites into the atmospheric domain.

However, what is thought-provoking about Canada's national space budget during the Cold War is how financial resources were allocated to space-related projects and to whom the resources were allocated to. Ultimately, Canada's total national space budget was actively divided by the Federal Government between civilian and military space organizations. Relating back to the previous discussion regarding the strategic aspects of Canada's national space activities, the Canadian national space budget allocation following the immediate aftermath of the Sputnik I in 1957 was approximately equal and provided by the Federal Government to the DRB-NRC-RCAF on a project-by-project basis[351]. Yet, following the successful launch of Alouette I and the Chapman Report, the DRB and NRC were both provided moderate increases of $60 to $80 million dollars to their projects' budgets[352]. With the introduction of the Trudeau Government's space policies this trend continued, as the NRC-RCAF budgets were halved while, from 1968 to 1981, the Canadian government expenditures provided to civilian organizations doubled and, matching

[350] Alain Simon, op. cit., 6.
[351] Andrew B. Godefroy (1999), op. cit., 2.
[352] Jacques M. Desroches, "Canadian Industry's Capabilities in Space," in *Canada's Strategies for Space: A Paradox of Opportunity*, ed. By Brian MacDonald (Toronto, ON: Canadian Institute of Strategic Studies, 1983), 67.

this increase, tripled in industry-controlled projects[353]. Even the Mulroney Government's strategic commitment to a single-front approach to space technology acquisition maintained the funding division between, on one hand, civilian and industry space groups who would conduct scientific and technological objectives and, on the other hand, military space organizations that would implement a defence-related presence in the space environment.

With respect to the operationalization of national space activities, the division of a national space budget into two structurally different organizational areas of focus with vastly differing outer space objectives had the debilitating effect of limiting both productivity and the creation of multiple satellites. Without any clear strategic mandate established by the Federal Government, national space funding was largely allocated within both civilian and military departments by internal directors of space projects that were deemed to fall within the broad sphere of "the national interest". At times, this would result in some projects being ignored as project funding was allocated on a discretionary basis by the director's prerogative[354]. Recalling how space technology projects were funded prior to the end of the Cold War, former Brigadier-General Rick Pitre notes that projects were determined, prior to the 1990s, on a "case-by-case" basis where "immediate political returns and, by association, funding" were largely grounded on how accountable the project was to the Canadian public[355]. By this token, Pitre explains that for a space technology to have been supported during the Cold War by a project director (civilian or military), it had to have more "flavour than practicality" so as to legitimize its purchase to Canadians[356]. In this respect, the historical space funding in Canada was as transient as the strategic direction provided by the

[353] Jacques M. Desroches, op. cit., 69.
[354] Rick Pitre (Royal Canadian Air Force, Ret'd), Interviewed by Kiernan McClelland, *Research Interview*, September 29, 2016.
[355] Ibid.
[356] Ibid.

Prime Minister and Cabinet towards a national space strategy. Indeed, the "technological capability gap" that resulted from this lack of directed funding made it so that Canada, "from the perspective of both its economics and national welfare…could no longer afford to expose 'herself to the degree of economic and technological dependence' that characterized…national space programs"[357]. When coupled with the aforementioned historical rivalry commonplace for defence-related compensations between DRB-NRC-RCAF during the 1950s and 1960s and the Trudeau Government's budgetary cuts to the military space programs in 1981, Canada's civilian and military space organizations simply did not have the funds to develop and deploy the maximum number of sophisticated space technologies during the 20th century.

Even Canada's conventionally strong connection to private space industry, which prospered in the aftermath of the institutionalization of greater public-private relations by the Trudeau government, had the adverse effect of limiting artificial satellite production. Although the Trudeau Government's commitment to create a country-wide satellite communications capability equated with more resources being diverted to private industry, the lack of a clear strategic mandate from the 1970s to the early 1990s allowed Canada's space industries to freely pursue projects they were determined to have positive returns for Canadians. According to Jacques M. Desroches, former President of Canada's Aerospace Industries Association (AIAC) in the 1980s, positive returns through space industry would equate to jobs for Canadians. As the old axiom holds, "go where the money is and go there often"[358]. The mantra of Canadian space industry during and directly succeeding the Trudeau-era was no different. Although tasked with satellite communications, industry flocked toward the production of the transmitters and responders (hereafter called just "transponders") of space-based communication systems: a small, inexpensive

[357] Andrew B. Godefroy (2011), op. cit., 94.
[358] Jacques M. Desroches, op. cit., 67.

component of space technology that could easily be marketed to domestic and international consumers[359]. As there existed a clear demand for transponders (16 to 24 are normally attached to communication satellites at around $20,000 to $40, 000 depending on the bandwidth and connectivity of the devices) Canada, as several interviewees who had served in space industry can confirm, became good at the supplying portion of the technology[360]. The low cost of the Canadian-built transponders also meant that the Canadian space industry could improve its balance of payments to the Federal Government while remaining under its government-funded space budget; thereby allowing an increased likelihood that a space industry would be contractually renewed and funded[361]. Unfortunately, as imports were replaced by exports during the 1980s, the capacity for industry to produce multiple artificial satellites – beyond the sudden inducement by the Federal Government to complete funding on RADARSAT – waned as industrial efforts to produce satellite components were supported above any other technological project pursued within Canada's space industries.

Compounded by the strategic and political features illustrated by Canada between the periods of 1962 and 1991, the country's economic features further elaborated on the difficulties faced by successive Federal Governments in committing to frequent national space activities. As should come as no surprise, the deficiency of substantial funds in past government budgets allocated towards Canada's national space activities had a significant impact on Canada's ability to produce and maintain a number of satellite technologies since the beginning of the Space Age. With the Diefenbaker and Pearson Governments, funding for national space activities – including

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[359] Colin Franklin, "Industrial Opportunities in Space," in *Canada's Strategies for Space: A Paradox of Opportunity*, ed. By Brian MacDonald (Toronto, ON: Canadian Institute of Strategic Studies, 1983), 57-58; John Kirton, "Canada and the Exploitation of Space," in *Space Strategy: Three Dimensions*, ed. By Brian MacDonald (Toronto, ON: Canadian Institute of Strategic Studies, 1989), 32.

[360] Interviews conducted by the author on November 14 to November 26, 2016 at the 15th Annual Canadian Space Society Summit, Winnipeg, Manitoba.

[361] Jacques M. Desroches, op. cit., 69; John Kirton, op. cit., 32-33.

space technology development – was simply redistributed toward more domestic projects (supporting the mandate commitments made by the two Prime Ministers). Alternatively, the successive Trudeau Government slashed the military's historically-consistent space budget which had remained untouched from the end of the Cold War to the launch of Alouette I while retaining the civilian space budget without any financial increases. Even though a lack of funds following the initial success of the Alouette I handicapped Canada's space power ambitions, the decision by the Trudeau Government to divide the space budget between civilian and military space organizations inhibited the capacity of the nation to combine assets and, in the process, deploy more satellites. The problem with satellite exploitation during the Cold War was further sanctioned by the partitioning of available space funding alongside multiple space technology producers. Because of the absence of national priorities in space by the Federal Government, these space technology producers were provided considerable autonomy to pursue projects that they wished to pursue. Often leading to multiple civilian and military projects being on the go at any one time, cooperation between national space organizations and industry focused on providing acceptable returns to the Canadian public rather than pursuing any practical technological capability.

4.5 Conclusion

The twilight of human exploration into the upper atmosphere, in the immediate aftermath of the Sputnik I launch in 1957, put Canada in a significantly advantageous position to enter outer space along with the superpowers. As an ambitious country which passed into the Cold War with its scientific and technological status intact following the Second World War, Canada seemed ready and willing to enter outer space as a long-standing significant presence in the region. Following the immediate launch of Alouette I, national space activities were anticipated by Canadian policy-makers and society to signal the start of frequent space-based technology

launches into the orbits[362]. More space-based technology, it was recognized, would yield an enduring legacy for Canada within the space environment[363].

