SPACE STRATEGY AT A CROSSROADS

Opportunities and Challenges for 21st Century Competition

Edited by Benjamin Bahney

Center for Global Security Research
Lawrence Livermore National Laboratory
May 2020

SPACE STRATEGY AT A CROSSROADS

Opportunities and Challenges for 21st Century Competition

Edited by Benjamin Bahney

Center for Global Security Research
Lawrence Livermore National Laboratory
May 2020

This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory in part under Contract W-7405-Eng-48 and in part under Contract DE-AC52-07NA27344. The views and opinions of the author expressed herein do not necessarily state or reflect those of the United States government or Lawrence Livermore National Security, LLC.
ISBN-978-1-952565-00-7 LCCN-2020906184 LLNL-TR-807217 TID-59002

Table of Contents

Introduction

In its November 2018 report to Congress, the bipartisan National Defense Strategy Commission applauded the main themes of the Trump administration's 2017 National Defense Strategy. But it was also deeply critical of the strategic thought so far done by the U.S. defense community about the requirements, operational and otherwise, of securing U.S. and allied interests in the types of conflicts we now face. Indeed, it assessed these shortfalls as crippling to the exercise of American power and as dangerous in crisis and war. Is the U.S. military space community exempt from such criticism? Should it be?

Since 2016, the Center for Global Security Research (CGSR) has convened a series of workshops and speaker programs on U.S. military space strategy. We have focused on three primary questions:

1. What is the place of space in the Pentagon's 2015 third offset strategy?
2. With a military strategy in place (in 2017) for war in space, what is our strategy for space in war?
3. What are the needed connections between U.S. military space strategy and the challenges of long-term strategic competition?

We have found many signs of progress in identifying new strategic challenges in space and developing new strategic thought. An expert community in space strategy is slowly developing. It encompasses not just U.S. military and official experts but also experts from among U.S. allies and from the private sector. Think tanks and academe are adding space capacity. Policy and strategy documents have passed through multiple iterations. There has been good progress in linking U.S. military strategy to the broader imperatives of an era of strategic rivalry and competition among major powers.

But progress is not success. And the latter appears to be a long way off. Among the expert community we have found substantial dissatisfaction with the rate of progress relative to the rate of change and to the need for ideas well founded in current realities. For example, in a December 2019 workshop at CGSR, thought leaders in the U.S. military space community made the following key arguments (on a not for attribution basis):

- "The 2018 National Defense Strategy enjoins Americans to embrace a more competitive mindset—to learn to 'out-think, out-maneuver, out-partner, and out-innovate' our adversaries. The U.S. military space community has not embraced this mindset. Instead, it has struggled to do the easier things in order to try to sustain its world-leading status. But those easier things have fallen short."

- "The U.S. military space community is hardly exempt from the criticism that U.S. defense leaders have done far too little thinking about how to prevail in long-term strategic competition, how to 'expand the competitive space,' how to meet new operational challenges, and how to deter and to fight and win at reasonable cost if deterrence fails. Our hubris, based on our past preeminence, is toxic. It is also dangerous."

- "The U.S. Space Force is an important step forward. But form should follow function and we're forming the Force without having an understanding of its functions. And we cannot characterize those functions without understanding the dynamics of the terrestrial conflicts in which space capabilities and vulnerabilities will play some role."

- "To become as competitive in space as we need to become, and can become, we must be at least as bold and risk-taking in our thinking as we were at the dawn of the space age and as we were in the race to the moon. We must begin with an unsentimental understanding of the threat environment; that is, we must understand space's particular roles in the deterrence and escalation strategies of our adversaries—and in our countering strategies. Then we need a clear concept of what an open and secure architecture could be."

This small volume is intended to help catalyze and inform thinking about these challenges. It draws on work at CGSR and elsewhere exploring the links between competitive strategies and the U.S. military space enterprise. It also draws on discussions from a workshop we convened in December 2019.

I am grateful to the authors for their effort to craft these papers. I am especially grateful to my CGSR colleagues Ben Bahney and Jonathan Pearl for their intellectual leadership on these matters. The views expressed here are the personal views of their authors and should not be attributed to any institution.

Brad Roberts
Director
Center for Global Security Research

About the Contributors

John D. Hill has served as the principal director for Space Policy in the Office of the Under Secretary of Defense for Policy since 2013, where he formulates space-related national security and defense policies, including for the conduct of international space cooperation. His past experience in the Department of Defense includes serving as principal director overseeing defense policies and programs regarding Afghanistan, Pakistan, and Central Asia from 2010 to 2012, and as principal director with similar responsibilities relating to East Asia from 2006 to 2010. Mr. Hill joined the Department of Defense as a presidential management fellow and was later selected for the inaugural class of Mansfield Fellows on detail to various Japanese government agencies. He earned his M.A. in International Affairs from American University and his B.A. in Political Science from the University of California, Los Angeles.

Peter L. Hays is an adjunct professor of Space Policy and International Affairs at George Washington University's Space Policy Institute and a senior policy advisor with Falcon Research. He has been directly involved in helping to develop and implement major national security space policy and strategy initiatives since 2004 and serves as a senior advisor on space governance, cadre, and strategic messaging issues. Hays previously taught space policy courses at the U.S. Air Force Academy, the School of Advanced Airpower Studies, and National Defense University. Hays' major publications include *Handbook of Space Security*, *Space and Security*, and *Toward a Theory of Spacepower*. He holds a Ph.D. from the Fletcher School of Law and Diplomacy at Tufts University.

Matthew Daniels is research faculty and a senior fellow at Georgetown University and a senior expert for the Office of the Secretary of Defense. He was previously the inaugural technical director for Artificial Intelligence in the Office of the Under Secretary of Defense for Research & Engineering. Prior to that, Daniels served as advisor to the Director of Net Assessment in the Office of the Secretary of Defense, focusing on space programs and artificial intelligence. He was also a senior technical advisor in the Office of the NASA Administrator, focusing on development of cislunar space, and a research engineer at NASA working on optimal control, probability theory, and new science missions. He was a science fellow at Stanford's Center for International Security and Cooperation and is a recipient of the Department of Defense Medal for Distinguished Public Service. Daniels received his Ph.D. and M.S. degrees in Engineering from Stanford, and a B.A. in physics from Cornell.

Bleddyn Bowen is a lecturer in International Relations at the University of Leicester, where his research interests include space strategy, spacepower theory, military space activities, U.K. and E.U. space policy, and space debris. His monograph *War in Space: Strategy, Spacepower, Geopolitics* with Edinburgh University Press and Oxford University Press America will be published in 2020. He has previously provided testimony to the U.K. Parliament's Brexit Select Committee on the impact of Brexit on the U.K.'s participation in the Galileo program, and has previously lectured at Aberystwyth University, King's College London, and the Royal College of Defence Studies. Bowen holds a Ph.D. in International Politics from Aberystwyth University in Wales. He can be found on Twitter at @bleddb.

Pablo Alonso-García is a research associate at the Center for Global Security Research (CGSR) at Lawrence Livermore National Laboratory, a Policy Researcher at the RAND Corporation, and a Ph.D. Fellow at the Pardee RAND Graduate School. Prior to that, he had a long career in the aerospace and defense industry. Initially a systems engineer for the European Space Agency, he moved to managerial positions at Airbus working in product and corporate strategy. His research interests include European space policy, integration dynamics, and multilateral industrial programs. At CGSR, he is exploring great power competition in the space domain, the new entrepreneurial space era, and its implications for the positioning of Europe as a major space power. Alonso-García holds a Bachelor and Master of Engineering from the Universities of Oviedo and León in Spain, a double MBA degree from ESADE Business School and The University of Texas at Austin (McCombs), a Master in International Relations from the London School of Economics and Political Science (LSE), and a Master in Public Administration from Harvard University.

Benjamin A. Silverstein is a research associate at the Center for Global Security Research (CGSR), focusing on the intersection of emerging technology and strategic stability. His research concentrates on how states and multinational organizations consider integrating counterspace technologies into deterrence models. Prior to CGSR, Silverstein worked in Geneva, Switzerland at the United Nations Institute for Disarmament Research, investigating opportunities for international arms control and preparing for the 2019 Group of Governmental Experts on further practical measures for the prevention of an arms race in outer space.

Benjamin Bahney is a senior fellow at the Center for Global Security Research (CGSR) at Lawrence Livermore National Laboratory. He researches the dynamics of the emerging strategic competition in space and cyber, and how this competition will impact deterrence in the 21st century. He is also a regular participant in the U.S.-China Track 1.5 dialogue on military cyber stability. Bahney has contributed writing to the *New York Times*, *Foreign Affairs*, *Foreign Policy*, Lawfare, and War on the Rocks. He was also a contributing author to the edited volume *Cross-Domain Deterrence: Strategy*

in an Era of Complexity (Oxford Univ. Press, 2019). He was formerly an analyst at the RAND Corporation. He has an M.A. in International Affairs from the University of California, San Diego and a B.A. from the University of Pennsylvania.

Jonathan Pearl is a senior fellow at the Center for Global Security Research (CGSR) at Lawrence Livermore National Laboratory. His work examines the implications of space, nuclear, and advanced technologies on national security and strategic competition. His research interests include deterrence, escalation control, arms control, nonproliferation, and strategic stability. Pearl was formerly a Lawrence Scholar at CGSR, a Stanton Nuclear Security Fellow at the Council on Foreign Relations, and a Jennings Randolph Peace Scholar at the United States Institute of Peace. Prior to that, he was an adjunct researcher and summer associate at the RAND Corporation, a nuclear scholar at the Center for Strategic and International Studies, and a foreign policy and national security advisor to former Senator Christopher J. Dodd. Pearl holds a Ph.D. and M.A. in Government and Politics from the University of Maryland, and a B.A. in Music from Florida Atlantic University.

Defining the Goals and Requirements of Strategic Competition in and through Space

John D. Hill[1]

The growing importance of space to the United States and the world has received much attention in recent years. So too have the growing threats to space capabilities and the associated implications for strategic stability and security.[2]

These space domain dynamics are part and parcel of the re-emergent great power competition identified in the United States National Security Strategy, which states that the People's Republic of China (PRC) and Russia "are contesting our geopolitical advantages and trying to change the international order in their favor."[3] Elaborating on this competition, the 2018 National Defense Strategy adds that "China is a strategic competitor using predatory economics to intimidate its neighbors while militarizing features in the South China Sea. Russia has violated the borders of nearby nations and pursues veto power over the economic, diplomatic, and security decisions of its neighbors."[4] Far from becoming responsible stakeholders in the rules-based international system that has developed over the past 75 years, and from which they and other nations benefit greatly, the PRC and Russia each seek to undermine that system from within and rearrange it into a new international order designed specifically to empower themselves through their respective models of autocratic capitalism and great power spheres of influence.

Recognizing these trends, the United States National Space Strategy articulates the nation's vital interest in space—"to ensure unfettered access to, and freedom to operate in space, in order to advance America's security, economic prosperity, and scientific knowledge." Noting that "our competitors and adversaries have turned space into a warfighting domain," the National Space Strategy "affirms that any harmful interference with or attack upon critical components of our space architecture that

1 This paper is based on remarks of the author during a December 10-11, 2019 Center for Global Security Research (CGSR) conference titled "Space Strategy and Strategic Competition." The views expressed are solely those of the author and do not necessarily reflect the views of CGSR or the United States Department of Defense.

2 See, for example, U.S. Defense Intelligence Agency, *Challenges to Security in Space* (January 2019). Accessed March 25, 2020. https://www.dia.mil/Portals/27/Documents/News/Military%20Power%20Publications/Space_Threat_V14_020119_sm.pdf. Also see National Air and Space Intelligence Center, Competing in Space (December 2018), https://www.nasic.af.mil/Portals/19/documents/Space_Glossy_FINAL--15Jan_Single_Page.pdf?ver=2019-01-23-150035-697. Accessed March 25, 2020.

3 The White House, *National Security Strategy of the United States of America* (December 2017), p27. Accessed March 25, 2020. https://www.whitehouse.gov/wp-content/uploads/2017/12/NSS-Final-12-18-2017-0905.pdf.

4 U.S. Department of Defense, *Summary of the 2018 National Defense Strategy of the United States of America* (2018), p1. Accessed March 25, 2020. https://dod.defense.gov/Portals/1/Documents/pubs/2018-National-Defense-Strategy-Summary.pdf.

directly affects this vital interest will be met with a deliberate response at a time, place, manner, and domain of our choosing."[5]

Space and Great Power Competition

Great power strategic competition in space as it relates to the Department of Defense (DoD) is not about returning humans to the Moon or racing to Mars and other new destinations. Nor is it about competition for resources such as water at the lunar South Pole or minerals from asteroids. Important as such endeavors may be, they are largely the work of civil, scientific, and commercial exploration, research, and competition and mostly lie beyond the purview and mission scope of DoD and its recently established U.S. Space Force and U.S. Space Command (USSPACECOM).[6]

Instead, the DoD mission in space is and will remain closely tied to employing and ensuring the advantages of space-based capabilities in deterring conflict on Earth and in fighting and winning the nation's wars when deterrence fails. DoD's evolving organizational structure accounts for the nature of great power competition across all domains and instruments of national power. It also recognizes that great power strategic competition in space is largely indistinct from, and driven by the same motivations as, strategic competition on Earth.

Within that frame of reference, the new U.S. Space Force will be responsible for organizing, training, and equipping space forces; and focusing full-time on developing the concepts, doctrine, capabilities, and expertise needed to ensure superiority in space that is strategically linked to superiority across all military domains. The U.S. Space Force will present those forces to the Combatant Commands, most notably to USSPACECOM, but also to the others.

Collectively, the Combatant Commands will be responsible for developing their operational concepts and their operational plans within a multi-domain framework that recognizes the potential for conflict to start in and extend to any domain and across all domains. More specifically, USSPACECOM will employ its assigned U.S. Space Force elements, as well as elements that it receives from other Military Services, within an area of responsibility that includes everything beyond 100 km above mean sea level. Its mission is to deter conflict, defend U.S. and allied freedom of action in space, deliver combat-relevant space capability to the joint and combined force, and employ space forces to advance U.S. and allied interests in, through, and from the space domain.

5 The White House, Fact Sheet, "President Donald J. Trump is Unveiling an America First National Space Strategy" (March 23, 2018). Accessed March 25, 2020. https://www.whitehouse.gov/briefings-statements/president-donald-j-trump-unveiling-america-first-national-space-strategy/.

6 Pursuant to Presidential direction, the Secretary of Defense established the U.S. Space Command on August 29, 2019. On December 20, 2019, the President signed the National Defense Authorization Act for Fiscal Year 2020 (Public Law 116-92), which established the U.S. Space Force as an armed force within the Department of the Air Force. Accessed March 25, 2020. https://www.congress.gov/bill/116th-congress/senate-bill/1790/text.

These organizational measures rest on the premise that war is still fundamentally a function of terrestrial political differences. In particular, war is about the divergent terrestrial political interests of belligerents who have chosen military means to secure their objectives. War extending to space, or originating in space, is not really about space, but about those same terrestrial political objectives. If a nation can gain the upper hand in conflict on Earth by employing the advantages of space or by denying an adversary those same advantages, it probably will.

For the past 30 years, the United States has demonstrated the battlefield advantages delivered by space-based capabilities clearly and dramatically, and has increasingly come to rely on these capabilities to enable the U.S. way of war. In parallel, for two decades the PRC and Russia have both developed growing counterspace arsenals—as well as space capabilities of their own—in order to have the military capability necessary to prevent the United States and its allies and partners from intervening successfully to deny the PRC and Russia their terrestrial political objectives in the event they opt to employ a military option. Both have already done this to varying degrees with some success.

Indeed, by asymmetrically holding space capabilities at risk, both hope to be able to dissuade the United States and its allies and partners from intervening. This is Sun Tzu's ancient dictum in action: the idea that the supreme art of war is to secure the adversary's acquiescence without a fight.[7]

To that end, the PRC and Russia both see their military options as requiring the ability to deny the United States the advantages of its space-based capabilities—capabilities that underpin the deterrent and warfighting power of the United States by enabling the U.S. to impose costs on an aggressor, respond to crises rapidly, strike precisely, project power globally, and command and control forces in multiple distant combat theaters simultaneously. Both countries are developing sophisticated on-orbit capabilities and an array of counterspace weapons capable of targeting nearly every class of U.S. space asset. Likewise, they are both expanding their respective abilities to utilize space and have each created military space forces that they are training and equipping.

Objectives of Defense Space Strategy

Notable developments in military space operations over the past 20 years include the re-emergence of co-orbital counterspace threats, the proliferation of direct-ascent, hit-to-kill antisatellite missiles, and the emergence of directed energy weapons posing threats that early generations of space systems were not designed to face or withstand. These changes have raised doubts about the long-term ability of the United States and its allies and partners to ensure the

7 Or, as translated by Lionel Giles in 1910, "Hence to fight and conquer in all your battles is not supreme excellence; supreme excellence consists in breaking the enemy's resistance without fighting." Sun Tzu, *The Art of War*, Chapter III.2.

availability of space capabilities commensurate with the degree to which joint forces, national leaders, and modern economies rely on them. Left unaddressed, such trends could result in the strategically disastrous situation of being highly reliant on highly vulnerable capabilities.

Preventing such an imbalance is why the pursuit of space domain mission assurance as an element of overall warfighting mission assurance[8] has become a primary objective of defense space strategy for the United States and many of its allies and partners.[9] Modern military power depends upon having superior ability to employ and ensure capabilities delivered from and within space, throughout any and all phases of conflict, making space domain mission assurance an imperative.

Second, as potential adversaries expand their capacities to utilize space to multiply their combat power, it is essential that the United States and its allies and partners be able to defeat or deny the most threatening adversary uses of space, when necessary, to ensure they are not used for hostile purposes. During the initial stages of the post-Cold War era, the absence of an advanced, space-capable adversary largely obviated the need for investment in capabilities meant to deny the hostile use of space—but that time has clearly passed.

Third, the importance of space for economic and other activities of all nations makes it essential to ensure that, in pursuing the first two objectives, the United States does so in a manner that preserves the space domain as a safe and sustainable environment for all operators, consistent with U.S. National Space Policy, by which "The United States considers the space systems of all nations to have the rights of passage through, and conduct of operations in, space without interference."[10]

Fourth, a defense space strategy and posture must credibly convey to potential adversaries that the United States has sufficient will and capability to act successfully to protect its interests and the interests of its allies and partners in space and on Earth. Simultaneously, that strategy must credibly convey to the world that the United States will do so in an appropriate and proportionate way that upholds the principles of international law.

8 See Office of the Assistant Secretary of Defense for Homeland Defense & Global Security, "Space Domain Mission Assurance: A Resilience Taxonomy," White Paper (September 2015). Accessed March 25, 2020. https://policy.defense.gov/Portals/11/Space%20Policy/ResilienceTaxonomyWhitePaperFinal.pdf. Also see U.S. Department of Defense Directive 3100.10: Space Policy (October 18, 2012), Incorporating Change 1 (November 2016).

9 See, for example, France's new defense space strategy, released on July 25, 2019, which establishes a new space command element and emphasizes the need for expanded space situational awareness and development of capabilities for self-defense in space. Links to the complete strategy and an English summary can be found at: https://www.defense.gouv.fr/actualites/articles/florence-parly-devoile-la-strategie-spatiale-francaise-de-defense. Accessed March 25, 2020. Also see the Japan Ministry of Defense's December 18, 2018, National Defense Program Guidelines for FY 2019 and beyond, which describes growing threats to space capabilities, the importance of space superiority and "mission assurance of the entire space system." https://www.mod.go.jp/e/d_act/d_policy/national.html. Accessed March 25, 2020.

10 The White House, *National Space Policy of the United States of America* (Jun. 28, 2010), p3. Accessed March 25, 2020. https://obamawhitehouse.archives.gov/sites/default/files/national_space_policy_6-28-10.pdf.

Key Cross-Cutting Elements

Among the many initiatives DoD is pursuing to secure these objectives, four cross-cutting elements are particularly salient to the challenges of strategic competition.

First is a fundamental mindset reorientation within the defense space enterprise toward treating space as a warfighting domain and not just as a location for providing data-driven services. This reorientation is already well underway with the establishment of USSPACECOM and the U.S. Space Force. Whereas the Air Force historically focused on delivering capabilities from an uncontested space domain and minimized the concept of space superiority, these organizational changes are key enablers of a new focus on understanding and meeting the challenges of establishing and sustaining superiority in space in the same manner that the Army, Navy, Air Force, and Marines relentlessly pursue superiority in their respective terrestrial domains.

In other words, just as the functions required in the space domain have changed, so too must the organizational forms change to achieve delivery of those new functions. Recent establishment of the National Space Defense Center, the Joint Task Force Space Defense, and Space Flag exercises modeled after the Air Force's Red Flag exercises exemplify measures to reorient to this new mindset. Likewise, the mission shift from space *situational* awareness—which focused primarily on monitoring space traffic for safety of flight purposes, to space domain awareness, which emphasizes tasks such as characterizing and tracking potential threats in space—represents a fundamental shift of mindset regarding this key foundational capability for all space operations.

Second, and in concert with the first element, it is essential to build a more lethal and resilient force in space, just as the 2018 National Defense Strategy requires increased lethality and resilience of forces across all domains.[11] In particular, defense space architectures must reduce reliance on high cost, bespoke systems that often take more than a decade to develop and deploy. Through its new Space Development Agency and a reorganized Space and Missile Systems Center, DoD is developing architectures that will incorporate DoD, commercial, and allied elements to provide diversified and redundant pathways for carrying out space missions, including by capitalizing on growing commercial investments and innovations in low-cost, rapidly produced, and deployed systems, such as proliferated low-Earth orbit (P-LEO) constellations and other non-traditional operating modes. Key enablers of this architectural shift include emergence of increasingly diversified commercial sources of reliable and responsive launch services and development of a modern, common enterprise ground network, a unified cloud-based data library, and a data transport network with common data formats and communications protocols. These changes will enhance the quality and timeliness of data collected and delivered from space, as well as strengthen resilience and mission assurance in ways that will

11 U.S. Department of Defense, *Summary of the 2018 National Defense Strategy of the United States of America* (2018), p5-6.

increase the ability to anticipate, detect, attribute, and prevent or respond to attacks in space while reducing the benefits that an aggressor might hope to obtain through such attacks.

Third, the United States must strengthen alliances and build international partnerships in space. Historically, faced with little competition from adversaries in the space domain, the United States could protect its space advantages through high levels of classification and limited involvement of allies and partners in its space architectures and operations. Now, as commercial innovation and technology diffusion have dramatically lowered the barriers to entry to space markets, the relative ability of even allies with small budgets to contribute meaningfully to space architectures and operations has grown. As a result, the opportunity costs of perpetuating the traditional go-it-alone approach continue to increase.

Shifting to embrace combined space operations and architectures begins with the imperative to transition from a longstanding mindset of U.S.-only space operations and architectures. It requires instead a mindset of actively identifying, developing, and capturing opportunities with allies and partners to build combined space operations and interoperable, or even integrated, architectures. The conversion of the Joint Space Operations Center at Vandenberg Air Force Base, California, to become the Combined Space Operations Center (CSpOC) with the initial embedding of British, Canadian, and Australian exchange personnel (including plans to add additional partners) is a prime example of this integration.

In parallel, led by Germany, France, and the United Kingdom, allies are also assigning liaison officers to the Multinational Space Collaboration cell at CSpOC, enabling greater exchange of information and partnering in space operations between CSpOC and allied space operations centers. These steps build on related efforts by which the longstanding operations order for Operation Olympic Defender is now releasable to allies, and USSPACECOM is able to integrate capabilities that those allies may choose to provide.

Despite this progress, the United States must reconcile longstanding guidelines for classifying space information with the growing imperative to share information in order to enable allied collaboration in operations and architectures. This reconciliation could occur in at least three ways: lowering the classification of existing categories of information, approving release of existing information at higher classification levels to particular allies and partners, and designing new space systems and architectural elements with allied releasability and interoperability as system performance parameters. DoD's approach to a P-LEO architecture for data generation, processing, and transport is an example of this latter method.

Fourth, to reduce the potential for misperception and miscalculation from which conflict could arise while improving the long-term safety and viability of space operations, a defense space strategy must support the wider role of the United States in continued leadership of activities that shape the environment of space domain operations.

For example, the United States has been an active leader and participant in developing the formal outer space legal regime, which for the United States is anchored by 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 (hereinafter Outer Space Treaty) and three other treaties from the 1960s and 1970s.[12] The United States has also been a leader in activities contributing to development of voluntary, non-binding multilateral guidelines and best practices for safe and responsible space operations, such as guidelines developed through the United Nations pertaining to debris mitigation,[13] transparency and confidence-building measures,[14] and long-term sustainability of outer space activities.[15] Domestically, shaping activities include new presidential policy directives on the streamlining of regulations on commercial use of space[16] and on space traffic management,[17] under which the U.S. government has updated its orbital debris mitigation standard practices[18] and is improving its support to the space situational awareness and space traffic management needs of the growing number of worldwide space operators.

Conceptually, shaping activities might also encompass new space arms control initiatives. For example, the Outer Space Treaty imposes restrictions on certain military operations in outer space, such as prohibiting the placement of "any objects carrying nuclear weapons or any other kinds of weapons of mass destruction" in orbit around the Earth or installing such weapons on celestial bodies, or stationing such weapons in outer space "in any other manner." On the other hand, the Outer Space Treaty does not establish similar prohibitions with respect to placing in Earth's orbit weapons that are not weapons of mass destruction. Likewise, the Outer Space Treaty prohibits the establishment of military bases, installations and fortifications, the testing of any type of weapons, and the conduct of military maneuvers on the Moon

12 The other three treaties to which the United States is a state party are: The Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space (1968), The Convention on International Liability for Damage Caused by Space Objects (1972), and The Convention on Registration of Objects Launched into Outer Space (1975). The United States is not a state party to the Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (1979).

13 Space Debris Mitigation Guidelines of the United Nations Committee on the Peaceful Uses of Outer Space, as agreed by the United Nations General Assembly through resolution 62/217 of December 22, 2007.

14 Report of the Group of Governmental Experts on Transparency and Confidence-Building Measures in Outer Space Activities (A/68/189*), submitted to the United Nations General Assembly on July 29, 2013.

15 Guidelines for the Long-term Sustainability of Outer Space Activities of the Committee on the Peaceful Uses of Outer Space, in Report of the Committee on the Peaceful Uses of Outer Space Sixty-second session (June 12–21, 2019), United Nations General Assembly Official Records Seventy-fourth Session Supplement No. 20 (A/74/20, para 163 and Annex II).

16 The White House, Presidential Memoranda, "Space Policy Directive-2," 83 Fed. Reg. 24,901 (May 24, 2018).

17 The White House, Presidential Memoranda, "Space Policy Directive-3," 83 Fed Reg. 28,969 (June 18, 2018).

18 See "U.S. Government Orbital Debris Mitigation Standard Practices, November 2019 Update" at https://orbitaldebris.jsc.nasa.gov/library/usg_orbital_debris_mitigation_standard_practices_november_2019.pdf. Accessed March 25, 2020.

and other celestial bodies, but does not otherwise prohibit such activities in outer space itself.[19]

Despite these initial achievements of the Cold War era, a number of factors have proven to be insurmountable obstacles for more recent space arms control initiatives. For example, the dual-use nature of many space systems, the challenges of verifying specific activities in outer space or the full extent of a particular space system's capabilities, and the difficulties that may often be entailed in assessing intent or determining whether a hostile act in space is imminent or has even occurred, all compound the difficulties of negotiating space arms control agreements. Other complications include the risk that space systems might be attacked through their space segments, ground segments, or radio-frequency links, and the possibility that such attacks might come from within the space domain, or from the terrestrial domains or the cyber domain. Though hardly unique to space, these characteristics are inherent to space systems and space operations, making the challenges of space arms control particularly vexing.

As a result, multilateral efforts have been unable to produce new, binding space arms control measures in the years since the United Nations General Assembly's 1978 Special Session on Disarmament resolved that "[i]n order to prevent an arms race in outer space, further measures should be taken and appropriate international negotiations held in accordance with the spirit of the [Outer Space Treaty]." Based on this resolution, Russia and the PRC regularly sponsor a "No First Placement of Weapons in Outer Space" resolution as part of their efforts since 2008 to launch negotiations in the Conference on Disarmament on a "Treaty on the Prevention of the Placement of Weapons in Outer Space, the Threat or Use of Force against Outer Space Objects."[20] However, these proposals regularly founder on the same problems of definitions, verifiability, and impracticality. Moreover, the increasingly evident gap between these proposals' purported objectives and the character and extent of the Russian and PRC sponsors' ongoing counterspace programs and activities further detracts from the credibility of such initiatives, underscoring both the need for a continued keen skepticism about the utility of such proposals and the generally dim prospects for additional space arms control.

Thus, a final component of shaping the environment for space operations in an era of strategic competition requires raising the level of public awareness regarding the nature and extent of space operations and their contributions to international security and daily civil and commercial life. Such information and education initiatives must work in tandem with efforts to increase awareness of the growing threats to these

19 For further discussion, see U.S. DoD Law of War Manual § 14.10 (Updated December 2016). Accessed March 25, 2020. https://dod.defense.gov/Portals/1/Documents/pubs/DoD%20Law%20of%20War%20Manual%20-%20June%202015%20Updated%20Dec%202016.pdf?ver=2016-12-13-172036-190. Also see Paul C. Ney, Jr., "Charney Lecture: The Rule of Law in International Security Affairs: A U.S. Defense Department Perspective" in *Vanderbilt Journal of Transnational Law* 52, no. 4 (October 2019), p780-782.

20 See, for example, General Assembly Seventy-fourth session, First Committee, Agenda item 96(b), Prevention of an arms race in outer space: no first placement of weapons in outer space, October 18, 2019 (A/C.1/74/L.59).

capabilities stemming from strategic competition, and the imperative to face those threats with the same realism and sense of purpose encountered across all domains.

Conclusion

That the human experience has seen relatively little conflict extending to space since Sputnik I became the first artificial object to orbit Earth in 1957 has more to do with the difficulties of operating in space than with the nature of the domain or the human beings who operate systems in space. As in every other domain, nations' growing mastery of the ability to orbit and operate systems in the space domain will inevitably encompass an ever-expanding range of human activities, including activities that engender human conflict.

To meet the requirements of strategic competition extending to space, DoD space strategy is reorienting to space as a warfighting domain. Recognizing and accepting this reality of the modern space environment is the first step in confronting the challenge it presents to ensuring the nation's vital interest in unfettered access to, and freedom to operate in space. It is a challenge that must be addressed not as a discrete problem of defense space strategy, but as part of the larger challenge of integrating defense space strategy with overarching national strategy for deterring conflict on Earth.

That overarching strategy depends on ensuring the capabilities that underpin the power of the United States to impose unacceptable costs on an aggressor and prevail in conflict. It requires new approaches to ensuring space architectures and operations that draw on commercial innovation and the strength of alliances, and depends as well on credible means and demonstrated will to defeat threatening capabilities in space while preserving the space environment for all space operators. Finally, and notwithstanding the significant problems inherent to formal space arms control, such a strategy entails determined efforts to shape the space operating environment through increased public awareness and through formal and informal mechanisms, both international and domestic, in order to reduce the risks of misperceptions and miscalculations that could lead to conflict while increasing safety and sustainability for all space operators.