By the end of the 20th century, the material occupancy in outer space by Canadian space assets consisted of a handful of niche civilian space missions (particularly the ongoing CSA partnership with the ISS) and a few aging satellites and space-based technologies[364]. Standing as a stark contrast to governmental and public optimism that superseded the success of Alouette I in 1962, Canada went from the beginning of the Space Age to the end of the Cold War having virtually made no substantial advances to implement a long-term presence, as advocated in the *National Space Study*, in the upper atmospheres. Indeed, a strew of successive government decisions between 1962 and 1991 yielded a set of strategic, political, and economic factors that, either accidentally or deliberately, limited the frequency of national space activities that Canada could pursue during the period. For example, the absence of a unified civilian and military space strategy and the historic absence of a strategic space mandate commitment by the Prime Minister and Cabinet resulted in the country, for nearly half a century, being unclear on its national priorities and objectives within the space environment. Regardless of political party, the PMO during the transformative years of early space activities remained unclear and, as a consequence, unwilling to commit to grand space strategies that would combine the nation's space resources toward frequent space technology launches. Furthermore, the long-standing retrenchment from pursuing Canada's traditional space politics objectives within international forums – which would permit the country the international approval it yearned for to increase its space-based capabilities – and the partitioning of the national space budget between civilian, industry, and military space

[362] N. Harvey Lithwick, op. cit., 41.
[363] Uncredited, "A view from space," *Financial Times of Canada*, November 1968, 3; Robert Cohen, "Year of decision for all-Canadian satellite network," *Financial Times of Canada*, January 9, 1967, 7.
[364] Canadian Space Agency, "Mission and Mandate," *Government of Canada*, January 2017.

organizations during the Cold War had resulted in the deterioration of Canada's visible material presence in outer space.

Table 4.1: Evaluation of Canada's National Space Activities in the 20th Century Security Environment

Canada (1962 – 1991)	**Strategic Characteristics**	**Political Characteristics**	**Economic Characteristics**
	• Absence of clear national space security strategy or space policy for national space organizations. • Lack of strategic mandate for outer space by PMO. • Disagreement over strategic objectives between civilian and military space organizations.	• Firm advocate of multilateralism with international partners at beginning of the Space Age. • Bilateralism with the United States within international space politics. • Supports OST.	• Partitioning of space budget funding between civilian, military and industry projects. • Military space program cuts. • Increase in space industry financial support by Federal Government.

So what does this mean for Canada's national space activities during the Cold War? What can be concluded from this evaluation is that a combination of strategic, political, and economic factors had a significant impact on the administration of Canada's national space activities from 1962 to 1991. If one is to consider the Figure 4.1, it wasn't just one government decision that clashed with the capacity of the nation to conduct more frequent space operations. Whether approved in Parliament, the United Nations, or a market executive's boardroom, successive government settlements on national space activities had escalated the long-standing obstacles faced by Canadian space operations (including qualified government coordination and support, qualified personnel who understood the limitations of space operations, and fulsome project funding for space technology). The government and public optimism that accompanied the immediate launch of Alouette I was not unfounded; but it was, in hindsight, premature in

addressing the substantial challenges that the country's national space activities were to face in the future.

In summary, the Canadian case study does not suggest that Canada was ever in a position at any time in the Cold War to launch multiple artificial non-offensive satellites as a means of increasing its share of national power and prestige within the space environment. Put plainly, as former Brigadier-General Rich Pitre espoused during an interview, the historical legacy of past space-related decisions during the Cold War has yielded "significant challenges and obstacles" to the strategic objectives of Canada's civilian and military space programs: "in general, [Canada's national space programs] were not prepared for the challenges of the Cold War…[and, as a result] we were still a work in progress"[365]. Former President of the CSA, Walter Natynczyk, would add to this statement by commenting "we are still a work in progress"[366]. Indeed, while it is true that Canada was the third country to enter outer space, our scientific and technological capabilities in the region were wanting even to the end of the Cold War. The 'hard pill' that must be swallowed is that, in the case of Canada during the Space Age, being one of the first countries to become spacefaring did not preclude the means of guaranteeing an enduring strategic presence within the space domain.

[365] Rick Pitre (Royal Canadian Air Force, Ret'd), Interviewed by Kiernan McClelland, *Research Interview*, September 29, 2016.
[366] Walter Natynczyk (Former Canadian Space Agency President), Interviewed by Kiernan McClelland, *Research Interview*, February 11, 2017.

Chapter 5: The Space Oddity: A Comparative Assessment of Space Power Variables between Canada and the Great Space Powers in the Cold War

5.1 Introduction

Although the United States, Soviet Union, and Canada all began on terra firma and possessed a similar commitment toward technological innovation that drove national space activities following the end of the Second World War, only the two superpowers of the United States and the Soviet Union established a lasting national influence expected of a space power within the space environment. Indeed, the United States and Soviet Union were able to retain their advantageous positions as space powers throughout the transformative years of early space flight during the Cold War[367]. By deploying multiple artificial satellites into the high earth orbits whilst simultaneously maintaining outer space as a peaceful sanctum, the great space powers were able to demonstrate to the world that they held absolute control over the upper atmospheres[368].

On the other hand, Canada, despite its scientific and technological potential, was unsuccessful in developing into a space power with a long-term satellite presence. Instead, contrasting the United States and Soviet Union, Canada deployed limited space assets as a means of increasing its power in space up until the eventual conclusion of the Cold War. Although Canada did possess a formative strategic space policy framework (the *National Space Study* or "Chapman Report") early during the Space Age which encouraged the launch of multiple satellites as a means of acquiring space power, the strategic space policy that Canada ultimately followed was defined by a broad space strategy with no clear core objectives and a lack of available space assets that

[367] Everett C. Dolman, *Astropolitik: Classical Geopolitics in the Space Age* (New York, NY: Routledge, 2001), 18; James Clay Moltz, *The Politics of Space Security: Strategic Restraint and the Pursuit of National Interests* (Stanford, CA: Stanford University Press, 2011), 86.
[368] D. A. Turner and J. Vedda, "Foreign space developments and US policy," in *Space and Defense Policy*, ed. By Damon Coletta and Frances T. Pilch (New York, NY: Routledge, 2009), 308.

served a more emblematic, rather than a practical, function[369]. Consequently, in between the launch of Alouette I in 1962 to the end of the Cold War, Canada's strategic presence in space withered; as did the country's aptitude to develop into a space power during the earliest years of human space activities.

This chapter will provide a comparative assessment of the space power variables manifested by Canada and the United States and Soviet Union from the start of the Space Age to the end of the Cold War. Specifically, the chapter will highlight explicit strategic, political, and economic variables – such as the number and content of strategic space documents and space-based capabilities, political leadership and support, and total space budget resources – that differed between Canada and the great space powers as they conducted national space activities during the Cold War. By analyzing and elaborating on these differences, this chapter will explain why Canada did could not develop into a space power comparable to the United States and Soviet Union. As this chapter concludes, Canada did not possess a clear space strategy comparable to the great space powers that guided national space activities toward sustaining a long-term satellite presence. Compounded by the absence of a clear space strategy, Canada did not possess strong political leadership that was willing to direct national space organizations towards continuing frequent space operations. Lastly, Canada did not possess the economic resources needed to conduct and maintain sustained the plurality of satellite operations expected of a space power like the United States or the Soviet Union. Although its national space organizations clearly articulated a desire to develop the country's space activities to match the space presence of the superpowers, Canada during the time period in question could simply not focus its strategic, political, and economic

[369] J. H. Chapman, P. A. Forsyth, P. A. Lapp, and G. N. Patterson, "Upper Atmosphere and Space Programs Special Study 1#," *Science Secretariat Privy Council Office*, February 1967, 111.

resources like the great space powers towards endorsing a strategic space policy founded on the deployment and maintenance of multiple satellites.