Is This the Space Force You're Looking For? Opportunities and Challenges for the U.S. Space Force

Peter L. Hays[21]

Creation of the Space Force in December 2019 marks a momentous change in the structure of America's military and a significant shift in U.S. thinking about the military utility of space. While this development alone cannot resolve all space strategy issues and is only the beginning of much implementation work, it may end more than 30 years of dithering—a period when the United States was not satisfied with how it organized its national security space activities and churned through several different structures. Yet, because organizational structure is only a second-order issue, deeper questions remain unanswered related to U.S. objectives and priorities in using space for strategic and military purposes.

The United States has yet to focus enough or reach consensus domestically, let alone internationally, on first-order issues such as space weaponization, options for exploiting space resources, creating wealth in and from space, or other overarching issues related to the objectives it seeks from space. Similarly, it has not focused sufficiently or reached consensus on the reasons why these are important, and what the best strategies are to pursue these objectives. These are all issues and decisions that deserve some level of attention but, as it stands up its first new military branch in more than 70 years, it is critical for the United States to focus initially on the first-order issue of prioritizing what the Space Force should do. The Space Force clearly holds significant potential, but it also faces continuing disagreements about its most important and appropriate near-term missions as well as limitations in the ability of a military organization to effectively address the full range of critical space challenges the United States currently faces.

This paper prioritizes four interrelated initial opportunities and challenges for the Space Force: developing appropriate doctrine and culture, blunting growing counterspace threats, improving space acquisition, and accelerating creation of wealth in and from space. It also outlines some concerns stemming from ongoing political dynamics and historical analogies. The Space Force's greatest opportunity and its enduring challenge is developing comprehensive doctrine and a strong and distinct culture. This new service must debate, refine, and further develop nascent doctrinal principles that will guide its operations, growth, and culture.

As a starting point, we offer the following maxim for the U.S. Space Force: *space provides inherently global and all-domain capabilities including overwatch, communications, and orientation which radically improve the effectiveness and*

21 The views expressed in this article are solely those of the author and do not necessarily reflect those of Falcon Research, George Washington University, or the U.S. government.

efficiency of terrestrial military operations. And it therefore follows that, space control—or ensuring freedom of action in space for the United States and its allies and, when directed, denying an adversary freedom of action in space—is not optional.[22] The Space Force must find ways to blunt Chinese and Russian counterspace capabilities that threaten space operations, weaken global Joint Force operations, and undermine modern digital life. Next, the Space Force should reform and speed space acquisition, particularly by identifying specific areas where commercial actors and allies can—and cannot—reasonably provide U.S. military capabilities. A final initial priority for the Space Force must be to determine its appropriate role in accelerating the creation of wealth in and from space.

Developing Space Doctrine and Incubating a Space-Minded Culture

There is nothing the Space Force will do that is more important and challenging than developing appropriate doctrine and culture. Simple, clear, and strongly held doctrine orients a military and is a sine qua non for creating a strong and distinct military culture. Creation of the Space Force as an independent organization should improve the development of space doctrine and help it move more quickly beyond what are, arguably, some of the most tenuous but often invoked analogies from maritime and air doctrine. Over time, as the process for space doctrine development matures, it should provide an excellent foundation for the generation-long process of incubating a space-minded culture for the Space Force.

The Space Force faces very significant challenges as it develops independent doctrine and culture, as military personnel have seldom operated in space and have never fought in space. Sailors and pilots played an essential role in the development of both maritime and air doctrine; they could build from at least decades if not centuries of routine military operations at sea or in the air and often modified and sharpened their arguments after new operational experiences and debates with fellow operators. Without anything approximating this history and operational experience, the Space Force must think creatively and draw from all possible sources in developing doctrine to deter and win space conflicts. The Space Force must also look backwards to see what doctrine for operations at sea and in the air may have to offer for space, despite all the logical shortcomings with this approach. Seminal theorists who developed important perspectives on military operations in these two domains

22 M.V. Smith, *Ten Propositions Regarding Spacepower* (Maxwell Air Force Base, AL: Air University Press, October 2002), p69-74.

include: Alfred Mahan, Julian Corbett, Giulio Douhet, Billy Mitchell, and John Warden.[23] Some of the key concepts that these theorists developed or applied to the air and sea domains are command of the sea, command of the air, sea lines of communication, common routes, choke points, harbor access, concentration and dispersal, and parallel attack.[24] Several of these concepts have been appropriated directly into various strands of embryonic space theory; others have been modified slightly then applied. For example, Mahan and Corbett's ideas about lines of communications, common routes, and choke points have been applied quite directly onto the space domain. Maritime and airpower concepts that have been modified to help provide starting points for thinking about space doctrine include using the concept of harbor access to think about access to space, and the idea of command of the sea or air to consider space control.

The greatest shortfall in current space doctrine is that it lacks anything like the simple, clear, and strongly held mantra that guided early airpower advocates: airpower is *inherently offensive, manifestly strategic, and should, therefore, be organized independently*. And just as this mantra guided early airpower advocates, similar concepts may guide the Space Force toward initial doctrinal maxims like those suggested above. As the Space Force struggles to develop its own simple yet powerful overarching doctrine, it must continue to wrestle with many fundamental questions stemming from the environmental attributes of the space domain and issues with analogizing directly from sea or air doctrine. Few concepts from maritime theory translate directly into airpower theory—why should we expect either maritime or airpower theory to apply directly for the distinct domain of space?

Creation of the Space Force should also help it avoid Air Force missteps in the development of space doctrine. During most of the Cold War, the Air Force insisted that air and space form a seamless operational domain that it defined as aerospace, a position opposed by the rest of the Department of Defense (DoD) that saw distinct air and space domains.[25] Under the seamless aerospace concept, for decades the Air Force tended to "force-fit" space doctrine into the mold of air doctrine and argued, inappropriately, that the three major airpower characteristics of speed, range, and

23 Several of these individuals were quite prolific. The following list represents their best known works: Alfred Thayer Mahan, *The Influence of Sea Power upon History, 1660-1783* (Boston: Little, Brown, 1980); Julian S. Corbett, *Some Principles of Maritime Strategy*, ed. by Eric J. Grove (Annapolis: Naval Institute Press, 1988. First published 1911); Giulio Douhet, *The Command of the Air*, ed. by Richard H. Kohn and Joseph P. Harahan (Washington, D.C.: Office of Air Force History, 1983. First published 1921); William Mitchell, *Winged Defense: The Development and Possibilities of Modern Airpower—Economic and Military* (New York: Dover, 1988. First published 1925); and John A. Warden III, *The Air Campaign: Planning for Combat* (Washington, D.C.: National Defense University Press, 1988). On the importance of these works see, Jon Tetsuro Sumida, *Inventing Grand Strategy and Teaching Command: The Classic Works of Alfred Thayer Mahan Reconsidered* (Washington, D.C.: Woodrow Wilson Center Press, 1997); Philip S. Meilinger, ed. *The Paths of Heaven: The Evolution of Airpower Theory* (Maxwell Air Force Base, AL: Air University Press, 1997); and David R. Mets, *The Air Campaign: John Warden and the Classical Airpower Theorists* (Maxwell Air Force Base, AL: Air University Press, April 1999).

24 John J. Klein, *Space Warfare: Strategy, Principles and Policy* (Abingdon: Routledge, 2006); and John J. Klein, *Understanding Space Strategy: The Art of War in Space*, (Abingdon: Routledge, 2019).

25 Lieutenant Colonel Peter Hays and Karl Mueller, "Going Boldly—Where? Aerospace Integration, the Space Commission, and the Air Force's Vision for Space," *Aerospace Power Journal* 15, no. 1 (Spring 2001), p34-49.

flexibility applied equally well to spacepower. This was regrettable because speed and range have different meanings in space than in the air, and spacecraft are among the least flexible of all today's military systems.

Fortunately, the Space Force can now build on the much more appropriate space characteristics in the joint publication on space operations that include: freedom of action, overflight, global perspective, responsiveness, multi-user capacity, speed, reach, and persistence.[26] Another underdeveloped construct for space doctrine is building from continental maritime theorists such as Raoul Castex and others instead of continuing the focus on open-ocean (or blue-water) operations like those emphasized by Mahan. Rebalancing toward a more limited or continental perspective on military space operations would align more closely with the current characteristics and attributes of space operations, particularly in low-Earth orbit or the "cosmic coastline"[27] that is highly vulnerable to attack from Earth. Later, it will be more appropriate to rebalance back toward Mahan and other blue-water maritime theorists as space capabilities mature, conflicts over space resources intensify, and the potential for large-scale, highly maneuverable space combat emerges, particularly in higher orbits and cislunar space.[28]

Additionally, the Space Force should consider the four-part typology developed by Air Force Lieutenant Colonel David E. Lupton in 1983 (and expanded for his 1988 book *On Space Warfare*).[29] Lupton's four schools of thought about the strategic utility of space—sanctuary, survivability, control, and high ground—still provides a useful framework to examine interrelationships between doctrine, the need for space weapons, organizational structures, and the evolution of strategic thinking about space. While there remain adherents in each of Lupton's schools, over time there has been considerable movement toward the control and high ground schools. It is likely that the creation of the Space Force will accelerate this trend. Military organizations worldwide and throughout history have tended to favor offensive doctrines for a variety of reasons including prospects for increased funding, autonomy, and relevance.[30] Moreover, it is likely that the Space Force will push to declassify or at least lower the classification level and releasability of some space activities that are currently classified; it may also look to publicly develop force application capabilities such as space-based missile defenses that would support the high ground school.

26 Joint Publication 3-14, "Space Operations," (Pentagon: Joint Staff, April 10, 2018): I-4 and I-5.

27 Bleddyn E. Bowen, *War in Space: Strategy, Spacepower and Geopolitics* (Edinburgh: Edinburgh University Press, forthcoming).

28 Cislunar space refers to everything within the Moon's orbital radius, classically including the Earth-Moon L2 point.

29 Lieutenant Colonel David E. Lupton, U.S. Air Force, (Ret.) "Space Doctrines," *Strategic Review* 11 (Fall 1983), p36-47; and Lupton, *On Space Warfare: A Space Power Doctrine* (Maxwell Air Force Base, AL: Air University Press, June 1988).

30 "Offensive" is one of the nine Principles of War emphasized in U.S. military doctrine. See, for example, Joint Publication 3-0, "Joint Operations," (Pentagon: Joint Staff, October 22, 2018).

Blunting Foreign Counterspace Threats

The largest and most immediate operational challenge facing the Space Force is blunting the growing counterspace threats the United States now faces. By describing space as a warfighting domain, the 2018 National Defense Strategy marked a fundamental shift away from legacy perspectives on uncontested military space operations and aspirations for free access and peaceful purposes enshrined in the Outer Space Treaty. America's potential adversaries, particularly China and Russia, now view space—from launch, to on-orbit, the up- and downlinks, and the ground stations—as a weak link in U.S. warfighting capabilities. Conversely, the United States for generations believed space to be a permissive environment and did not make major investments in defensive capabilities, even as almost all modern military operations became increasingly reliant on space capabilities.

These facts, coupled with the reemergence of great power competition, have led adversaries to believe that by denying U.S. space-enabled capabilities, they can gain strategic advantage over U.S. response options—making those options less assured, less opportune, and less decisive. These assumptions can be destabilizing as adversaries may believe they can deter U.S. entry into a conflict by threatening or attacking U.S. space capabilities. This may even embolden adversaries to employ a space attack as a "first salvo" in anti-access/area-denial (A2/AD) strategies.[31] This is a potentially dangerous situation that has moved past an inflection point and is starting to create strategic disadvantages rather than the strategic advantages space traditionally provided the United States. From a Clausewitzian perspective, the Space Force must also consider whether current U.S. space strategy may be approaching a culminating point where it becomes counterproductive to continue either offensive or defensive space operations in wartime.[32]

Creation of the Space Force should help the U.S. military deal more effectively with growing counterspace threats. A dedicated military organization focused on countering advances in Chinese and Russian counterspace capabilities should be able to achieve more unity of effort and be more efficient and effective than our current structures. Of course, simply creating a new organization will not guarantee effectiveness. As with most complex issues, details matter regarding the Space Force's ability to forge effective relationships with other national security space stakeholders as well as

31 For government assessments of the growing counterspace threat, see Daniel R. Coats, "Worldwide Threat Assessment of the Intelligence Community," (Washington: Statement for the Record: Senate Select Committee on Intelligence, January 29, 2019); Defense Intelligence Agency, *Challenges to Security in Space* (Washington: Government Printing Office, January 2019); and National Air and Space Intelligence Center, *Competing in Space* (Wright-Patterson Air Force Base, OH: NASIC, January 2019). For think tank assessments, see Todd Harrison, Kaitlyn Johnson, and Thomas G. Roberts, *Space Threat Assessment 2019* (Washington: Center for Strategic and International Assessments, April 2019); and Brian Weeden and Victoria Samson, eds., *Global Counterspace Capabilities: An Open Source Assessment* (Washington: Secure World Foundation, April 2019).

32 Clausewitz discusses "The Culminating Point of the Attack" and "The Culminating Point of Victory" extensively in Book Seven. These concepts refer to a point beyond which an attacker should not proceed due to a variety of problems that may include stretched supply lines, weakened morale, and inability to successfully defend against counterattacks. See Carl von Clausewitz, *On War*, Michael Howard and Peter Paret, eds. (Princeton: Princeton University Press, 1989), p528 and p566-73.

its success in setting appropriate requirements, justifying sufficient funding, and prioritizing the best ways to address Chinese and Russian counterspace capabilities.

For the Space Force, one of the more difficult issues will be balancing the three pillars of space mission assurance: resilience, defensive operations, and reconstitution, as well as determining the relative weight to be placed on offensive and/or defensive measures to reduce the effectiveness of adversary counterspace capabilities. As noted above, it is likely that the Space Force will align more closely with the control and high ground schools rather than with the survivability school regarding the need for offensive counterspace capabilities to enhance the survivability of critical U.S., allied, and commercial space systems. A final set of related considerations for the Space Force is the appropriate balance between offensive and defensive counterspace missions versus all the space missions that enable Joint Force operations. Both missions are critical, but an independent Space Force may favor counterspace operations at the expense of continuing to provide the same level of support to enable Joint Force operations.

Improving Space Acquisition

The next key task for the Space Force is improving space acquisition. Perspectives on prioritizing this task relate to views about how "broken" space acquisition is currently. Many, including Vice Chairman of the Joint Chiefs of Staff General John Hyten, believe that space acquisition takes too long and costs too much. Others acknowledge these difficulties but see them more as a reflection of dysfunctions across the whole DoD acquisition process rather than as problems specific to space acquisition. Both sides would agree that the burgeoning commercial space sector with its billionaire space barons creates important and novel opportunities for the military to leverage these new capabilities and services to supplement or replace some traditional national security space missions.

To better leverage commercial space activity, the Space Force should comprehensively, transparently, and consistently determine those space mission areas where it can rely on commercial services or international partners. Some space mission areas such as nuclear command, control, and communications should never be outsourced, while others such as environmental monitoring might be completely provided by commercial or international partners. Other mission areas could be operated by the U.S. or its allies, or commercially provided. A whole-of government approach is then needed to assess the commercial viability of those services upon which the U.S. government intends to rely, either wholly or in part, and the government must act to improve the commercial viability of these services. This is not explicitly picking winners, but using comprehensive approaches such as serving as an anchor tenant, structuring import-export bank loans, adjusting export controls, and tailoring licensing and regulatory procedures to improve the commercial viability of services the U.S. government needs. Improving synchronization between the fielding of space

systems and ground user equipment is another major acquisition issue the Space Force may be able to address more effectively, particularly if funding for ground user equipment transfers to the Space Force.

The Space Force is to be organized, trained, and equipped (OT&E) to provide freedom of operation for the United States in, from, and to space; and to provide prompt and sustained space operations. The expectations regarding what process changes may be needed for OT&E functions will not be focused on the Space Force itself, but rather on the new Assistant Secretary of the Air Force for Space Acquisition and Integration position, the Space Force Acquisition Council, and space Service Acquisition Executive (SAE) responsibilities. Key issues and questions as these new positions, authorities, responsibilities, and processes are established include: whether space requirements and acquisition processes should continue to follow the joint capability integration and development system, or perhaps require new processes to go faster and better leverage commercial developments; how the new space SAE authorities and responsibilities may help to reduce traditional tensions and tradeoffs between air and space funding within the Department of the Air Force; and how adoption of parts of the National Reconnaissance Office's (NRO) streamlined acquisition processes may help to speed space acquisition.

Accelerating Creation of Wealth in and from Space

A final priority for the Space Force is discerning its role in the creation of wealth in and from space, an issue that may ultimately shape the future of humanity. The Space Force must focus on the opportunities and challenges presented by this issue, but they are also long-term matters and it is not evident that a military organization is the best way to focus on these concerns. As humanity continues to explore and increasingly harvest space resources, the fundamental values and economic models that underpin these activities are critical. The states and companies that first harvest space resources are likely to set important precedents and play a major role in developing the governance structure for such operations. Helping to set these precedents is an enormous opportunity for the Space Force that also presents serious challenges with respect to the amount of overlap with and difficulties in balancing exploration with all the required near-term priorities discussed above as well as concerns about a military organization doing this type of work.

For at least two generations, the United States has been thinking seriously about long-term space exploration and exploitation challenges, along with the proper balance between these priorities and required near-term efforts, as well as the appropriate role of the military in these activities. Unfortunately, it has yet to reach consensus on the best approaches. In 1997, General Howell Estes, a commander of the original U.S. Space Command, articulated a powerful vision for valuing space commerce above military space activity that is today an even more important consideration for the Space Force:

> *Today, more than ever, it is important that all Americans understand that our investment in space is rapidly growing and soon will be of such magnitude that it will be considered a vital interest—on par with how we value oil today. . . .*
>
> *Now while it might seem appropriate that I should be more concerned with military space, I must tell you that it is not the future of military space that is critical to the United States—it is the continued commercial development of space that will provide continued strength critical for our great country in the decades ahead. Military space, while important, will follow.*
>
> *Commercial space, as I said earlier, will become an economic center of gravity, in my opinion, in the future and as such will be a great source of strength for the United States and other nations in the world. As such, this strength will also become a weakness, a vulnerability. And it's here that the U.S. military will play an important role, for we will be expected to protect this new source of economic strength.*[33]

Two recently retired Air Force officers, Lieutenant General Steven Kwast and Lieutenant Colonel Peter Garretson, were among the strongest advocates for creating a Space Force to accelerate exploration and harvesting of space resources. Kwast and Garretson identify long-term strategic competition with China in space as the greatest challenge facing the United States and maintain that the Space Force must concentrate primarily on this challenge instead of focusing on America's terrestrial military advantages over the short-term. This is an attractive vision that aligns with some of the best traditions in American foreign policy and the benefits of a frontier to be tamed, as identified in Frederick Jackson Turner's Frontier Thesis.[34] Questions, however, remain concerning the appropriate priority of this effort, how much of this work would overlap with the required priorities described above, and whether a military organization might unnecessarily militarize U.S. approaches to civil and commercial space issues.

Cautions and Concerns

One concern relates to the history of the U.S. Coast Guard and U.S. Marine Corps and their roles within the Department of the Navy. Coast Guardsmen and Marines have always been part of relatively small organizations when compared to the Army, Navy,

33 General Howell M. Estes, III, "The Promise of Space Potential for the Future," prepared remarks to the United States Space Foundation's 1997 National Space Symposium, Colorado Springs, CO (April 3, 1997).

34 Steve Kwast, "Where the Space Force must go," Politico (January 17, 2020). Accessed March 25, 2020. http://www.politico.com/news/2020/01/17/where-the-space-force-must-go-098884. For historiographic commentary on the Frontier Thesis, see Ray Allen Billington, *The American Frontier* (Washington: American Historical Association, 1958).

and Air Force; their small size has sometimes exacerbated struggles with their culture, primary missions, and relevance. At its inception, the Space Force will be only about one-third the size of the active duty Coast Guard, less than one-tenth the size of the Marines, and about the same size as just one of the Army's 10 active duty divisions. While the Space Force may punch above its weight in terms of operational impacts, it is vanishingly small in terms of personnel within DoD. This may lead to a variety of potential problems, including pressures to pursue more ambitious and risky missions to assert its relevance.

A second concern relates to the common assertion that creating the Space Force today is analogous to creating the Air Force in 1947 when, in fact, these two events are not similar in any significant ways and present a very misleading and unhelpful comparison. The most significant distinctions between 1947 and 2019 include: the unique and sometimes powerful role of the highly secret NRO during the Cold War and the high level of secrecy surrounding almost all military space activities in general; far greater technological complexity and expense in deploying space hardware; no history of the use of force from space or demonstrations of force from space that would challenge traditional military service missions; no strident public advocacy for the Space Force by the officer corps; no developed doctrine or major wartime application of force from space; and much less focus by Congress on the development of spacepower and its appropriate organizational structure.

A cautionary tale relates to the creation of the Royal Air Force (RAF) in 1918 and the impact of this structure on the development of naval aviation and other airpower capabilities by the United Kingdom. The Royal Navy suffered a rapid fall from preeminence during the interwar period, a decline caused by many factors but perhaps none as significant as the United Kingdom's failure to continue developing world-class naval aviation capabilities, understand that aircraft carriers could supplant battleships as the primary naval strike force, or envision multi-carrier operations. Under the "dual-control" system, the Royal Navy lost control of its aviation assets when the RAF was created and the RAF became a competitor to the Royal Navy for limited military resources during the austere interwar period. Moreover, the upstart RAF never came close to being as large or politically powerful as the Royal Navy, was often fighting for its very survival, and was focused primarily on doctrine and equipment for strategic bombing. Perhaps even more disturbingly, it was not primarily the RAF but outside civilians who championed development of the world-changing Chain Home radar network that enabled the RAF to prevail in the Battle of Britain.

The highly politicized environment that birthed the Space Force creates a final set of concerns to be touched on here. If the Space Force comes to be seen as partisan issue, it will face extreme scrutiny and limited funding that might call into question its existence and make it difficult to successfully pursue the critical priorities outlined above. Even without partisan squabbling, the United States made serious mistakes in disestablishing the original U.S. Space Command in 2002 and breaking apart Air Force leadership of the NRO in 2005. With the reemergence of great power

competition and the critical contributions of space in addressing this challenge, the last thing the United States needs is extreme polarization driving the structure of its national security space activities.

As the Space Force stands up, it faces great opportunities and serious challenges. Its approaches for developing doctrine and culture, blunting counterspace threats, improving space acquisition, and accelerating space resource exploitation are likely to be the most important factors in establishing its relevance and efficacy. Congress, the President, and DoD itself will be carefully overseeing the Space Force's progress and—if the organizational restructuring of the past several decades is any indication—will not hesitate to revisit management and organizational structure issues if they perceive the Space Force is not advancing America's interests in space quickly or effectively enough. Throughout, we must remain mindful that new organizations do not guarantee success and apply lessons from past missteps.

Mētis for American Space Programs: Creating Space Strategies

Matthew Daniels

This paper briefly addresses three questions: Are we meeting our needs for U.S. strategic and scholarly thinking on space security? What do we need in good space strategies? And where do strategic thinkers for space programs come from, and what can be done to educate or create new ones? The U.S. has significant opportunities to grow its strategic thinking on space security—a good starting place is in *competitive strategies* approaches, which matured in the Department of Defense during the Cold War. For current U.S. leaders, two particular opportunities also exist: creating new organizations to develop strategic thinking for U.S. national security space programs, and investing in radically improved education programs for junior officers and early-career civilians.

Future U.S. space capabilities will determine a large portion of our overall capabilities for military operations, national intelligence and treaty verification, and economic growth. For most of the last 30 years, U.S. leaders have been largely able to take military and intelligence space capabilities for granted: our approaches to these space programs appeared honed years earlier, and the 1990s and 2000s presented no major threats or peer-level competitors in space. By the late 2010s, however, the U.S. has begun to recognize the largest changes to the space security environment since the end of the Cold War, an emerging period with significant military preemption and escalation pressures in space during crises, and the largest reorganization of U.S. military space activities in almost 60 years.

These factors create significant uncertainty for the decade ahead. The U.S. will require a larger pool of space professionals, spanning military officers, civilian experts, engineers, diplomats, and scholars. Our ability to navigate major choices wisely will depend particularly on the work of strategic thinkers for U.S. space programs—the central topic of this paper.

Mētis describes a Greek concept for "strategic intelligence" encompassing wisdom, inventiveness, foresight, and wiliness.[35] *Mētis* contrasts to brute force: Homer's Odysseus embodied this quality to navigate risky, quickly-changing situations. The U.S. will need long-term perspectives with a dose of *mētis* to navigate modern security challenges in Earth-orbit.

35 Lawrence Freedman introduces it this way: "*Mētis* described a particular notion of a strategic intelligence for which there is no obvious English equivalent. In Greek it was related to *mētiaō*: "to consider, meditate, plan," together with *metióomai*, "to contrive," conveyed a sense of a capacity to think ahead, attend to detail, grasp how others think and behave, and possess a general resourcefulness." See Lawrence Freedman, *Strategy: A History* (Oxford University Press, 2013).

Are We Meeting Our Needs for Strategic Thinking about Space Security?

The policy choice to maintain high levels of secrecy around U.S. national security space programs has led to an environment with few serious analyses on space strategy outside the U.S. government. Likewise, most analyses of this kind within the U.S. government do not reach the public view. This paper comments instead on the externally visible conditions under which such work is undertaken as of 2020.

U.S. military and intelligence space organizations have existed since the early Cold War, with a culture of extreme secrecy that also dates to that period. These organizations have become exceptional in specific capability areas. Accordingly, leaders, engineers, and operators are generally trained within organizational cultures that have retained and honed particular processes for years or decades.

These attributes do not naturally endow an ability to adapt as circumstances change: one of the largest risks for organizations with programmatic inertia and extreme secrecy is approaching strategic choices with insularity and incrementalism.

Against this organizational situation, we can evaluate the strategic context: the 2010s have presented the largest inflection in the space security environment in 30 years.[36] Based on current trends, the security environment in 2030 will present changes at least as large as the last decade. We can see this in many ways. For example: if even one space internet constellation is deployed in the 2020s, it could double or triple the quantity of operational satellites in Earth-orbit; as China and Russia field hypersonic glide vehicles, the U.S. will face a choice about whether to pursue global midcourse tracking or defense against a new class of advanced missiles, with large space implications; the U.S. and China will both be expanding their human spaceflight programs toward the Moon; and finally, a public U.S. Defense Intelligence Agency report indicates that over the years ahead, "foreign governments are developing capabilities that threaten others' ability to use space. China and Russia, in particular, have taken steps to challenge the United States… Both states are developing jamming and cyberspace capabilities, directed energy weapons, on-orbit capabilities, and ground-based antisatellite missiles that can achieve a range of reversible to nonreversible effects."[37]

We should always consider the need to adapt our organizations when strategic circumstances change. For national security space programs, comparing organizational risks to the strategic environment gives a first-order answer before all other details: there is great value in new and more strategic thinking, and there is great opportunity to grow our work on novel U.S. space strategies.

36 As a simple example, we could compare the situation of early 2020 to that of just 10 years ago: in 2010, China had visibly tested one direct-ascent anti-satellite weapon (ASAT), but still appeared to have a modest overall space program; Chairman Xi was not in power; the Wolf Amendment had not yet passed; the Space Shuttle was still flying; hypersonic glide vehicles (HGVs) were not on the front page of national papers; the modern commercial space wave had not yet begun (Falcon 1 had just launched), and no new commercial constellations were yet in orbit.

37 Defense Intelligence Agency, *Challenges to Security in Space* (January 2019), p3. Accessed March 25, 2020. https://www.dia.mil/Portals/27/Documents/News/Military%20Power%20Publications/Space_Threat_V14_020119_sm.pdf.

What Should We Be Seeking in Space Strategies?

What makes a defense space strategy? The heart of any strategy is a bridge from ends to ways of pursuing those ends. The *ends* of a defense space strategy must be anchored in national military and strategic ends, not simply "doing space better." The *ways and means* should consist of space activities and investments.

We can outline the broad ingredients of good defense space strategies. A useful starting place is what has come to be called the competitive strategy approaches to defense strategy developed in the 1970s for the U.S. Defense Department, and pioneered especially by Andrew Marshall.[38] Where much prior military strategy had focused on strategy in war, central questions for U.S. defense thinkers and planners during the Cold War focused instead on how to shape investments for a political-military-economic competition that could extend in peacetime over years or decades.

This challenge is particularly acute because of the organization of U.S. defense bureaucracies, which creates a tendency to try to spend against all observed threats—a rich person's strategy that is unaffordable in the best of times. Daily information flow to most senior defense officials drives this tendency: defense sub-bureaucracies usually present their capability gaps to explain resource requests; and intelligence organizations usually emphasize the most urgent or alarming information they possess about military competitors.

To manage these factors, competitive strategy approaches that emerged during this period generally direct a focus on building upon our own enduring strengths (and areas of enduring challenge for a competitor's military), rather than trying to spend against all the threats we observe.[39]

Competitive space strategies have several necessary ingredients, which must be sought first in detailed analysis and assessments:

- What are our enduring strengths in space activities and capabilities?
- What are major, relevant trends? What are possible inflections in these trends? What are some first-order issues if the world goes down these different paths?
- What is the strategic perspective of our competitor(s)? How do all of these questions look from their perspective?
- How does the structure and culture of our competitors' government and military bureaucracies shape their behavior? In light of that, how might our actions shape their behavior?

Beginning with a focus on competitive strategies is especially important because the U.S. and China, in particular, appear to think very differently about

38 For example, see A. W. Marshall, "Competitive Strategies—History and Background" (March 1988).

39 See for example: Stephen Rosen, "Competitive Strategies: Theoretical Foundations, Limits, and Extensions," in Thomas Mahnken, ed., *Competitive Strategies for the 21st Century: Theory, History, and Practice.*

military space competition. Improved crisis stability and improved U.S. positions over long timescales both require better appreciation of how China approaches military space competition.

What Can We Do to Attract or Train New Strategic Thinkers?

We can approach this by describing the kinds of skills and backgrounds we should seek in such people; the kinds of teams in which to employ them; and finally, two particular initiatives that current leaders could undertake. Some people seem naturally inclined to this kind of work.[40] The background of such individuals also appears disproportionately shaped by experiences, and not just formal education or reading. Several attributes seem particularly useful for individuals who will undertake strategic analysis and assessments on military space competition for the U.S.:

- A deep, intuitive familiarity with the space domain and space operations, including common orbital dynamics quantities and properties. Richard Feynman has talked about the value of numeracy to solving problems and creating ideas in physics.[41] Similarly, it helps to have a familiarity with the space domain to increase intuition and reduce interruptions.
- Apprenticeships with strategic leaders and thinkers. Exposure to science fiction is also useful—especially positive, definite visions of the future.
- A good education, especially in technical degrees but also for generalists.
- Extensive reading of history by education or personal interest. Ideally, exposure to economics and business strategy as well.
- Experience working on multi-year endeavors and working with bureaucracies.
- Personal experience of working at or exploring various kinds of space sites—R&D laboratories, mission design teams, launch sites, and operations centers.