5.2 Strategic Comparison between Canada and the Great Space Powers

Perhaps the greatest discrepancy between the United States, Soviet Union, and Canada that arose between the beginning of the Space Age and the end of the Cold War was the strategic variable of space power that influenced the ability of the nation to sustain a long-term satellite presence in outer space. As discussed in the examination of space power theory in Chapter 2, for a spacefaring state to be considered a space power it must have a space strategy that that can directs it national space activities towards a common strategic objective. Although all three spacefaring states entered the Space Age with a clear understanding that their nation's interests could be improved through national space activities, their space strategies on how to exploit the space environment remained very different.

If one is to consider the number and content of declassified strategic space documents produced by the great space powers compared with Canada, it is evident that the superpowers presented a stronger, more consistent strategic direction for sustained satellite operations during the Cold War. With the launch of Sputnik I launch on October 4, 1957, each of the superpowers quickly implemented a space strategy that utilized satellites to guarantee their own national interests in space. However, rather than risk nuclear annihilation over destroying each other's space assets, the great space powers opted to direct the national space activities of all civilian and military space organizations towards a comprehensive strategic commitment of proportionally deploying multiple non-offensive space technologies among civilian and military space

organizations[370]. In the United States, this strategic commitment was first highlighted prior to Sputnik I in the *United States National Security Council Directive 5520*, and reiterated throughout the Cold War through subsequent strategic space documents (including the 1958 *National Aeronautics and Space Act* and *NSC 5814/1*, 1976 *National Security Decision Memorandum 333*, 1978 *Presidential Directive 37*, and 1982 *National Security Decision Directive 42*)[371]. Working toward increasing the satellite presence of the country, civilian space organizations would assist the military space activities and vis-versa. This strategic commitment was continually reiterated throughout the Cold War. Back in the Soviet Union, directing national space organizations to launch more space technologies became a long-standing strategic commitment which persisted in the superpower's strategic decision-making during the Cold War. Indeed, the deployment of multiple satellites to populate contested areas of the orbits using all available resources was seen by the U.S.S.R. as its pre-eminent strategy for balancing the influence and prestige of the U.S. in upper atmospheres throughout the Cold War[372]. Unlike the United States, which continued to increase its satellite presence after 1991, this space strategy could no longer be supported financially by the Soviet Union by the end of the 1980s[373]. Still, both superpowers identified very early on in the Space Age that, in order for their interests to be guaranteed in space, they would have to commit their civilian and military space organizations to a comprehensive space strategy

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[370] Mira Duric, *The Strategic Defence Initiative: US Policy and the Soviet Union* (Surry, U.K.: Ashgate Publishing, 2003), 41; Matt Bille and Erika Lishock, *The First Space Race: Launching the World's First Satellites* (College Station, TX: Texas A&M University Press, 2004), 13.

[371] National Security Council, *NSC 5814/1* (Washington, D.C.: Dwight D. Eisenhower Presidential Library and Museum, 1958), 5; The National Aeronautics and Space Administration (NASA), *National Aeronautics and Space Act of 1958, As Amended* (Washington, D.C.: NASA, 2008), 4-5; National Security Council, *National Security Decision Memorandum 333* (Washington, D.C.: NSC, 1976), 1; National Security Council, *Presidential Directive/NSC-37*, National Space Policy (Washington, D.C.: NSC, 1978), 1; National Security Council, *National Security Decision Directive Number 42* (Washington, D.C.: The White House, 1982), 1-2.

[372] Michael E. O'Hanlon, *Neither Star Wars Nor Sanctuary: Constraining The Military Uses of Space* (Washington, D.C.: Brookings Institution Press, 2004), 2-3.

[373] James Clay Moltz, op. cit., 272-273.

that would provide the foundation for regularly conducting space activities regularly. The number and content of the declassified strategic space documents – which are in abundance and consistent with the strategic space power factor – therefore indicates that the great space powers had clear engagement with their civilian, industry, and military organizations that, in turn, allowed them to effectively direct frequent satellite operations.

Conversely, Canada was conflicted over what exact strategic direction Canada's civilian and military space organizations were to commit to during the Cold War. Indeed, there was considerable infighting between Canada's three main space organizations in the late 1950s – between the Defence Review Board (DRB), the National Research Council (NRC), and the Royal Canadian Air Force (RCAF) – over who held jurisdiction over national space activities. Although these three organizations agreed that something had to be down to guarantee "the protection of Canadian national interests [in space]", a space strategy was never adopted because of disagreement over which agenda, either the DRB and NRC's "science-oriented agenda" or the RCAF's "technology-focused agenda", would be implemented[374]. This disagreement between government departments charged with organizing space activities would remain a common theme up until the Mulroney Government released its space policy paper in 1986. With the 1986 paper, a common memorandum between all relevant national civilian and military space organizations was reached. Nevertheless, contrasting the great space powers, Canada had remained, for the better part of the Cold War, disjointed on how exactly its national space organizations would exploit the space environment. Because neither civilian nor military groups could compromise on a national space strategy, there was no consensus from the departments over which space technologies were needed by the country to acquire its unrealized national interests in space. Continuing throughout

[374] D. J. Goodspeed, *A History of the Defence Research Board* (Ottawa, ON: Queen's Printer, 1958), 52.

the Cold War, the lack of any common space strategy (and, as will be discussed later in this chapter, political leadership) meant that Canada could not perfect itself towards utilizing any one piece of space technology; as the Americans and Russians were able to do with satellite technology. Hence, departmental infighting between Canada's three main space organizations from 1958 to 1986 had a pronounced impact on the capacity of the country to commit to multiple satellite operations as a means of guaranteeing national interests in space.

Canada's strategic misperception over how it would exploit outer space with multiple satellites is made more apparent by the lack of space-based capabilities developed by the nation between 1962 and 1991, especially when compared to the capabilities produced by the great space powers during the same period. While the great space powers articulated a clear strategic direction through a generation of declassified documents that advocated the use of a wide spectrum of space-based technologies (comprising of reconnaissance, communications, meteorological, navigation, and offensive satellites), the Federal Government of Canada continually deferred to launching and maintaining those systems that were deemed "essential" by the government to assist in the preservation of the everyday activities of Canadians[375]. During the Cold War, these essential systems were consistently referred to, in declassified communications within government, as either "communication" or "scientific" systems that would promote the "peaceful use of space"[376]. Given the limited space assets owned by Canada at the end of the Cold War, there was no uniformity across these documents over what specific types of systems, communication or scientific, would

[375] John Vardalas, *The Computer Revolution in Canada: Building National Technological Competence* (Cambridge, MA: MIT Press, 2002), 173; Andrew B. Godefroy, *Defence and Discovery: Canada's Military Space Program, 1945-74* (Vancouver, B.C.: UBC Press, 2011), 174.

[376] Charles Mills Drury (Department of Industry), "White Paper on a Domestic Satellite Communication System for Canada," February 1968, Ottawa, Ontario, 11; Standing Committee on Research, Science and Technology on the Study of Canada's Space Program, "Canada's Space Program: A Voyage to the Future, Report of the Standing Committee on Research, Science and Technology on the Study of Canada's Space Program," June 1987, Ottawa, Ontario, 2.

be used to guarantee Canada's strategic objectives in space. Indeed, the national space objectives to use these systems were interpreted differently depending on the government of the day. For example, early national space activities directed under the Diefenbaker or Pearson governments considered "scientific" systems as ionospheric satellites (like Alouette I and II) to be placed and maintained in the orbits; Trudeau considered more symbolic space gestures (the Canadarm and Canadian Astronaut Program specifically) to be the primary scientific space projects; Mulroney shifted the dialogue back to simply using "scientific satellites"[377]. This disparity over what exact space technology would be utilized by Canada to guarantee its strategic objectives indicates a clear absence of long-term strategic thinking towards a space strategy during the Cold War.