The structure of teams working on new strategic assessments also matters. Generally, by their organization and placement, such teams should have a clearly defined mandate and a sense of working on the frontier of important problems. Special attention should be paid to countering the tendency of government bureaucracies, especially military bureaucracies, to push out individuals who seem "eccentric." In some cases, such individuals are exactly the ones to bring new perspectives—Isaac Asimov notes the value of the person "of good background… and unconventional habits."[42]

40 See, for example: A. W. Marshall, "Strategy as a Profession for Future Generations," in Marshall, J.J. Martin and Henry S. Rowen, eds., *On Not Confusing Ourselves: Essays on National Security Strategy in Honor of Albert and Roberta Wohlstetter.*

41 See for example, Feynman's discussions about working with Hans Bethe at Los Alamos. An enjoyable source is the book *Surely You're Joking, Mr. Feynman!*

42 Isaac Asimov, "Where Do New Ideas Come From?," essay (1959). Reprinted in *MIT Technology Review* (October 2014).

In light of these factors, two opportunities seem particularly useful for the U.S. Department of Defense:

- *Creation of new organizations to develop strategic thinking for U.S. space programs*. The most appropriate model would be analogous to RAND of the 1950s: an organization independent of other existing institutions, but able to provide classified analyses and strategic assessments to the military and civilian leadership of the U.S. Space Force and the Department of the Air Force. Such an organization would also develop future military and civilian leaders for U.S. space programs by hosting them for tours of duty. Several subjects are ripe for work by such an organization, and would be valuable especially to the U.S. Space Force: much broader work on the "strategic geography" of cislunar space;[43] development of new strategic metrics and novel concepts of operation for U.S. space systems; better synthesis of the strategic approaches, strengths, and weaknesses of foreign and U.S. military programs; and definition of opportunities for new or reformed international agreements regarding military space activities.

- *Investment in radically improved education programs for junior officers and early-career civilians.* This should include a greater fraction of junior officers obtaining technical doctorates. Inspiration can begin with graduate versions of programs like NASA Academy and Israel's Talpiot program.[44] Attributes to focus on include a first-rate education in exchange for public or military service, education and early-career programs that have been deemed prestigious due to their selectivity and difficulty to complete, and early-career responsibility to create something new or put something in space. In the years ahead, the U.S. Space Force should also provide suborbital flights, and eventually orbital flights, as part of training for high-achieving junior officers—such opportunities will attract and retain the best talent in a growing officer corps.

43 Cislunar space refers to everything within the Moon's orbital radius, classically including the Earth-Moon L2 point.

44 For the latter, see: Christopher Rhoads, "How an Elite Military School Feeds Israel's Tech Industry," *Wall Street Journal* (July 6, 2007).

Conclusion

The U.S. has many national interests in space activities, spanning scientific exploration, economic development, defense of the U.S. and our allies, and treaty verification. While there is agreement on little else, most begin by observing that the 2020s appear to present one of those occasional large-scale inflections in the international security environment. And today's changing security environment has a particular locus in Earth-orbit.

Connecting our national interests to long-term strategies for U.S. space programs is more important today than it has been for at least a generation. States have created and pursued long-term strategies for millennia. We must begin to do so in space. The first step is creating the institutions and people for wise, long-term thinking in new American space programs.

Allies in U.S. Space Strategy: An Agenda for Space in Post-Brexit Britain

Bleddyn E. Bowen

The United States has never been alone in space. It has always had to deal with other, sometimes adversarial, space-capable states. By the end of the Cold War, several of America's allies had become capable space-faring states in their own right. The continuing proliferation of spacepower in the 21st century is enabling smaller economies to not only catch up with the United States, but also to invest in niche space capabilities beyond what America has previously possessed. American space strategy should take allied perspectives, resources, plans, and capabilities into account as spacepower appears to be at the crest of an emerging multipolar world order. The time is also ripe for the United States to participate in and advise its allies on potential spacepower development pathways. In allied states, the argument to invest in military and intelligence space capabilities and to protect against the threat to them has been won; now they must figure out where to spend their relatively sparse resources.

Allies must consider how their capabilities fit into the wider American structure, but also vice versa. It is easy to claim that allies need to "pay their share" for a U.S. military alliance, but where that money should be spent in allied defense ministries remains a marginalized subject and a difficult question to answer. If only for the beginning of constructive dialogue, an intervention by U.S. specialists in discussion with allies could be fruitful to help scrutinize where allied funds can be best spent to fill gaps that the United States will not or cannot address, and where new sovereign assets may be useful potential backups to comparable American systems. A priority for the United States is to prevent needless duplication or triplication of space capabilities in allies where they could spend their money in other more value-added capability areas. This may not be possible in all areas as some states will want to retain sovereignty and autonomy in specific areas.

This chapter looks at the case of the United Kingdom. There are significant trade-offs to be made in its space strategy, and its limited pool of military resources may be saddled with an extremely expensive Global Navigation Satellite System (GNSS). This chapter encourages the United States to consider advising the United Kingdom on investing in more fruitful areas for military and intelligence space capability development, rather than build a U.K. GNSS that will do little to add value and capability whilst creating significant opportunity costs due to its sheer cost. In particular, the United States should encourage the United Kingdom to invest in small satellite-based intelligence, surveillance and reconnaissance (ISR) platforms, small polar launches, and Space Situational Awareness (SSA). These can all add value

not just for British military needs but also provide useful data and services for the United States.

This increased British ambition in space is also taking place in a context where other actors can offer America far more than Britain in terms of space-based assets, and Britain cannot afford to spend the lion's share of its acquisitions budget on something that is not that useful to itself nor the United States. Japan and the European Union are capable of spending large sums on space capabilities and develop a broader range of competencies and assets that will be of direct value to America. Indeed, the European Union is on its way to building a world-class military-grade space infrastructure, raising some questions as to the future relevance of NATO in space in the decades to come (see chapter 5 for more on NATO and the E.U.).

The United States could be clearer on what it would prefer its allies to be spending on space, rather than just demanding its allies spend more. American space professionals must also realize that what may look like small programs in the U.S. space sector may be gargantuan projects for smaller states and provide constructive support and advice where possible. Any significant investment in space by any ally is of interest to the United States, and it is therefore extremely important that the U.S. anticipate areas to benefit from and to lend its experience and significant expertise in increasing the efficiency and real value of allied spacepower-building beyond generic visions of redundancy and depth.

U.K. Spacepower: Defined by Integration in a Binary System

British spacepower is defined by degrees of dependency and integration between America and Europe. In something of a binary system, British integration with the United States is far more military and intelligence-oriented, whilst integration into the European Space Agency (until Brexit) the European Union's flagship space projects took on a more scientific, commercial, and industrial character.[45] Unlike France, Britain was able to capitalize on the "special relationship" it had already established in the nuclear, missile, and intelligence sectors with the United States in the early Cold War. Britain decided that its limited resources were better employed by abandoning expensive sovereign technology projects and instead persuading America to take its views into account in the development of nuclear, missile, and space technology. Britain became a useful integrated part of America's ballistic missile early warning system and a base of operations for the U.S. Air Force in the European theater.

In turn, the United Kingdom, as part of the Five Eyes partnership, was able to depend on the United States for much of its spacepower support. The exception to this was the development of the Skynet military satellite communications (SATCOM) system which provided British intelligence agencies and military forces with a global

45 This is examined further in Bleddyn E. Bowen, "British strategy and outer space: A missing link?," *British Journal of Politics and International Relations* 20, no. 2 (2018).

and secure communications channel on a sovereign operational basis. This general dependency on and integration with the United States means that the United Kingdom has never had to think in larger strategic terms about spacepower and the evolution of technologies in the orbital environment. Spacepower became something of a missing link within Whitehall as space was "covered" by the United States.

Contrary to a history of minimal government interest, the 2010s saw something of a sea change in the prominence of space policy in the United Kingdom. Spacepower has arguably come of age in Whitehall. In 2010 the United Kingdom formally set up a civil space agency to congeal and coordinate the U.K.'s civil, commercial, and industrial space sectors. The U.K. Space Agency (UKSA) enjoys a budget of approximately £400m annually, of which around 75% goes to the common pool at the European Space Agency (ESA). The amount the U.K. spends on the military and intelligence space sectors is classified. The 2010s saw the publication of the Ministry of Defense's (MoD) *U.K. Military Space Primer*, two new air and space power doctrines,[46] the first National Space Security Policy (NSSP), and a National Space Policy (NSP).[47] Together, these documents show a shift in the intellectual contours of the civil service and government departments. Space policy and spacepower are becoming mainstream concepts and issue areas for decisionmakers in the United Kingdom. The U.K. now officially recognizes that space is a serious military domain that must be consciously protected and exploited—an explicit statement that moved British military space and security debate from "whether something should be done" to "what should be done."

Despite this, space strategy and policy is not an area of complete consensus or coherent thought in Whitehall. Since 2017, a Defense Space Strategy (DSS) has been announced as forthcoming from the MoD by various defense secretaries and ministers. It is still delayed as of February 2020. In late 2019, the Johnson government announced its intention to form a U.K. National Space Council (NSC) at the Cabinet level, chaired by the Prime Minister. As with the DSS however, the detail on the remit and major decisionmaking capacity of the proposed NSC is unknown at this point. Input from the U.S. military and intelligence community is much needed here, especially as a decision on a U.K. GNSS may impose severe opportunity costs by creating a triplicate GNSS service [namely, the U.S. Global Positioning System (GPS), E.U.'s Galileo, and U.K.'s GNSS] for the transatlantic alliance structures and debilitating the British budget for other, more value-added and affordable space investments. This is all the more pressing as the U.K. is making advancements and investments in select areas that can make more sense for the United States as a friendly, niche, "added bandwidth," agile, and experimental capability provider in areas simply overlooked by the larger and more sluggish U.S. military space sector.

46 Bleddyn E. Bowen, "The RAF and Space Doctrine: A Second Century and a Second Space Age," *RUSI Journal* 163, no. 3 (2018); U.K. Ministry of Defence, "UK Air and Space Power," JDP 0-30, Shrivenham: Doctrine and Concepts Development Centre (2017).

47 U.K. government, National Space Policy (2015), https://www.gov.uk/government/publications/national-space-security-policy and National Space Security Policy (2014), https://www.gov.uk/government/publications/national-space-policy. Accessed February 24, 2020.

The U.K. government has invested in new Earth observation technologies such as the small-satellite Carbonite-2 live-video imaging satellite in low-Earth orbit (LEO). The MoD was involved in this project and now a £30m follow-up investment in the technology has been announced as Project Artemis, which enjoys some level of American participation. This shows in increasing appetite in the MoD for more sovereign ISR capabilities, and a willingness to experiment with technologies that the United States may not have previously considered. Such a capability taps into British strengths in the small satellite sector, where approximately half of Earth's small satellites are built. The MoD is also investing in Project Oberon to develop a Synthetic Aperture Radar (SAR) small satellite cluster, following the success of the NovaSAR technology demonstrator. Whilst the new U.S. Space Development Agency talks about integrating off-the-shelf technologies for military purposes, the U.K. MoD has already been trying it out with British space industry. Due to this commercial industrial success the U.K. is moving ahead with small satellite launch capability from northern Scotland, and could help provide more operationally responsive capabilities for allied missions—something the U.S. Air Force has spoken about for decades but failed to bring about. This is one area where the U.S. can scale up as a fast-follower, building on proven successes by allies in niche capability areas.

These new ventures enhance the existing strengths Britain has in space and will potentially be an important source of space-based allied support for U.S. space strategy. The U.K. is an essential component of the U.S. ground-based nuclear missile launch early warning network through the RAF Fylingdales site in the North Yorkshire moors. This system can provide some space detection and tracking functionality, but is not optimized for that role. SSA is a clear area for U.K. investments that the United States could encourage, both in terms of SSA sensors and analytical power. A second source of analysis is already used in the U.S.-U.K. missile sector—so why not expand to SSA? A second independent and trusted opinion is good for intelligence analysis and SSA. Another strength for the U.K. is that it is accustomed to spacepower integration following its close modernization of the U.S. military over the last 30 years. Unlike some other European allies, Britain has been able to keep up with the emergence of spacepower's influence upon the battlefield and military operations. A shared experience and understanding of the tactical exploitation of spacepower makes for high levels of interdependency. This has been demonstrated in the Schriever and Red Flag war games, showing that even though allies can be highly integrated and dependent on the U.S., they are important for U.S. strategy to have on board.

Brexit Britain's Buran Moment?

Yet these strengths may be squandered as U.K. space strategy is lobotomized due to a highly public and politicized response to Brexit. Political vanity risks overtaking practical strategic decision-making and balancing trade-offs in investments. Britain risks building a massive new space infrastructure that it does not need, simply

because it mistakenly believes its credibility demands it whilst in reality it will not add any new capability to U.K. decision-makers. In this tumultuous time, policy debate in the U.K. needs impartial advice from a friendly and leading space power, independent of personal political gain, and independent of industrial and commercial influence. Such spending will determine in large part what practical military and intelligence support the U.S. can draw from Britain for the next few decades in space.

Brexit has been a significant blow to the U.K. GNSS industry, which was heavily dependent upon the military-grade and encrypted Public Regulated Service (PRS) aspect of the Galileo project (which it now has departed from due to the termination of its E.U. membership). In response, the U.K. government has spent £92m on a feasibility study for a replacement U.K. GNSS, which is estimated to cost of £5bn to acquire if it goes ahead. This project will financially dwarf the investments made in military and intelligence space technologies listed above. The opportunity costs of a U.K. GNSS are stark and should alarm the United States as well as other allies: it is likely to cost more than the *Skynet* system and is far more than the U.K. Space Agency budget of £400m.[48] There is little transparency from London as to who will foot the bill. At present the MoD is looking at significant cuts to its £35bn budget. GPS was always planned to be the MoD's primary GNSS service, even with Galileo in operation. In what seems to a vanity project echoing the Soviet Union's Buran Shuttle project, Britain is seemingly on track to build an extremely expensive and sophisticated piece of space technology that does not provide new or additional capabilities beyond what it already has access to or what it actually needs, like more SATCOM, ISR, and SSA capabilities.

Allied SATCOMs, ISR, and SSA have limited bandwidth and can be swamped in an operation or crisis. A GNSS service is not restricted by bandwidth, only the number of receivers which can be manufactured to requirements, so there is no need for more of that service as the U.K. will not be denied military GPS services. A U.K. GNSS would be a triplicate system, assuming continued GPS access and willingness in the U.K. and E.U. to agree to allow the U.K. to use PRS from Galileo. On the latter point, it is very much in the E.U.'s interests to ensure U.K. access to PRS receivers and services as the U.K. will provide defense and intelligence support to E.U. member states that will increasingly be using Galileo in future. A U.K. GNSS shows exactly the kind of redundancy that the U.S. should try to get its allies to avoid.

Comparing the potential cost of a U.K. GNSS with the U.K.'s government's rather modest investments in ISR innovation, small satellites, small satellite spaceports, and SSA demonstrates not only how acute resource issues can be for small allied states of the U.S., but also how poor decision-making can make a difficult situation

48 Richard Speed, "Space policy boffin: Blighty can't just ctrl-C, ctrl-V plans for Galileo into its Brexit satellite," *The Register* (December 3, 2018), accessed February 24, 2020, https://www.theregister.co.uk/2018/12/03/brexit_satellite/; Andrew Williams, "Could Britain collaborate with Australia on a Galileo alternative?" *Space News* (May 24, 2018), accessed February 24, 2020, https://spacenews.com/could-britain-collaborate-with-australia-on-a-galileo-alternative/; and Bleddyn E. Bowen, "Better the devil you know? Galileo, Brexit, and British defence space strategy," Defence in Depth (May 23, 2018), accessed February 24, 2020, https://defenceindepth.co/2018/05/23/better-the-devil-you-know-galileo-brexit-and-british-defence-space-strategy/.

worse and result in serious opportunity losses for allies. There is always some pressure to provide relevant capabilities and assistance to the United States. Different or additional ISR assets and analytical capabilities will be arguably more profitable for Britain in the currency of alliance relationships, bargaining, and burden-sharing than a third GNSS service. A middle power like Britain does not have all the space infrastructure needed to make its U.K. GNSS fully sovereign—it will need to rely on others for launching and replenishing its satellites, as well as others for global monitoring ground stations to enhance accuracy and system maintenance as GPS currently enjoys. Serious questions remain for a state like Britain as to what extent its space systems can truly be sovereign—not unlike its nuclear weapons systems.