Did Canada demonstrate a common strategic direction towards its national space activities during the Cold War? The answer is no. Canada was unable to produce a comprehensive space strategy that clearly outlined a strategic direction for the country's national space activities after entering outer space for the first time. The absence of any clear space strategy to direct Canada's national space activities continued until the end of the Cold War. In the process there was clearly an effect on the number and type of space-based technologies owned by the country by the end of the period. This is juxtaposed by the great space powers, who, following their first expidionary ventures into space, produced a space strategy that was unremittingly adhered to by civilian, industry, and military space organizations throughout the Cold War. Focusing a space strategy that supported the proportional deployment of multiple non-offensive space technologies among civilian and military space organizations, the great space powers of the U.S. and U.S.S.R. were

[377] NASA Facts: Alouette – Canada's First Satellite", *file F-12-62*, December 16, 1962, Library and Archives Canada (LAC), Ottawa, Ontario, 7; Ministry of External Affairs, "Satellites: the Canadian experience," *Government of Canada*, April 1984, 2-3.

more effectively able to develop a multi-faceted space-based capability consisting of multiple satellites.

5.3 Political Comparison between Canada and the Great Space Powers

Given the political variable of space power (which asserts that a space power must have strong political leadership that directs civilian, industry, and military space organizations), Canada, the United States and the Soviet Union demonstrated some level of political support for national space activities. If a state didn't have any political support that was sympathetic toward conducting national space activities as a spacefaring state, it would simply never have gone to space in the first place. However, while the political atmosphere of the Cold War was shrouded in the omnipresent threat of nuclear annihilation, the political leaders of the U.S. and U.S.S.R. behaved very differently from their counterparts in Canada where national space activities were concerned. As such, by comparing the political support exhibited by Canada and the great space powers during the Cold War, it can be better understood why Canada did not develop into a space power after the Alouette I launch of 1962.

The lack of strategic direction in outer space can also be attributed to a political variable of space power that differentiates Canada from the United States and Soviet Union: the deprivation of input from the Office of the Prime Minister (PMO) in directing national space activities. As discussed in Chapters 3 and 4, no Prime Minister in Canada has been as invested in outer space when compared with United States Presidents or Soviet Presidia during the Cold War. As exemplified by President Kennedy's "We choose to go to the moon" speech and the announcement of the Strategic Defense Initiative (SDI) by President Reagan, Presidents of the United States, whether Democrat or Republican, saw the continuation of national space activities as a necessary

expectation of the office[378]. Similarly, the Soviet Presidium, tied to General Secretaries like Andropov and Gorbachev, recurrently demonstrated an invested interest in the prolongation of space operations[379]. In the context of the Cold War, continuing national space activities was deemed necessary in order to balance the growing influence of the U.S. in the region[380]. Indeed, it was only when the Soviet Union couldn't feed itself at risk of systemic collapse that space operations were no longer supported politically by the leadership as a viable policy option.

On the other hand, Canadian Prime Ministers had either been largely ignorant or uninterested in committing government resources to national space activities. For example, Diefenbaker would routinely deviate from the facts in speeches when discussing Canada's space programs after the launch of Sputnik I in 1957; opting instead to claim that Canada had similar space capabilities to the U.S. in an effort to silence critics. Rather than implementing real change which would increase Canada's space capabilities, Diefenbaker chose to instead brush the issue aside to let Canada's space organizations compete against one another for jurisdiction over space operations. Likewise, Pearson often "turned away from international issues dealing with science and technology, as internal governmental reorganization and professionalization of the civil service became [his] top priorities"[381]. Although Pearson wasn't disingenuous in the same respect as Diefenbaker (choosing to not inflate facts regarding Canada's space capabilities), national space activities were simply not a strategically mandated issue that Pearson had campaigned on. For Pearson, more important political issues took precedence over sustaining national space activities. Following the election of Pierre Elliott Trudeau in 1968, political support for national space

[378] Par Steven Lambakis, *On the Edge of Earth: The Future of American Space* Power (Lexington, KY: University Press of Kentucky, 2001), 220-221.
[379] Mira Duric, op. cit., 46.
[380] Michael E. O'Hanlon, 2-3.
[381] Andrew B. Godefroy, op. cit., 71.

activities temporarily became a mandated issue. Yet, not even a year after instituting several political decisions – that redirected Canada's space programs toward industrial applications instead of military-related applications – Trudeau became disinterested in reforming Canada's civilian and military space organizations and moved on to addressing other, more substantive political issues[382]. Consequently, this left the "Canadian space capability diminished" in the mid-1970s as Canada's civilian space organizations were left with little government direction and resources to conduct sustained national space activities[383]. It was only after the Strategic Defence Initiative announcement by the Reagan Administration in 1983 that the Prime Minister, now Mulroney, again became politically invested in conducting national space activities.

The absence of directed political leadership in space policy decision-making also differentiates the United States and Soviet Union from Canada during the Cold War in the quest for space supremacy. In the case of the U.S, the President continually assumed command of important space policy decisions and directed civilian and military space organizations to pursue common objectives in outer space. This practise, following the creation of the 1958 *National Aeronautics and Space Act* by the Eisenhower Administration, grouped civilian and military considerations together under the directed leadership of the President; thereby allowing the country to direct its civilian, industry, and military space organizations toward a common space strategy. Similarly, the Soviet Presidium made compliance to a common space strategy the norm among the country's space organizations. In the case of both superpowers, the U.S. and U.S.S.R. were able to efficiently direct their national space activities towards sustained operations only by providing effective leadership that unified all relevant civilian, industry, and military participants toward a

[382] Rob Huebert, "Canada and Commercial Satellite Imagery: Technology in Search of Foreign Policy," in *Commercial Satellite Imagery and United Nations Peacekeeping: A View From Above*, ed. By James F. Keeley and Rob Huebert (Aldershot, U.K.: Ashgate Publishing Company, 2004), 195.
[383] Rob Huebert, op. cit., 197.

single communal approach in space. By contrast, in Canada, the Prime Minister had rarely directed national space activities. With Diefenbaker and Pearson, both men chose to remain uninvolved with space policy decision-making (leading, in large part, to the departmental infighting over space strategy that transpired between the DRB-NRC-RCAF during their 1950s and 1960s). Although mindful of national space activities, Prime Minister Pierre Elliott Trudeau would go one step beyond Diefenbaker or Pearson by further dividing Canada's national space organizations. Indeed, Trudeau made two decisions that effectively redirected and reduced space policy decision-making in Canada: to redirect the development of space technologies towards limited industrial applications whilst refocusing Canada's space program from military-related applications. The consequence of these two decisions immediately influenced the operations of Canada's national space organizations. With the historically strong military component of national space activities removed with no real effort to increase civilian space assets, Canada's space organizations were further divided. Consequently, Canada's national space activities diminished in the wake of Trudeau's decisions, as personnel and funds tied to sustained satellite launches were either transferred to civilian enterprises or cut[384]. Only following the release of a governmental policy paper on space operations in 1986 did the Prime Minister again assume some level of leadership over directing national space activities toward a common strategic direction[385]. The RADARSAT-1 incident in the late 1980s, when the Mulroney Government took a direct leadership role in apportioning financial resources drawn from the civilian and military space budgets, provincial governments, and industrial partners in order to preserve the project, illustrated an instance when the PMO took direct control over the implementation of a space policy decision[386]. Despite the

[384] Andrew B. Godefroy, "Canada's Strategy for Space, 1985-1999," *The Canadian Institute of Strategic Studies* Datalink #2, November 1999, 1.
[385] Rob Hubert, op. cit., 198.
[386] Ibid, 200.

space policy leadership exemplified by the Mulroney Government with RADARSAT-1, Canada's Prime Ministers, during a vast majority of the years during the Cold War, did not assume a direct leadership role in the space policy decision-making. Contrasting the great space powers, which had political leadership that efficiently directed national space activities to a common space strategy across administrations, Canada did not have political leaders or political parties that considered space warranted a mandated political issue and who were willing to direct Canada's civilian and military space organizations towards a single strategic direction in the upper atmospheres.

In addition to exhibiting strong political leadership, the United States and Soviet Union were also able to better support a long-term satellite presence, in accordance with their domestic political space policies, through the creation of international space legislation that governed space activities. By way of codifying a worldwide legal assurance that interpreted the space environment as a "peaceful sanctuary for all mankind", the great space powers continued to execute their space strategies during the Cold War, they focused on the use of multiple non-offensive space technologies to guarantee power in the upper atmospheres through the implementation of several articles of international space legislation. The most evident of these articles, the Article IV (2) of the 1967 "Outer Space Treaty" and the 1968 "Rescue Agreement", even went so far as to restrict offensive military technologies in space, thereby prohibiting any potential coercions that could affect the number of space assets operated by the superpowers [387]. The great space powers were thus seen by the international community as the champions of a peaceful space environment

[387] Ogunsola O. Ogunbanwo, *International Law and Outer Space Activities* (The Hague, Netherlands: Martinus Nijhoff, 1975), 92.

throughout the Cold War, although they continued to advance their own political agendas in space[388].

Whereas the United States and Soviet Union initially saw the peaceful preservation of outer space as a means of maintaining space dominance, Canada sought to counteract the growing influence of the superpowers in outer space by appealing to the international system. By pursuing a multilateral approach to international space legislation, Canada hoped to become a champion for third-party interests at the beginning of the Space Age. However, Canada was unsuccessful in this pursuit and instead, under the direction of Prime Minister Diefenbaker in the late 1950s, committed itself more visibly to a bilateral relationship with the United States as a means of guaranteeing a portion of its national interests in space. For the remainder of the Cold War, Canada acted as a "junior partner" of the United States as successive Prime Ministers continued to uphold the "status quo" within international space politics[389]. Bilateralism took precedence over multilateralism, resulting in Canada having a less pronounced role in the implementation of international space legislation and its national interests in space.

To be a space power, strong political leadership matters. The United States and Soviet Union during the Cold War exemplified two spacefaring states with political leaders who understood the strategic importance of outer space. These leaders, whether a President of the United States or Soviet Presidium, had an invested interest in continuing national space activities and in advocating for the continued use of the space environment per their nation's space strategies within domestic (by directing national space organizations) and international forums (through the creation of international space legislation). Canada never had such leadership during this period.

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[388] Nathan C. Goldman, *American Space Law: International and Domestic* (Ames, IA: Iowa State University Press, 1996), 4; John J. Klein, *Space Warfare: Strategy, Principles, and Policy* (New York, NY: Routledge, 2006), 11-12.
[389] Andrew B. Godefroy, op. cit., 74: James Fergusson, Interviewed by Kiernan McClelland, *Research Interview*, November 13, 2016.

Whether Grit or Tory, the Prime Minister of the Federal Government remained disinterested politically in continuing national space activities – including the maintenance of a satellite presence – since the beginning of the Space Age. The long-standing result of this circumstance left Canada's space organizations without proper leadership or support and the country's international space commitment unrealized. Without strong political leadership, the capacity of the country to also sustain multiple satellite operations also decreased.

5.4 Economic Comparison between Canada and the Great Space Powers

Compounded by strategic and political space power differences, the United States and Soviet Union demonstrated clear economic differences with Canada during the Cold War which impacted the ability of Canada to conduct and maintain a long-standing satellite influence in space. As noted in Chapter 3, both the United States and the Soviet Union exhibited comparable economic characteristics that assisted in the rapid development and deployment of artificial satellite technologies. Indeed, the United States and Soviet Union had, early in the Space Age, combined their national, civilian, and military space budgets to allow for the procurement of multiple space technologies more easily. As the strategic and political space power variables reinforce, Canada's national space budget was divided between the nation's civilian and military space organizations with no real political effort to combine financial space resources. Government departments were left to determine how to fund their space projects with the resources they possessed, leading to considerable infighting between Canada's space organizations from the 1950s to 1981[390]. Even Canada's strong connection to private space industry, implemented in the wake of Prime Minister

[390] Jacques M. Desroches, "Canadian Industry's Capabilities in Space," in *Canada's Strategies for Space: A Paradox of Opportunity*, ed. By Brian MacDonald (Toronto, ON: Canadian Institute of Strategic Studies, 1983), 67.

Trudeau's cuts in the 1960s, could never provide the resources need to sustain substantial satellite operations[391].

Perhaps the most obvious dissimilarity when comparing Canada to the great space powers is found with the country's financial engagement of its national space activities. The United States and Soviet Union simply could allocate more financial resources to their national space activities. On average, the total U.S. government spending on space technologies from 1959 to 1991 was approximately $23.6 billion, while the Soviet Union spent a yearly average of approximately $33.5 billion on space technologies[392]. Comparatively, Canada's national space budget for both civilian and military space programs has customarily been small. Indeed, the total space budget (accounting for both civilian and military space projects) equated an average of around $3.4 billion dollars per year from 1962 to 1991 with around $1.7 billion being credited to national space budgets conducted under the Mulroney Government (from 1984 to 1991)[393]. Resulting in a "technical capability gap", the lack of funding to national space activities made it so that Canada could "no longer afford to expose herself to the degree of economic and technological dependence that characterized…[the] national space programs" of the great space powers during the Cold War[394]. When considering the economic variable of space power, it may be concluded that Canada simply lacked the funds to develop and deploy the number of satellites needed to sustain a prolonged strategic presence in space.

To summarize, "size does matter" insofar as the economic variable of space power is concerned. The larger a spacefaring state's space budget, the more likely it is to allocate funds to

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[391] Jacques M. Desroches, op. cit., 69.
[392] Tamar A. Mehuron, "2003 Space Almanac," *Air Force Magazine*, August 2003.
[393] Colin Franklin, "Canadian Military Requirements in Space," in *Canada's Strategies for Space: A Paradox of Opportunity*, ed. By Brian MacDonald (Toronto, ON: Canadian Institute of Strategic Studies, 1983), 56-57; Alain Simon, "The Economic Impact of Space," in *Space Strategy: Three Dimensions*, ed. By Brian MacDonald (Toronto, ON: Canadian Institute of Strategic Studies, 1989), 5-6.
[394] Andrew B. Godefroy, op. cit., 74.

sustaining satellite technologies and space operations. The United States and Soviet Union were able to allot a more sizable portion of their national economies to national space activities enabling them to exploit the space environment more frequently than other spacefaring states during the Cold War. Moreover, because they had more funds to draw upon, maintaining a long-term satellite presence in the orbits was also more straightforward for these great space powers. Aged or broken satellites could easily be replaced without placing substantial strain on the country's economy. The opposite may be said about Canada during the Cold War. When considering the economic variable of space power, it may be concluded that Canada simply lacked the funds to develop and deploy the number of satellites needed to sustain a prolonged strategic presence in space. A myriad of government and political decisions that divided Canada's national space organizations during the Cold War, in addition to financial constraints placed on the size of the country's economy during the period, limited the ability of Canada to allocate the necessary funds to technological projects that would sustain multiple satellite operations.

5.5 Conclusion

Despite possessing considerable scientific and technological potential at the beginning of the Space Age, Canada did not develop into a space power during the Cold War. Whereas the United States and Soviet Union were able to launch numerous satellites and maintain a long-term material presence beyond the orbits, Canada did not pursue a strategic space policy that increased its influence, prestige, or power in space. Although the successful launch of Alouette I on September 29, 1962 and the publication of the "Chapman Report" implied that Canada was prepared to commit to a strategic space policy focused on using multiple satellites, its strategic presence in space by 1991 had declined to a handful of aging space technologies. In spite of holding

the honour as the third country to enter space, Canada's strategic space policy failed to direct the country toward preserving a long-term material presence in the upper atmospheres.