The allied spacepower landscape would be transformed if the U.K. were to spend even a fraction of the projected U.K. GNSS cost on a new space ISR and SSA program, tapping into the U.K. space industry's existing strengths. Coupled with an aggressive state-funded spaceport campaign, Britain could fund small satellite launchers and a functioning polar-launch spaceport with such financial largesse. This major inflection point in British space strategy should be of concern to the United States given the massive scale of this project relative to the total size of the U.K.'s military and intelligence space sector and budget.

The E.U.'s importance to U.S. space strategy

The U.S. must anticipate and be a constructive partner in helping other allies make such decisions, especially in the larger spacefaring states, such as Japan, France, and Germany. Yet France and Germany will be increasingly part of the E.U.'s emergence as a hard power actor in space. The E.U. and ESA, with the consolidation of European defense industry, have allowed European states to overcome the challenges of dependency and integration with the U.S. in military technology to form greater degrees of autonomy from the U.S. As flagship E.U. space infrastructure comes online, in a crisis a major entity such as the U.S. will need to act with—if not rely on—for support in space will be the E.U., simply because it will have a vast array of useful capabilities across the board. In the medium to long-term future, the E.U. may even supplant NATO as the major source of friendly spacepower assets and services that the U.S. can draw upon. This is not a good position for the U.K. as it loses its place in E.U. security-grade space infrastructure because of Brexit. Though NATO may be able to coordinate and integrate member state military space systems, the E.U. will have a large catalog of sovereign E.U. assets, data pools, and services that NATO will not. The metamorphosis of the E.U. into a hard power actor, or military power, seems to be particularly visible in space when compared to the relatively lackluster record of terrestrial E.U. military integration. Whilst NATO talks about space as an operational domain, it is the E.U. that actually possesses military-grade space assets.

Unlike NATO, Galileo is the realization of military-grade and security-relevant E.U. space infrastructure which has been in the pipeline for decades. Thanks to the E.U.,

the United States may be able to look forward to a future where it may have a backup military-grade GNSS should the worst ever happen to GPS in a crisis. Subject to negotiation with the E.U., Galileo's PRS will become available for use. Additionally, official U.S. DoD policy is now to integrate with allied regional and local navigation systems for defense purposes, such as the Japanese Quazi-Zenith Satellite System (QZSS); the Navigate with Indian Constellation (NAVIC); the E.U.'s precursor to Galileo, the European Geostationary Navigation Overlay Service (EGNOS); and a potential Australian Satellite-based Augmentation System (SBAS) for GPS.[49]

Copernicus looks set to become a major remote sensing apparatus for the E.U. and its members with high degrees of resolution, and was a major part of the increased budget contributions for ESA at the triannual ministerial summit in 2019. This could be particularly powerful if the objectives of the Multinational Space-based Imaging System for Surveillance, Reconnaissance and Observation (MUSIS) initiative is realized. Additionally, the E.U. is set to invest further in a government SATCOM project (GOVSATCOM), as well as space situational awareness (SSA). The E.U.'s space strategy documents are clear statements of intent in this regard—its emergence as a more comprehensive space power that can coordinate and integrate the wealth of European states into single space-based data streams and services will be a naturally large secondary source of space capabilities for U.S. strategy. The drawback, of course, is that the U.S. will have less influence on the direction of E.U.-level spacepower as compared to individual states outside such clubs, like Britain, Japan, and Australia. A reality for U.S. space strategy in the 21st century is that it will increasingly have to engage with the E.U. as something of an equal.

Conclusion

The proliferation of spacepower is often discussed from the American perspective as a negative thing, often framed in terms of rising or potential geopolitical adversaries and industrial competitors. Yet it is also a positive: if America's allies become more capable and interested in spacepower they will only be more useful in combating adversarial space powers, should the need arise. Most allies, however, will not be able to fully overcome issues of dependency and integration to some degree with the United States due to the expense of space activity and constrained budgets. The only exception is the E.U. Its economic size and track record demonstrate a capable hard power space actor that may, in the decades to come, dwarf any single NATO member state as a principal source of allied spacepower for the United States.

The U.S. needs to be proactive in diplomatically engaging with its allies in shaping the development of their spacepower where it can. Though the U.K. has strengths in specific areas of military and commercial spacepower, the British future in space

49 U.S. Department of Defense, "Strategy for the Department of Defense: Position, Navigation, and Timing Enterprise" (November 2018), p22-26.

is uncertain and troubled given the trials of Brexit, the increasing capacity of the E.U. as a spacepower, and the opportunity costs imposed by a potential U.K. GNSS project. The United States can play a constructive role here in advising and informing the strategic decision-making of cash-strapped allies who do want to invest but are struggling to decide where, or may be about to waste money on unnecessary duplication or even triplication of space capabilities.

Britain is grappling with the universal problems that all of America's allies face in space: where to balance autonomy, dependencies and integration, acutely limited resources, and limited personnel and workforce numbers, as well as how best to not only support American spacepower but also determine where to invest in the kind of space systems America needs its allies to invest in. Like the E.U.'s role as a facilitator of ambitious but smaller states, the United States can and should seek to enhance and accelerate the ambitions of its smaller allies in space, providing assistance and honest advice on decision-making where it can—but also satisfying allied needs for degrees of autonomy from the U.S. where desired and practical. The U.S. can provide a lot of the infrastructure for its smaller allies to let them develop spacepower in the segments that they can afford to do so—such as in small satellites and downstream applications. American allies in space do not want to be entirely dependent, but they cannot do everything themselves either, as demonstrated by recent activity and increased spending levels. A worst case scenario in the failure of U.S. pro-activeness in allied space strategy is that well-meaning allies may spend their money, but on areas that merely duplicate existing capabilities and limit allied contributions in more important areas, preventing the development of any added value for American spacepower.

Recent trends in allied states, not least Britain, are positive for American space strategy and the role of allies within it. America's principal allies now take military spacepower and the threats other states pose to space infrastructure far more seriously than 10 years ago. The debate is now what should be done in the military space sphere, not whether anything should be done. America in turn must engage constructively with this willingness so that allies put their scarce resources to the best possible use. These discussions will not always be harmonious or easy as each state will have differing priorities or sometimes conflicting interests, but that is hardly unique in terrestrial allied relationships. Spacepower is, after all, merely a continuation of politics by other means.

NATO and the E.U.: New Opportunities in Europe for Space Policy

Pablo Alonso-García and Benjamin A. Silverstein

Over the past decade, the European Union (E.U.) has gradually taken a more active role in space endeavors, and now plans to launch an E.U. Space Agency in the near future. With this proposal, the E.U. is seeking a new role in shaping European civil space capabilities, innovation, and governance. The European Space Agency (ESA)—the E.U.'s longtime partner and sole implementer of the European space program—has responded to this movement with reticence. The E.U. has also considered aspects of security and defense in outer space, in line with the greater military responsibilities taken under the Common Security and Defense Policy (CSDP). The E.U.'s new emphasis on defense in European space policy could not arrive at a better moment in the broader international context. NATO acknowledged space as an operational domain and issued its first space policy document in 2019. The policy rationalizes the provision of space-based support to collective defense operations that safeguard security in Europe, a goal of obvious interest to all E.U. members independent of their affiliation with NATO. The policy may also provide a framework for engagement between the E.U. and NATO on space security missions and offer U.S. policymakers new avenues through which to engage Europe.

NATO and the E.U. have a strong incentive to work together to coordinate space-focused exercises, which can demonstrate resolve and deter hostile or malicious behavior in space. In the pages that follow, we lay out the case for the new European politics of space and discuss opportunities for building on Europe's newfound focus on military space issues. To succeed in this endeavor, NATO should serve as a single customer for joint military technology to protect space assets. With new space defense systems and materiel, NATO and the E.U. have an opportunity to begin joint exercises in crisis management with a purpose to better manage European space security responses. New security systems and well-defined roles for NATO and the E.U. would allow European partners to build a level of autonomy in space activities and advance beyond a stagnation as junior partners.

The emergence of the E.U. as a full-fledged space actor

While the E.U. historically ceded the lead on European space policy to ESA and the member states, the E.U. issued a joint space strategy with ESA in 2000.[50] After this initial joint approach, the E.U. promulgated the Commission Green Paper on European

50 Vincent Reillon, "European Space Policy; Historical Perspective, Specific Aspects And Key Challenges" (January 31, 2017). Accessed February 21, 2020. https://epthinktank.eu/2017/01/31/european-space-policy-historical-perspective-specific-aspects-and-key-challenges.

Space Policy in 2003 that led to the 2007 Resolution on the European Space Policy, both drafted in collaboration with ESA. The policy promoted nine principles to coalesce the individual strategies of member states with those of ESA and the E.U. and established guiding priorities in research, industrial development, and future programs.[51] While the policy addressed security and defense, specifically seeking to "improve the coordination between defense and civilian space programs . . . in particular the synergies in the domain of security," the document made clear that military use of key programs such as Galileo and Copernicus "must be consistent with the principle that those are civil systems under civil control."[52]

This approach reflected ESA's foundational principle of engaging only in peaceful activities in space. However, the E.U.'s ambition in space goes beyond civil initiatives. The E.U. also steadily increased its influence and involvement in defense and security during this same period by enacting policies like the 1999 European Security and Defense Policy (ESDP) that later evolved into the Common Security and Defense Policy (CSDP). The CSDP introduced a clause that promised mutual assistance in case of armed aggression in a member state's territory, strengthened E.U. action to common external threats, allowed for the creation of E.U. battlegroups, and created the Permanent Structured Cooperation (PESCO) to advance the structural integration of European defenses.[53]

At the same time, the E.U. became a main stakeholder for ESA after the former spent $3.3 billion in 2007 to bail out the Galileo program—Europe's Global Navigation and Positioning system—and became the main investor in ESA's European Earth monitoring program now known as Copernicus in 2012. Although program ownership for these systems was transferred from ESA to the E.U., ESA retained responsibilities as the primary implementer and technical advisor.

This new funding priority, coupled with the strengthened role of the E.U. in European security affairs, influenced the next evolution of the Resolution on the European Space Policy, the 2016 E.U.'s Space Strategy for Europe. This expanded the three paragraphs of the 2003 Green Paper dedicated to defense and security to three pages, focusing on ensuring European autonomy in accessing and using space and the security of space infrastructure. Notably, the 2016 space strategy dropped the requirements for civilian control of key systems in security applications—Galileo and Copernicus—and introduced security missions for two other programs: government communications (GOVSATCOM) and space surveillance and tracking (SST) for situational awareness in orbit. These four programs are expected to form the backbone of the E.U.'s new space agency. In 2018, the E.U. announced its intention to rebrand the European Global

51 European Commission, "Space Strategy for Europe" (October 26, 2016). Accessed February 21, 2020. https://ec.europa.eu/transparency/regdoc/rep/1/2016/EN/COM-2016-705-F1-EN-MAIN.PDF.

52 Council of the European Union, "Resolution on the European Space Policy" (May 22, 2007). Accessed February 21, 2020. https://www.copernicus.eu/sites/default/files/2018-10/Resolution_EU_Space_Policy.pdf.

53 Papadimitriou *et al.*, "Perspective on space and security policy, programs and governance in Europe," *Acta Astronautica* 161 (2019), p183-191. Accessed March 25, 2020. https://doi.org/10.1016/j.actaastro.2019.05.015

Navigation Satellite Systems Agency (GSA), the supervisory body for Galileo/EGNOS, as the European Union Agency for the Space Program to unite all its funded programs under a single management and oversight function.

This announcement has created friction between ESA and the E.U. ESA fears that such a reorganization would diminish its role as the spearhead in advancing European space prowess and has expressed concerns about duplicative funding and organizational oversight that would put the overall collective European space enterprise at risk. This view was categorically expressed by ESA's Director General Jan Wörner, who wrote in the agency's blog: "There is no need to develop a new Space Agency in parallel in Europe, the ramp-up of which would take decades and cost billions—and would therefore in itself be a major risk to the programs it manages. We need to streamline, not double administrative layers."[54]

But the creation of a new E.U. space agency should not be seen as a competitive move, as the E.U. does not intend to replace ESA's competences. Indeed, it could serve to streamline the overall space program. ESA could concentrate on its core mission—fundamental science—and the E.U. could efficiently develop security and defense capabilities, allowing for better coordination with other E.U. agencies with strong interest in space applications. Since 2016, the European Defense Agency (EDA) has taken a more active role in cooperation with ESA to develop GOVSATCOM, in addition to many other projects including SST, uncrewed and remotely piloted aerial systems, intelligence collection, and chemical, biological, radiological, and nuclear threat response. Another E.U. entity, the European Union Satellite Centre (SatCen), which provides space-based products and services to support E.U. decisionmaking, participates on the Copernicus program's governing body to drive the application of Earth observation data for security applications.

Such tensions and disagreements highlight one of the recurring issues in European space policy: the governance triangle of the E.U., ESA, and the national space agencies of their member states each have their "own interests and competences, some of them may overlap, and thus the separation and attribution of roles is not always clear."[55] When it comes to space defense programs, the E.U. member states have been the main drivers in initiating programs based on national interests, sometimes seeking collaboration with other European countries on a case-by-case basis. E.U. countries often collaborate on satellite systems and grant reciprocal access to imagery and other data products, such as Helios (France, Spain, Italy), Helios2 (France, Spain, Belgium, Greece, Denmark), Athena-Fidus (France, Italy), Italy's COSMO-SkyMed used by France in exchange for Italian access to Pléiades,

54 Jan Wörner, "United Space in Europe, United Europe in Space," European Space Agency blog (May 31, 2018). Accessed February 20, 2020. http://blogs.esa.int/janwoerner/2018/05/31/united-space-in-europe-united-europe-in-space/.

55 Lucia Marta, "Consolidating the European Space Policy requires an evolution of its governance, which is currently structured around three main types of actor," London School of Economics and Political Science blog (June 6, 2013). Accessed February 21, 2020. https://blogs.lse.ac.uk/europpblog/2013/06/21/european-space-policy-is-governed-by-a-triangle-of-the-eu-the-european-space-agency-and-national-space-agencies.

or Germany's LUPE used by France in exchange for German access to Helios. The Multinational Space-based Imaging System (MUSIS) project perfectly illustrates this collaborative trend. A cooperative effort initiated by Belgium, Germany, Greece, France, Italy, and Spain, MUSIS is sponsored by EDA to share imagery from various national military satellites.[56] Sweden and Poland later joined the consortium, and the partnership remains open to new EDA members if their proposed contribution is acceptable to the existing partners. Projects like MUSIS confirm that individual nations within the E.U. value multinational European space defense programs. As a supranational organization, the E.U. leverages initiatives like the European Defense Fund (EDF) to co-finance joint defense industrial projects like MUSIS and other endeavors. Of note, the EDF has allocated €22.5 million for space situational awareness and early warning capabilities in the 2020 funding envelope.[57]

The E.U.'s ascent as a major influence in the defense and security posture has seen commensurate increases in the attention afforded to space projects, specifically those associated with security and defense. The E.U. has acknowledged the need to protect vital interests and assets in space as they relate to affecting security imperatives on the continent. ESA has also slowly warmed to the prospects of participating in defense and security projects, as well as leveraging existing civil systems for defense purposes. While ESA's motivations are potentially driven by institutional preservation instincts and a desire to retain primacy in collective European space projects, the apparent policy and organizational shifts indicate the magnitude of defense considerations on space policy in Europe. All these changes imply that the moment is ripe for a stronger and more coherent European space defense policy, especially in the face of a changing space defense landscape.