Table 5.1: Canada v. Superpowers – Space Power Variables Analysis Summary

Space Power Variables	**United States and Soviet Union, 1957-1991**	**Canada, 1962-1991**
Strategic Variables	• Possess a clear national space security strategy and policy for directing national space organizations. • Published multiple space documents to direct national space activities from 1957 to 1991. • Context of declassified space documents focused space operations on deploying artificial satellite launches as a means of increasing national power. • Owned multiple non-offensive space-based capabilities.	• Absence of clear national space security and policy for directing national space organizations. • First official space policy directing national space activities is released in 1986. • National space organizations consistently disagree over how to guarantee strategic objectives in outer space. • Owned communication and scientific space-based technologies.
Political Variables	• President/General Secretary consistently directs national space organizations. • Political leaders consider outer space a mandated issue. • Domestic and international space legislation support similar strategic objectives.	• Prime Minister does not assume a leadership position in directing national space activities. • Political leaders do not consider outer space a mandated issue. • Domestic and international space proposals differ over strategic objectives.
Economic Variables	• Total national space budget is combined between civilian, industry, and military organizations • Routinely increased financial resources dedicated to satellite development	• Partitioning of space budget funding between civilian, military and industry projects. • Funding cuts impact ability to sustain satellite development.

It can be determined that it was not just one factor that impacted Canada's ability to develop into a space power. Hindered by the absence of a clear space strategy during the Cold War, Canada's national space organizations could not agree on a common strategic approach to space which would have allowed the country to commit to more space activities during the period. Whereas some groups, like the DRB and NRC, advocated the use of a limited number of scientific assets, other groups, like the RCAF, suggested the implementation of more satellites into the space domain. Without a clear strategic space policy framework, Canada's space organizations were left pursing their own technological projects rather than combining their efforts to increase the nation's

satellite assets. Compounded by political leadership and support that did not have an invested interest in directing national space activities and insufficient economic resources for space technology procurement, it was not sensible for Canada to continue with a strategic space policy that emphasized growth in operational satellites. Without a common space strategy, political leadership and support, or the economic resources needed to sustain multiple satellite operations, Canada did not possess the strategic, political, or economic variables that quantify spacefaring states as space powers. To address the question presented at the beginning of this thesis, the inconsistent application of the strategic, political, and economic variables of space power caused the strategic space policy of Canada in 1962 to weaken markedly from the strategic space policy presented by the country after 1991.

But what could have Canada done differently that would have allowed it to become a space power of the period? Looking to the space power factors that had the greatest effect on influencing the great space powers of the United States and Soviet Union, a few suggestions can be made. First, if Canada had created a comprehensive space strategy early in the Space Age, similar to the Eisenhower Administration's 1958 *National Aeronautics and Space Act*, then the country may have been better able to outline its strategic objectives in space and, correspondingly, direct both its civilian and military space organizations toward accommodating a long-standing space presence. Second, if Canada's Prime Ministers had championed the continuation of a strategic space operations as a mandated political issue, much like the U.S. Presidents and U.S.S.R. Presidia had done, then Canada would have been more likely to develop a long-term satellite occupancy in space. Moreover, if Canada's Prime Ministers considered space operations as a mandated issue, the country's political leadership would have been able to direct national space organizations, international legislative efforts, and financial resources towards increasing Canada's satellite

presence. Lastly, if Canada had allocated more funds to national space activities or had combined it national civilian and military space budgets together, like the U.S. and U.S.S.R. had done for projects deemed in the national interest, it would have been in a better position to maintain a progressive increase in satellite launches and operations during the Cold War. Granted, this counterfactual exercise cannot be completely validated, but it is likely that space power factors that impacted the great space powers would have a similar influence on the national space activities of Canada. Given the country's promising start employing telecommunication satellites and published a forward-looking space strategy in 1962, it can be inferred that leveraging these factors would have led to the maturation of Canada into a space power during the Cold War.

Chapter 6: The Final Frontier: Delineating the Thesis' Core Findings, Ramifications, and Future Areas of Research

6.1 Introduction

Since the dawn of early human space flight after the Second World War, outer space has remained "the final frontier" in the area of strategic operations especially where Canada's modern national space activities are concerned[395]. Although the third country to enter the upper atmosphere in the Cold War with the launch of Alouette I in 1962, the strategic space policy of Canada, presented on September 29, 1962 in the *National Space Study* or "Chapman Report", shifted during the period from supporting the a long-standing strategic influence in space through the repeated use of numerous satellites, to the maintenance of a handful of space assets that could only achieve temporary space superiority. By the end of the century, Canada, now owning a small satellite capability of aging and niche civilian and military space technologies, accommodated a limited strategic presence in the space environment compared with other spacefaring states[396]. As a nation which seemed destined to exert its influence and prestige in space, Canada fell short on its efforts to reach its potential as a space power commanding a long-term presence in outer space during the formative years of early Space Age.

While the previous chapters of this thesis forwarded the discussion for why Canada was unsuccessful in its quest to become a space power, this chapter will provide a comprehensive summary of the core findings of this thesis. Furthermore, this chapter while elaborate on the potential domestic and international ramifications of this study and potential avenues for future research looking at Canada and the strategic study of space power.

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[395] *Star Trek*, "Amok Time", Directed by Josey Pevney, Written by Gene Roddenberry and Theodore Sturgeon, National Broadcasting Company (NBC), September 15, 1967.

[396] Joshua Kutryk (Royal Canadian Air Force) "To Earth Orbit and Beyond: Discussion Points for a Strengthened Canadian Defence Strategy in Outer Space," *The Royal Air Force Journal* 4.4 (2015): 6; Rick Pitre (Royal Canadian Air Force, Ret'd), Interviewed by Kiernan McClelland, *Research Interview*, September 29, 2016.

6.2 Canada, the Great Space Powers, and the Space Power Dilemma

Questioning why Canada's strategic space policy shifted away from supporting the launching of multiple space technologies, this thesis began by asking a question: *Why was Canada, despite its promising start employing telecommunications satellites and publishing a forward-looking national space strategy early in the Space Age, unsuccessful in developing into a space power with a long-term artificial satellite presence in the upper atmospheres during the remainder of the Cold War?* It was hypothesized that Canada was short on key strategic, political, and economic space power factors that would have enabled it to better manage and support more space activities during the Cold War. For whatever reason, Canada had experienced an absence of a common space strategy, strong political leadership and support, and robust economic resources that had empowered the superpowers of the period – the United States and Soviet Union – to develop into great space powers adept at maintaining a long-term material space presence. This thesis, therefore, set out from the start to compare space power factors between Canada and the superpowers to better understand what Canada 'did wrong' in its pursuit to become a space power during the transformative years of early human space operations.

Several core findings emerge from this thesis which clarify how the superpowers were able to develop into space powers during the Cold War. For a spacefaring state to be quantified as a space power, and, thus, capable of launching multiple satellites as a means of increasing national power in space, it must possess a clear space strategy that directs the space activities of all national space organizations. As exemplified by the United States and Soviet Union, with a clear space strategy, a country can more effectively combine civilian and military national space activities toward a single common approach to exploiting the space environment which includes producing and launching more space-based technologies. To be a space power with a long-term satellite

presence, political leadership also matters. Both American and Soviet governments consistently possessed political leaders who considered the continuation of national space activities as vital to their country's national position in world affairs. Because of the perceived importance of national space activities to the welfare of their state, the political leaders in the U.S. and U.S.S.R. continuously assumed a centralized leadership position in directing space operations. With more direct political leadership influencing domestic and international legislation, national space activities became more streamlined; being more streamline in turn equated more space technologies being produced and launched more frequently. Consequently, spacefaring states that are space powers, as demonstrated by the U.S. or U.S.S.R. during the Cold War, are likely to have strong political leadership. Lastly, "size does matter" insofar as space power is concerned. The larger a spacefaring state's space budget, the more likely it is to allocate funds to sustaining satellite technologies and continuous space operations. Again, the U.S. and U.S.S.R. exemplified this space power variable, as the superpowers were both capable of allotting a more sizable portion of their national economies to national space activities, thereby enabling them to exploit space more frequently than other spacefaring states during the Cold War. To summarize, the United States and Soviet Union existed as the great space powers of the Cold War because they shared similar strategic, political, and economic characteristics when conducing national space activities. Indeed, between the periods of 1957 to 1991, the superpowers were able to guarantee and, over the longer-term, maintain their strategic presence in space through effective leadership that could amalgamate participation from all relevant space organizations, as well as the space strategy and economic resources needed to sustain expensive ventures into the space environment.