The Moment for Europe to Rethink Its Role as a Space Power

Despite the shifts in European policy towards military space, Europe's ability to be a powerful player in space is at risk due to the inability of the member states to agree on a broader defense strategy and how it should drive their collective investments. The 2019 report *Measuring Space Power* applies an analytical and empirical model to map international space power.[58] The output of the model is a Space Power Matrix that positions the different actors based on their capacity (hard and soft) and their autonomy (technical and political).

56 European Defence Agency, "New EDA project on space-based earth surveillance system" (March 5, 2009). Accessed February 21, 2020. https://www.eda.europa.eu/docs/news/New_EDA_Project_on_Space-Based_Earth_Surveillance_System.pdf?Status=Master.

57 European Commission. "Stepping up the EU's role as a security and defence provider" (March 19, 2019). Accessed February 21, 2020. https://ec.europa.eu/docsroom/documents/34510.

58 Marco Aliberti, Matteo Cappella, and Tomas Hrozensky, *Measuring Space Power: A Theoretical and Empirical Investigation on Europe* (European Space Policy Institute: Springer, 2019). Accessed March 25, 2020. https://doi.org/10.1007/978-3-030-15754-8.

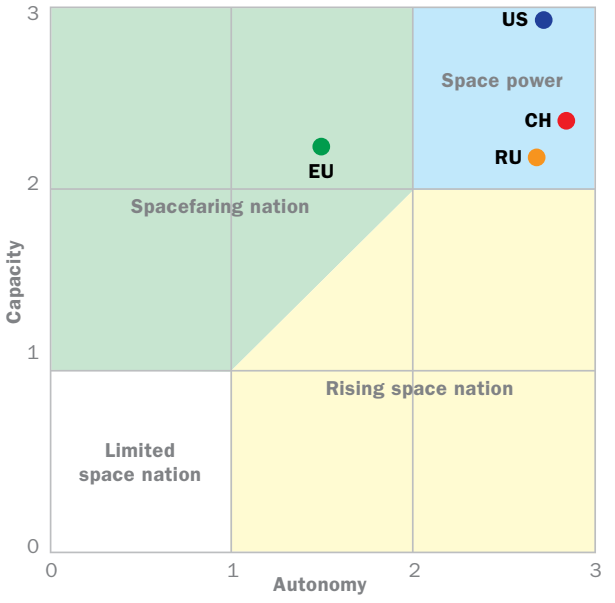

Figure 1. Space Power Matrix

The authors of this article expanded the model and introduced weights to more accurately represent the role of defense programs and budgets in national grand strategies. Furthermore, the model now projects two decades into the future based on plausible evolutions of present trends.

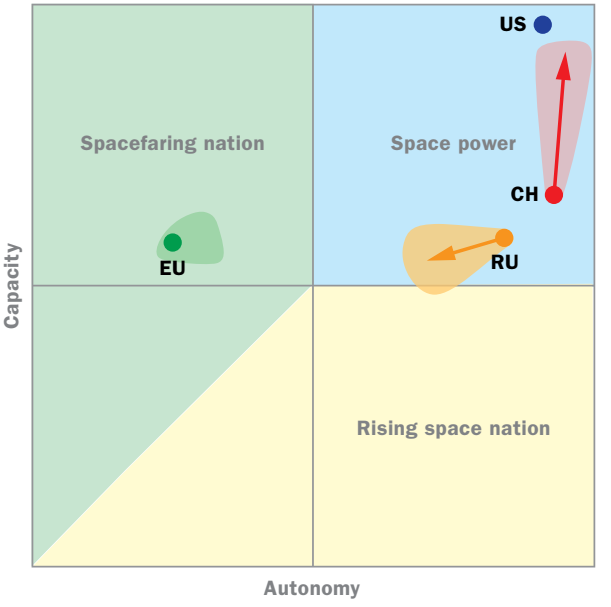

Figure 2. Weighted Space Power Matrix projected 20 years

According to the projection, Europe risks stagnation. Although defense and security has been tagged as one of the pillars of the E.U. space policy, institutional investment in strategic and military applications is not a main driver within the implementation plan, unlike those of the other space powers (i.e. U.S., Russia, and China). Limited military space programs in Europe keep the E.U. from competing with other major space powers on both economic and security terms. A narrow space defense and security market forces many innovators and space technology companies towards civil products, and the captive government markets "create externalities . . . that distort the terms of the competition, at the detriment of the European space industry."[59] This dynamic lays in stark contrast to the commercial space industries in Russia, China, and the U.S. that benefit from large investments that fund projects with dual civil and defense applications. European industry not only misses out on such spillover effects, but its high dependence on the commercial business and export sales due to the lack of a continuous public demand makes it also less resilient to economic downturns.[60]

The E.U. must be aware that failures to invest in indigenous space defense capabilities may result in sacrificing key industrial capacity. Blindly increasing demand for space security systems is not a solution, as higher investments will not suffice if they are not accompanied by convergence in the strategic needs of member states. The outcome of the current misalignment can be seen in the multiplicity of platforms and weapon systems available that create significant inefficiencies and operational burden. As of 2017, Europe operated 178 types of weapons systems versus 30 in the U.S.; whereas the U.S. has one battle tank, Europe has 17; whereas the U.S. operates six models of fighter jets, Europe operates 20; and whereas the U.S. has four types of frigates, Europe has 29.[61] Even more symptomatic of this fragmentation is the case of the A400M; a single aircraft that has seven different configurations, each adapted to the specific national interests of each of the seven nations that are partners in the program—Belgium, France, Germany, Luxembourg, Spain, the United Kingdom, and Turkey. The complexity of certifying seven different configurations is partly the cause of the delays and cost overrun that has put Airbus, the prime manufacturing contractor, under heavy financial and operational stress.

The EDA's Pooling & Sharing concept and NATO's Smart Defense programs have been proposed to specifically address this fragmentation. In the case of the E.U., the absence of a grand strategy that "offers a clear guideline for the operationalisation of foreign, security and defence policy" is likely going to delay

59 ASD-Eurospace, "Strengthening the European space sector through an ambitious industrial policy." May 16, 2019. Accessed February 21, 2020. http://www.spaceref.com/news/viewpr.html?pid=54072.

60 Ibid., 10

61 European Commission, "The European Defence Fund" factsheet. March 19, 2019. Accessed March 25, 2020. https://ec.europa.eu/docsroom/documents/34509.

any initiative in this area.[62] Such a grand strategy can only be achieved via more autonomy, without which the E.U. will fail to advance towards the "space power" quadrant in the model presented above.

A stronger role in defense and security may force the E.U. to rethink its traditional stance of constraining its interventions to peacekeeping, stabilization, and humanitarian missions in its near vicinity. The E.U. may also reconsider participating in long-range expeditionary operations that have so far been the purview of NATO and individual involvement of E.U. member countries.[63] There are yet other options. Indeed, the E.U. has an opportunity to further develop its space defense programs under NATO's security umbrella; NATO is positioned to sustain the development of European military space capabilities in a role parallel to ESA's civilian space mission.

NATO and the E.U. as Natural Partners for a Common Defense Space Policy

The relationship between NATO and the E.U. goes beyond the overlap in member states. In lieu of a European army, NATO provides an invaluable deterrence and defense capability in Europe. E.U. members make immense contributions toward security and defense through the NATO-E.U. Declaration on European Security and Defense Policy and the Berlin Plus arrangements. These frameworks, when coupled with the recent NATO declaration of space as an operational domain, empower E.U. member states to collectively engage with NATO on security and defense in and through space.[64]

First, the new NATO policy aims to reduce barriers to sharing space-based capabilities between allies. This extends to E.U.-led operations under the Berlin Plus arrangement. Furthermore, the most recent Joint Declaration on E.U.-NATO Cooperation states "The capabilities developed through the defense initiatives of the E.U. and NATO . . . should be available to both organizations, subject to the sovereign decisions of the countries that own them."[65] The policy paves the way for joint consultations on matters of space security and defense, and especially on consultations regarding existing capabilities that might be mutually beneficial to NATO and the E.U. One clear area for cooperation is secure satellite communications. NATO awarded a 15-year, $1 billion contract for providing secure communications to a consortium of allies in 2020. The E.U. constellation of communications satellites

62 Cenan Al-Ekabi, ed., *European Autonomy in Space* (Springer, 2015). Accessed March 25, 2020. https://doi.org/10.1007/978-3-319-11110-0.

63 Seth Johnston, "A Europe that Protects? U.S. Opportunities in EU Defense," Belfer Center for Science and International Affairs (November 2019). Accessed February 21, 2020. https://www.belfercenter.org/publication/europe-protects-us-opportunities-eu-defense.

64 NATO, "NATO Defence Ministers approve new space policy, discuss readiness and mission in Afghanistan" (June 27, 2019). Accessed February 21, 2020. https://www.nato.int/cps/en/natohq/news_167181.htm.

65 NATO, "Joint Declaration on EU-NATO Cooperation" (July 10, 2019). Accessed February 21, 2020. https://www.nato.int/cps/en/natohq/official_texts_156626.htm.

is a collaboration between many of the same nations. Rationalizing the cooperative arrangement between the two organizations could allow both organizations to realize both cost savings and increased interoperability in times of crisis.

Second, NATO offers a unique environment to plan for security needs and pool resources, boosting the foundational objectives of EDA, PESCO, and the EDF. The United States may oppose such a development, as it has already expressed reservations to similar proposals due to concerns over duplicated projects, as well as concerns that such an arrangement might restrict the participation of countries who are not part of the EDA or E.U. and reduce demand for U.S. defense industry exports. However, this strategy of artificially preserving European defense markets for U.S. industrial offerings is not the best way to build strong allies. Instead, the U.S. strategic posture would be well served to support allies that can innovate and develop their own industrial defense capabilities. Furthermore, an arrangement could be crafted that would both preserve market access and support the maturation of a European space defense industry.

NATO could serve as a conduit across the Atlantic and bolster industry participation among allies, as European defense companies also find barriers when participating in U.S. procurement bids. Moreover, the U.S. and Europe share many security concerns and have similar technical capabilities (albeit often on different scales) in the space domain. Therefore, it is an ideal domain in which the U.S. could demand higher investment from European allies. Departing from a dynamic in which the U.S. aims to own full capabilities and rely on the European allies' systems solely as redundancies and backup systems would provide mutual security benefits in the context of an overarching transatlantic space defense policy.

Third, NATO and the E.U. have a long history of joint crisis management and distinct authority in the event of a pan-European security event. The two organizations also share many of the same vulnerabilities in space. NATO and the E.U. have an opportunity to engage in joint exercises specifically focusing on space security. Such activities would generate inter-institutional trust and define parallel crisis management tasks. Joint exercises would also demonstrate a strong deterrence posture to potential adversaries or those who might consider interfering with NATO or E.U. space capabilities.

These exercises would essentially signal what is and what is not acceptable behavior in space, both through the types of hypothetical scenario invented and the tools employed in response. This could be considered by some to be setting boundaries on international norms in space. While the E.U. has already issued a draft of a Code of Conduct in Outer Space Activities, it was poorly received by many members of the spacefaring community. Using joint exercises to signal boundaries might provide some of the same benefits as a code of conduct without requiring an international document and enumeration of principles. Furthermore, it would allow participating states to maintain autonomy in sovereign military outer space activities.

Challenges in the NATO-E.U. Defense Space Policy

There is obvious overlap between the E.U., ESA, and NATO in both space security needs and member states with nascent or extant space security capabilities. However, satisfying the gaps in European space security and defense policy is not without institutional challenges. While much depends on the desires within the E.U. and NATO, there are general obstacles to integrated space security and crisis response capabilities. First, and perhaps most importantly, the two organizations would have to have a shared understanding of the threats in space. This challenge is two-fold; it would require a common threat assessment framework and a joint situational awareness capability to identify when those threats impact space systems. While both organizations recognize an essentially identical set of threats, underlying institutional concerns regarding the dissemination of classified information would likely arrest efforts to wholly or partially merge space security and defense programs. Establishing classified information sharing between the two organizations would potentially benefit a host of different missions, but this would be an immense challenge. Working to align specific programs or projects may focus collaboration on tangible outcomes, providing real incentives for overcoming classification roadblocks.

Additionally, as mentioned above, one of the axes of E.U. space governance is the national agencies of the E.U.'s member countries. Among this group, France traditionally holds the strongest leverage in space activities, and has historically advocated for autonomy in aerospace technologies (now considered by Paris to be a strategic sector). The national space agency, the Centre National de la Recherche Scientifique, supplies much of the European thought leadership on space missions and is renowned for its world-class capabilities fueled by a budget that ranks among the top five worldwide. French companies like Airbus and ArianeGroup, the company whose launchers provide Europe with independent access to space, are headquartered in France. Moreover, France is the largest contributor to the ESA budget and as such the largest national representation among its staff are French nationals.

Therefore, the leadership and influence of France in European space policy cannot be overstated. The historical record shows the effects of French determination and drive toward strategic autonomy; the development of Galileo is in large part the result of French desires to develop an independent positioning, navigation, and timing system that would allow Europe to untether from complete reliance on the American GPS network. While the United States will be the individual technological leader in a trans-Atlantic space security partnership, France may play the role of kingmaker. This is not to say that the other states in the relationship can be overlooked.

Conclusions

NATO and the E.U.'s formal forays into military space offer the broad European security community opportunities to collaborate and engage on cooperative missions in space security. The U.S. and European allies would both benefit in this domain by investing in military capabilities to protect vital interests such as shared space-based secure communication infrastructure. While the E.U.'s pool of resources might be better suited to develop force-enhancing capabilities, NATO is well positioned and has a strong history of serving as a single point of contact and a customer for security materiel jointly produced by multinational consortia. Opening this new industrial opportunity for European allies would support competition through innovation, but perhaps more importantly would provide incentives for European industrial actors to diversify their production portfolios to include offerings that would not suffer the same economic shortfalls as civil space systems.

Furthermore, the E.U. has an opportunity to revive their efforts to develop norms of behavior in space. While the prospects for promulgating a written code of conduct may be slim, an E.U.-NATO partnership to simulate European outer space crises would assist both organizations in delineating roles and responsibilities for space security. Beyond these benefits, iterative exercises would set implicit guidelines on behaviors. These exercises would additionally open new diplomatic channels at both organizational and nation-to-nation levels.

To succeed in this role and both play an effective role in crisis management and avoid platform fragmentation that plagues other operational domains, the E.U. needs to acquire further autonomy to facilitate the coalescence of national strategies. Such a stance is necessary to eliminate inefficiencies and secure the future of the European space industry and advance collective and sovereign European space power. Absent these efforts, Europe risks remaining in its role as a junior partner to the U.S. for the foreseeable future.

The creation of the E.U. Space Agency for the Space Program is also a positive development that should be advanced. Rather than creating competing bodies, this initiative would serve to better organize the European efforts in space, will allow the E.U. to strengthen the defense and security programs and capabilities, and improve its coordination with other E.U. agencies like EDA and SatCen. However, the initiative seems to have stalled since the E.U. announced it in 2018.

Finally, policymakers must be mindful of the political challenges and friction between the memberships of both organizations. While strained relationships between the NATO members that are not part of the E.U. might hamper engagements, the main actors in space security would be well served to limit the scope of discussions to space security and exercise restraint in trying to address tangential or external issues that creep into other debates. While it is important to address issues regarding democratic freedoms, deficits in the rule of law, and human rights concerns, diplomatic overtures between the E.U. and NATO should be able to separate space security from other affairs.