Considering the space power variables exemplified by the superpowers during the Cold War, this thesis determined that Canada's modern space assets by the end of the 20th century had

been influenced by an array of government decisions made during the Cold War. Whether done accidentally or deliberately, these government decisions ultimately limited the frequency of national space activities, including satellite launches, conducted by Canada from 1962 to 1991. As declassified documents suggest, the Federal Government often experienced considerable departmental infighting between civilian and military organizations responsible for national space operations, all the while experiencing no significant direction from the Prime Minister (who, regardless of political party, would defer the driving of national space activities in place of more important political issues). Consequently, national space operations decreased in regularity and space-based technology projects deemed not in the "public interest" were suspended as Canada's national space organizations continued to compete against one another for personnel and resources without any direct intervention from the Prime Minister. Compounded by the portioning of Canada's national space budget between civilian, industry and military space organizations during the Cold War, Canada's visible material presence in outer space began to wane as the country was left without a space strategy, political support, or financial resources needed to sustain continuous space operations.

Ergo, Canada's strategic space policy changed so markedly from its original conception, first drafted in the 1962 "Chapman Report", because a strong strategic version required factors of space power established by the superpowers during the Cold War. Whereas the United States and Soviet Union effortlessly guaranteed their statuses as prominent space powers, Canada was continually faced with a dilemma as to how it could effectively and efficiently navigate a strategic presence for itself in space. As hypothesized, these differences between Canada and the superpowers in the space environment can be summarized as follows: without a common space strategy, political leadership or support, or the economic resources needed to sustain multiple

satellite operations, Canada did not possess the strategic, political, or economic variables that quantify spacefaring states that are considered to be dominant space powers. Referring back to the question presented at the beginning of this thesis, the inconsistent application of the strategic, political, and economic variables of space power caused the strategic space policy of Canada in 1962 to weaken distinctly from the strategic space policy presented by the country after the end of the Cold War in 1991. Despite its considerable scientific and technological potential at the start of the Space Age, Canada was not a space power during the Cold War.

6.3 Domestic and International Ramifications of Research Study

Several ramifications emerge from this study of Canada's strategic space policy. At the time of writing, this thesis presents the only academic assessment using variables of space power to analyze Canada's national space activities and its similarities and differences with the great space powers during the Space Age. As the only study of its kind to group theoretical considerations of space power with the implementation of Canada's national space activities, this thesis occupies an exclusive place in the literature published on Canada's strategic role in outer space and on space power theory. Complementing the academic contributions of Fergusson, Godefroy, Huebert, and Sloan concerning the strategic exploitation of space by Canada, this thesis elaborates on why Canada wasn't successful in reaching its potential as a space power during the 20th century. By presenting explicit strategic, political, and economic rationale that identify specific strategies and policies (the Chapman Report and subsequent lack of comprehensive space strategies), political figures (the Canadian Prime Ministers), and space technologies (Alouette I and RADARSAT), this thesis adds to the literature by emphasising that a combination of internal influences impacted Canada's ability to become a space power. Moreover, this thesis provides the first academic text in which Canada's national space activities were evaluated using variables

effecting the development of a state into a space power. Similar to previous articles published over the decade which have measured the United States and Soviet Union as space powers, this thesis presents a contribution to the field of strategic studies that contemplates a country often overlooked by the contemporary literature on space power[397]. Hopefully, with this thesis acting as the reference point for analyzing Canada using space power variables, the dialogue can continue to develop the strategic role that the burgeoning Canadian space power has played in international affairs within the confines of the high-earth orbits.

Besides providing a major contribution to the academic literature on Canada's national space activities and space power, the conclusions reached in this study further differentiate Canada from the United States and Soviet Union during the formative years of early space activities. Indeed, this thesis, which outlines what the great space powers 'did right' and Canada 'did not do' during the Space Age, is significant insofar as it presents a criticism of Canada's historical approach to conducting national space activities. For example, through an the analysis presented in Chapter 4, it was determined that the Federal Government of Canada or Prime Minister had not directed the nation's space organizations toward a comprehensive strategic direction, resulting in intergovernmental competition and infighting between space organizations for technical resources and political support. Without strategic or political direction, the country's space assets decreased. On the other hand, a unified approach to space operations and strong political leadership allowed the U.S. and U.S.S.R. to dominate space during the Cold War. Similarly, because of the partitioning of the nation's space budget between civilian, industry, and military enterprises, Canada did not have the financial coffers needed to produce the number of satellites required to

[397] Walter A. McDougall, *...the Heavens and the Earth: A Political History of the Space Age* (New York, NY: Basic Book, 1985); Benjamin S. Lambeth, *Mastering the Ultimate High Ground: Next Steps in the Military Uses of Space* (Santa Monica, CA: RAND, 2003); Bert Chapman, S*pace Warfare and Defense: A Historical Encyclopedia and Reference Guide* (Santa Barbara, CA: ABC-Clio, 2008).

sustain a long-term strategic presence in space. Alternatively, the U.S. and U.S.S.R. had the economic resources needed to launch a large number of satellites during the Cold War. Standing as a major ramification of this study, it can therefore be concluded that Canada was simply not in the same league as the United States or Soviet Union when it came to national space activities during the Cold War. Although a 'hard pill' to swallow by some, Canada did not have the strategic foresight, the political support, or the financial resources needed to match the influence of the great space powers.

Yet, the conclusions communicated in this thesis will also help direct future Canadian policy-makers toward creating a future strategic space policy that better allows the country to increase its strategic presence in space through the use of multiple satellites. As this thesis forwards, if Canada wishes to become a space power in the same manner as the great space powers, it needs to reorganize its strategic space policy to permit the uninterrupted development and deployment of multiple space technologies. Given the space power variables demonstrated by the country when compared to the great space powers, this can now be accomplished by Canada through one of many options that address one of the strategic, political, or economic issues that had previously impacted Canada's space presence. One option, given the country's historical lack of available space budget funds and strategic direction in space during the Cold War, could be that Canada becomes a connoisseur of cheap, easily producible small, micro, or even pico satellites. At the same cost of a single larger satellite, Canada could more easily manufacture several smaller units at home and in the process expand its strategic presence more easily within the orbits over the next decades[398]. Another option for Canada may be that its political leadership begin to push a "national vision" for outer space. As noted by former Brigadier-General Rick Pitre, "[i]f Canadians

[398] Colin Franklin, "Industrial Opportunities in Space," in *Canada's Strategies for Space: A Paradox of Opportunity*, ed. By Brian MacDonald (Toronto, ON: Canadian Institute of Strategic Studies, 1983), 57-58.

realize that their basic services come from space – like their cell phones, internet, hockey games – it will reduce the cost and the ordinary Canadian acceptance of the more expensive ventures into the region"[399]. Given these two options, there are many avenues that Canada can take to remedy the mistakes made in past space-policy decision making. However, instead of providing the correct answer to which option is better, this thesis instead provides the first step for understanding that there existed a problem during the early years of human space activities and that Canadian policy-makers need to be mindful that the mistakes of the past don't affect the national space activities of Canada in the future.

The final ramification of this study is also the most global in scope. Specifically, this thesis describes how even the most promising technologically-advanced states – those with a strong level of scientific innovation – can still falter in their efforts to develop into space powers. Using Canada as the primary case study, this thesis adds to the strategic study of space power by presenting an analysis of a spacefaring state that was one of the most scientifically and technologically advanced countries in human history; that, despite beginning in a strong strategic presence in space at the beginning of the Space Age, regressed to a nation with a limited space technology capability by the end of the Cold War. All the while, over the last decade, space has become populated by an influx of "cheap, easily producible…satellites" by states wishing to exploit a share of the national power "[which is] characteristic of the [space] environment"[400]. For those states – like China, Iran or India – who are considered "late to the Space Age", the ability to launch multiple satellites has not been affected by the state's comparatively smaller gross domestic product (GDP) per capita[401].

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[399] Rick Pitre (Royal Canadian Air Force, Ret'd), Interviewed by Kiernan McClelland, *Research Interview*, September 29, 2016.
[400] Michael E. O'Hanlon, *Neither Star Wars Nor Sanctuary: Constraining The Military Uses of Space* (Washington, D.C.: Brookings Institution Press, 2004), 35; 38-39.
[401] Nayef R. F. Al-Rodhan, *Meta-Geopolitics of Outer Space: An Analysis of Space Power, Security and Governance* (Oxford, U.K.: Palgrave-MacMillian, 2012), 27.

India for instance, despite being ranked 158th in the Central Intelligence Agency (CIA) World Factbook's GDP per capita index in 2017, early this year launched a record-breaking 104 owned and operated satellites with a single rocket[402]. Like India, the new wave of spacefaring states that have emerged following the end of the Cold War have, for the most part, been able to maintain a sizable strategic presence in space despite having a reduced average GDP per capita compared to Canada during the heyday of national space activities between 1962 and 1991[403].

To summarise, this study can also provide insight into how countries that are poorer than Canada have been able to become space powers. Creating and sticking with a common space strategy, having strong political support for national space activities, and optimizing how a space budget is spent matters for any spacefaring state wishing to establish a long-term strategic presence in space. It can therefore be reasoned then that those states that have emerged as space powers over the last decade have, in part, demonstrated these space power variables in some capacity, thereby allowing them to conduct more frequent satellite launches over the last few years. This is to say that, despite being poorer than the most states in western society, even smaller nations can go to space if they really want to. On the other hand, this study further enforces the suggestion that even the wealthiest of states may not develop into major space powers if certain factors affecting national space activities and the use of multiple space technologies are absent in space policy decision making.

6.4 Future Research into Canada's National Space Activities and Space Power

Just as the physical confines of outer space are limitless, so, too, are the possibilities for future research analysis and assessment of Canada as a space power within the 21st century security

[402] Samantha Mattewson, "India Launches Record-Breaking 104 Satellites on Single Rocket," *Space.com*, February 2017; Central Intelligence Agency, "Country Comparison: GDP – Per Capita (PPP)," *The World Factbook*, June 2017.
[403] Nayef R. F. Al-Rodhan, op. cit., 28.

environment. Although this research has determined why Canada's strategic space policy changed from initially supporting the exploitation of multiples satellites during the Cold War, it has not examined how space power factors or variables further impacted the country's ability to become a space power after 1991. This was the case because many of the published documents detailing Canada's space operations after the end of the Cold War remain classified and unavailable. Indeed, key information – such as the RADARSAT-2 and RADARSAT-3 earth observation satellite projects – remain confidential. However, as more information from the 1990s and early 2000s becomes available, future research should consider this period and assess whether Canada's national space activities continued to lack the space strategy, political support, or economic resources that it demonstrated during the Cold War.

Special attention should also be provided in the future to investigate the impact that new and emerging space technologies, such as RADARSAT-3 and Sapphire (the Canadian Armed Forces' (CAF) space situational awareness (SSA) satellite), will have on the advancement of Canada's strategic space policy in the upcoming decades. As Canada continues to outline its commitment in the late 2010s to "[e]xpanding [its] capabilities in space" by investing in "multi-purpose" space-based systems, these potential space technologies should also be matched to the strategic objectives that Canada would like to gain through its space exploitation[404]. Rather than launching space technologies haphazardly – for the sake of appeasing allies or civilian and military shareholders by simply "putting something into space" – future research analyzing Canada's national space activities should clarify and emphasize which space-based systems are needed to

[404] Canadian Space Agency, "Canada's Space Policy Framework: Launching The Next Generation," *Government of Canada*, February 2014, 10; Department of National Defence, "Strong, Secure, Engaged: Canada's Defence Policy," *Government of Canada*, June 2017, 15.

compliment the strategic objectives of the country[405]. This research can begin forthwith by looking at the new generation of satellites currently being developed by the Government of Canada; starting with the RADARSAT systems and extending to distant offensive space-technology projects outlined under the Department of National Defence's military space program[406].

Another potential avenue for future research involves expanding on how spacefaring states that are considered middle powers can develop into space powers. Canada, as the primary case study in this thesis, exemplified a middle power that had the potential to become a space power but was unsuccessful in its attempt to develop into one. Nonetheless, Canada was only one of many middle powers during the Cold War that sought to advance a strategic space presence. Following the launch of Alouette I in 1962, other middle powers – like Australia, France, or Japan – also conducted their own national space activities in pursuit of their own national objectives in space[407]. What future research should evaluate is whether other middle powers were successful in their pursuits to become space powers and, if they weren't successful, how similar their strategic space policies were to Canada's. By understanding how other spacefaring states conducted national space activities during the Cold War, the variables of space power exemplified by Canada as presented in this thesis can be compared and contrasted. Future research should therefore determine if the middle powers shared similar characteristics to Canada during their early space activities, such as a lack of a common space strategy, political support, and economic resources, or if Canada was merely a unique example of a country that just couldn't quite direct its strategic space policy toward launching multiple satellites in the pursuit of its national interests in space.

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[405] Anonymous (Department of National Defence Employee), Interviewed by Kiernan McClelland, *Research Interview*, September 25, 2016.
[406] Walt Natynczyk, (Canadian Space Agency), Interviewed by Kiernan McClelland, *Research Interview*, February 11, 2017.
[407] D. A. Turner and J. Vedda, "Foreign space developments and US policy," in *Space and Defense Policy*, ed. By Damon Coletta and Frances T. Pilch (New York, NY: Routledge, 2009), 316.

6.5 Concluding Remarks

Although the United States, Soviet Union, and Canada began their activities in outer space in a similar position on Earth, only the superpowers established a lasting strategic influence in the space domain. This thesis has analyzed and assessed the strategic, political, and economic space power variables of the first three spacefaring countries that, to paraphrase the popular vernacular from science fiction, have gone where very few countries have gone before. What has been determined through this thesis is that, whereas the superpowers stand as great space powers during this period, Canada was not really a space power during the Cold War. The United States and Soviet Union were able to retain their advantageous positions as great space powers by deploying multiple artificial satellites into the celestial orbits whilst maintaining their material presence in space for decades. On the other hand, Canada demonstrated many inherent differences that contrasted the variables of space power that influenced the rise of the superpowers as the preeminent space powers of the Cold War. As hypothesized at the beginning of the thesis, the absence of a common space strategy, strong political leadership and support, and economic resources for national space activities – all of which the United States and Soviet Union possessed – impacted Canada's ability to launch numerous satellites and maintain the long-term material presence in space expected of a true space power. Hence, in the twilight of humankind's first foray into the space environment, Canada was unsuccessful in its pursuit to develop into a space power.

"The greatest danger facing us is ourselves, an irrational fear of the unknown…[but] there's no such thing as the unknown – only things temporarily hidden, temporarily not understood"[408]. Articulated by Captain James T. Kirk (played by a Canadian, William Shatner) in the *Star Trek* television show, this quote provides an appropriate summary of Canada's space

[408] *Star Trek*, "The Corbomite Maneuver", Directed by Joseph Sargent, Written by Gene Roddenberry and Jerry Sohl, National Broadcasting Company (NBC), November 10, 1966.

power motivations during the Cold War and beyond. The greatest challenge facing Canada's development into a space power was from "ourselves"; originating from domestic, rather than international, influences. "[F]ear of the unknown", embodied by strategic and political concerns over how to enter the space environment obstructed the capacity of the country to guarantee a long-term strategic position in space. Yet, as Kirk continues, there is no such thing as unknowns, only things not temporarily understood at a specific point in time. Although Canada did not possess the same strategic, political, or economic space power factors that allowed the United States and Soviet Union to maintain a long-term presence in outer space during the Cold War, it can still learn from its history. By understanding that a comprehensive space strategy, strong political leadership, and substantial economic resources are required for a spacefaring state to develop into a space power, Canada can begin to implement changes to better direct its future space power ambitions. The ultimate high ground, that is, the celestial dominion of outer space could still, one day, see Canada accommodate a strategic presence in the region as a space power among the spacefaring fraternity.

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