China's Space Strategy: A Three-Headed Dragon

Pablo Alonso-García

The debate about the purpose and desired tasks of the new U.S. Space Force has focused around the questions of whether the U.S. needs to simply defend its existing military space systems from foreign attack, or whether it should primarily be protecting U.S. commercial space interests. Other commentators have remarked that the U.S. should be even more forward leaning, seizing key territory on the Moon and seeking to have unrivaled access to material resources in outer space.

Rather than seizing on this debate directly, this piece analyzes the Chinese space program to understand how the key space competitor of the U.S. is turning to space for its own national and strategic ends. The three key aspects that policymakers need to know about China's space strategy are that it: 1) has built an impressive aerospace industrial sector around punitive U.S. regulations, 2) has utilized that industrial base to create impressive military support capabilities, and 3) will increasingly seek to use these capabilities to gain and exploit natural resources in space. As of today, however, the future outlook of space politics is not defined at all and can still go in many directions—from an extension of great power competition on Earth to a fully collaborative international effort.

China's Space Strategy and the Success of Its Industrial Policy

Although China joined the club of space-faring nations in 1970 when it launched its first satellite, its space program was modest until the year 2000. Until then, China achieved key development milestones with a few decades of delay with respect to the leading nations. But in the last 20 years it has closed the gap with impressive speed. Its launches have grown exponentially from five per year to 37 in 2018, the first time that China sent more rockets into space than the U.S. Its first space lab was orbiting Earth in 2013—only 10 years after the first taikonaut (Chinese astronaut) was sent into space. It sent its first lunar orbiter to the Moon in 2007. Ten years later, it landed a rover on the dark side of the Moon, a feat that no other nation had completed before. BeiDou, the Chinese global navigation and positioning system, will reach full operational capability in 2020, and China is now second to the U.S. in the number of satellites it has launched into space, achieving world-class capabilities in communications and high-resolution imagery.

These impressive achievements in such short time are the outcome of a master plan put in place by China's State Council to become the leading space power nation by 2040. The country is meeting the plan's milestones with little deviation. In the last update of this master plan, the white paper titled "China's Space Activities in 2016,"

the government sets out its vision to become a "space power in all respects."[66] But strong political will and large budgets are not enough to explain China's success; it also owes a lot to the country's industrial policy which has heavily leveraged globalization and offshoring.

After China's ascension to the World Trade Organization (WTO) in 2001, many high-tech companies moved production to China or started to contract Chinese providers with the aim of building up their manufacturing capabilities. It was just a question of time that the know-how spread, and companies moved from manufacturing iPhones to designing high-end competitive products that introduced indigenous innovations. In the aerospace industry, Airbus opened in 2009 a final assembly line in Tianjin for its A320 series, a joint venture with the state-owned China Aviation Industry Corporation (AVIC). Less than 10 years later, the C-919 aircraft made its maiden flight. It was manufactured by state-owned COMAC with airframes made from AVIC. Not surprisingly, the C-919 is an inferior clone of the A320, but like iPhones, its next generation will likely be competitive and present its own innovations.

Chinese high-tech manufacturing capabilities have developed enormously, thanks to China's attractiveness to western companies. In parallel, Chinese expertise has been also acquired through industrial espionage[67] and reverse engineering,[68] aided by a loose protection and enforcement of intellectual property rights.[69] The breadth of Chinese activities even extend to scholars and researchers in American universities and R&D centers; a 2019 Senate report deemed China's Talent Recruitment Plans (currently over 200 programs, with the Thousand Talents Plan being one of the most prominent) a direct threat to U.S. security. The report states that such plans are intended to provide "access to know-how, expertise, and technology" through foreign-trained scientists and experts "all necessary for China's economic development and military modernization."[70]

This does not mean that China will close the gap any time soon. As a defense analyst recently pointed out when talking about the poor quality of indigenous jet engines, "the appropriation strategy remains constrained by bottleneck technologies due to lack of testing data and industrial ecology."[71] Another key technology where

66 The white paper also reproduces President Xi Jinping's words on April 24, 2016, during the anniversary of the country's opening satellite launch in 1970: "To explore the vast cosmos, develop the space industry and build China into a space power is a dream we pursue unremittingly." Accessed February 24, 2020. https://www.fmprc.gov.cn/ce/cgvienna/eng/dbtyw/hplywk/t891650.htm.

67 Members of China's Ministry of State Security (MSS) charged with conspiracy "to steal sensitive commercial technological, aviation, and aerospace data." Accessed February 24, 2020. https://www.justice.gov/opa/press-release/file/1106491/download.

68 Michael Peck, "Russia Is Angry That China Stole and Copied Its Jet Fighter Designs," National Interest (September 13, 2019). Accessed February 24, 2020. https://nationalinterest.org/blog/buzz/russia-angry-china-stole-and-copied-its-jet-fighter-designs-80351.

69 Florin Zubascu, "Poor IP protection in China causes 'irreparable harm' to EU companies," Science | Business (January 14, 2020). Accessed February 24, 2020. https://sciencebusiness.net/news/poor-ip-protection-china-causes-irreparable-harm-eu-companies.

70 United States Senate, "Threats to the U.S. Research Enterprise: China's Talent Recruitment Plans," Staff Report, Permanent Subcommittee on Investigations (2019).

71 Robert Farley, "China's Large and Mighty Air Force Still Has 1 Big Problem," National Interest (February 12, 2020). Accessed February 24, 2020. https://nationalinterest.org/blog/buzz/chinas-large-and-mighty-air-force-still-has-1-big-problem-122621.

China is still five to 10 years behind the U.S., Europe, South Korea, or Japan is semiconductors, as the country is still dependent on foreign technology and has been unable to make advanced indigenous designs. The Chinese government knows that this industry is critical for technological competition and is investing more than $170 billion into its semiconductor industry to spur its development.[72]

The exact same technologies that China is having a difficult time eliminating bottlenecks for are also the fundamental pillars of the aerospace sector. Because they are considered strategic by all countries due to their dual-use capabilities, they have traditionally been one of the main targets of Chinese espionage. Such is the perceived threat to national security that in 2011, the U.S. Congress banned NASA and the Office of Science and Technology Policy from hosting Chinese scientists and establishing any bilateral cooperation with China. The close links of the Chinese space program with the People's Liberation Army (PLA) are also a deterrent to establishing collaboration with NASA. Some key parts of the Chinese space program, such as the manned space program, are directly controlled by the PLA under the China Manned Space Agency (CMSA). The civilian agency, the China National Space Administration (CNSA), is a subordinate agency of the State Administration for Science, Technology and Industry for National Defense (SASTIND), a civilian ministry within the within the State Council under the Ministry of Industry and Information Technology. Regardless of the civilian nature of this hierarchy, the fact that NASA's Chinese counterpart is part of an agency with a name that includes "for National Defense" should raise questions.

On top of this, the International Traffic in Arms Regulations (ITAR) regulatory regime has also impacted the Chinese space program, for its control extends to any component that goes into space. As mentioned before, China's microelectronics and semiconductors—basic components in satellite systems—are not yet on par with western technology. Restrictions do not only apply to satellite manufacturing but also include delivery vehicles, meaning that payloads containing U.S. technology cannot even be launched with a Chinese rocket.

On the other hand, restrictions have further stimulated the development of Chinese indigenous technologies and programs. If the Chinese government pushed for the development of its own international space station, it was largely motivated by the American veto to Chinese participation in the International Space Station (ISS) project.[73] The ITAR restrictions have also helped China to capture and secure part of the space upstream market, allowing China to provide ITAR-free turnkey solutions in satellite manufacturing, launch, and ground station support.[74] The offering has

72 Brian Wang, "China's Semiconductor Catchup is Critical to Future Technology Competition," Next Big Future (February 23, 2019). Accessed March 25, 2020. https://www.nextbigfuture.com/2019/02/semiconductor-race-and-parity-is-key-to-global-technological-competition.html

73 Brian Harvey, *China in Space: The Great Leap Forward* (Springer Nature, 2019).

74 Charlie Campbell, "From Satellites to the Moon and Mars, China Is Quickly Becoming a Space Superpower," *Time* (July 17, 2019). Accessed February 24, 2020. https://time.com/5623537/china-space.

obviously attracted countries such as Venezuela or Iran with which the U.S. has had longstanding strained relationships, but it has also found receptive ears in countries like Brazil that do not want to invest in technology that the U.S. might one day bar them from accessing.[75] And while many European companies are also trying to compete with their own ITAR-free solutions, it is hard for them to beat Chinese prices.

National Defense Space and the Quest for Natural Resources

The development of China's space capabilities is coherent with its increasingly outward looking and active military policy. The PLA's need to have strong space capabilities to project power outside its borders is in line with the 2019 defense white paper, which said to "build a strong and modernized naval force and transition . . . from defense on the near seas to protection missions on the far seas."[76] Since 2014, China has launched more warships, submarines, support ships, and major amphibious vessels than the entire number of ships now serving in the United Kingdom's fleet.[77] This fleet requires bases around the world for provisioning, overhaul, and control, and therefore the first overseas military base operated by the PLA Navy (PLAN) was opened in August 2017 in Djibouti, in the strategically located Horn of Africa. This new mission requires advanced communication, navigation, positioning, and Earth observation capabilities, as do China's global infrastructure projects—the strategic Belt and Road Initiative being its most ambitious example.

Thus, the rise of China as a space power could appear to be just another aspect of its emergence as a global power. Many articles have already explained how its space program is embedded in the overall Chinese efforts to develop the country, boost national pride, and gain international prestige. But behind such efforts, there is also a bet to tip the balance of power—and a vision of outer space as a source for resources to be controlled and exploited that is much more ambitious than the "flags and footprints" paradigm the world is used to.

Chinese missions to the Moon have been focused as much on fundamental science as they have been on analyzing its composition, looking for potential rare minerals, water, and other resources like helium-3 that many claim could be a revolutionary source of energy. China's plans to build a base on the Moon in the 2030s is a "means to accomplish its goals of asteroid mining, deep space exploration, and exploitation."[78] In addition to mining for resources, China is also

75 Peter B. de Selding, "Brazil Bypassing the U.S. as It Builds out a Space Sector," Space News (May 15, 2015). Accessed February 24, 2020. https://spacenews.com/brazil-bypassing-the-us-as-it-builds-out-a-space-sector.

76 The State Council Information Office of the People's Republic of China, *China's National Defense in the New Era* (Beijing, China: Foreign Languages Press, 2019).

77 David Lague, "China's vast fleet is tipping the balance in the Pacific," Reuters (April 30, 2019). Accessed February 24, 2020. https://www.reuters.com/investigates/special-report/china-army-navy.

78 Namrata Goswami, "China's Get-Rich Space Program," The Diplomat (February 28, 2019). Accessed March 25, 2020. https://thediplomat.com/2019/02/chinas-get-rich-space-program.

heavily investing in technologies to make possible space-based solar power,[79] which was originally demonstrated by Japan in 2015.[80] All these projects have one thing in common: access to resources; not only to get to them, but also to control them.

High-ranking officials in the space program and in the government have made public statements that give hints on the Chinese perspective. Lt. Gen. Zhang Yulin, deputy commander of the China Manned Space Program and deputy head of the Central Military, declared in 2016 that "the earth-moon space will be strategically important for the great rejuvenation of the Chinese nation."[81] Wang XiJi, a Long March rocket designer, warned that by "not acting quickly, other countries, in particular the U.S. and Japan, would take the lead and occupy strategically."[82] Ouyang Ziyuan, chief scientist of China's Moon exploration program, declared in 2013 that "the Moon could serve as a new and tremendous supplier of energy and resources for human beings . . . This is crucial to sustainable development of human beings on Earth . . . Whoever first conquers the Moon will benefit first."[83] And the latest hearing before the U.S.-China Economic and Security Review Commission in 2019 recalled the words of Ye Peijian, Head of China's Lunar Mission: "The universe is an ocean, the moon is the Diaoyu Islands [Senkaku Islands], Mars is Huangyan Island [Spratly Islands]. If we don't go there now even though we're capable of doing so, then we will be blamed by our descendants. If others go there, then they will take over, and you won't be able to go even if you want to. This is reason enough."[84] His analogies clearly refer to territories where China has territorial claims and sovereignty disputes with other countries, highlighting their emphasis on geopolitical aspects of outer space.

Such statements and the Chinese positioning on the South China Sea and other areas rich in resources have caused some to worry that "if China gains control of cis-lunar space, there are no guarantees for fair access."[85] Moreover, there is a high risk that China will use "first presence rights" to justify lunar territorial claims, which could be hardly prevented by the unverifiable and unenforceable outer space treaty and the current ambiguity in space law. The International Institute of Space Law Position Paper on Space Resource Mining says that "in view of the absence of a clear prohibition of

79 United States-China Economic and Security Review Commission, "Hearing on China in Space: A Strategic Competition?" (2019). Accessed March 25, 2020. https://www.uscc.gov/sites/default/files/2019-10/April%2025%202019%20Hearing%20Transcript.pdf.

80 Brian Wang, "Ten Kilowatts beamed 500 meters in a proof of concept for space based solar power," Next Big Future (March 13, 2015). Accessed February 24, 2020. https://www.nextbigfuture.com/2015/03/ten-kilowatts-beamed-500-meters-in.html.

81 Staff Writers, "China's ambition after space station," Space Daily (March 8, 2016). Accessed February 24, 2020. https://www.spacedaily.com/reports/Chinas_ambition_after_space_station_999.html.

82 Namrata Goswami, "China in Space: Ambitions and Possible Conflict," *Strategic Studies Quarterly* 12, no. 1 (2018), p74-97.

83 Staff Writers, "China's ambition after space station," Space Daily (March 8, 2016). Accessed February 24, 2020. https://www.spacedaily.com/reports/Chinas_ambition_after_space_station_999.html.

84 Ibid., 16

85 Tyler Farley, "China's Space Program & Its Growing Threat to U.S. Interests," *Patterson Journal of International Affairs* (September 5, 2019). Accessed February 24, 2020. http://pattersonjournal.com/2019/09/05/chinas-space-program-its-growing-threat-to-u-s-interests.

the taking of resources in the Outer Space Treaty one can conclude that the use of space resources is permitted," opening the door for such policy of *fait accompli*.

The broader space community's lack of acknowledgement of this Chinese perspective has been synthesized as follows: "For the most part, U.S. space experts are in denial of China's space success or tend to be dismissive of how the discourse on outer space is changing: moving from either 'showing off' space technology to impress people on Earth (the hallmark of the Apollo era) or simply developing counterspace weapons for military advantage, to actually viewing space in its own right, with resources to extract (Chang'e era)."[86] Therefore, the time is coming to review international treaties and codes of conduct in outer space to accommodate for this new perspective—and the technological developments that are getting us closer to using space to access new resources.

Conclusions and Implications

In short, China has a multifarious view of the strategic purposes of space: it has built its space programs into a formidable industrial sector for national wealth and prestige, is fielding new military space systems to enable a more global set of national defense capabilities, and is setting the stage to compete for resources in space in the coming years. What this means is that the U.S., Europe, and East Asian allies and partners must recognize that China's space strategy is multidimensional, and that a lack of attention to any of these three key aspects carries pronounced risk.

Equally risky is to misread where China's interests lie and continue thinking about space under old frameworks. The U.S. has not paid special attention to the Moon until recently. Ignored by the Obama Administration, few would expect to see the Trump Administration investing again in missions to the Moon. But in March 2019, Vice President Mike Pence announced in a public speech that returning to the Moon within five years was the policy of the administration and that "the first woman and the next man on the Moon will both be American astronauts, launched by American rockets from American soil."[87] Included in the backdrop to this change in priorities are China's plans to send taikonauts to the moon by the end of the decade and build an outpost at the lunar south pole. Considering how the Chinese program has achieved its milestones fairly on schedule, such plans should be taken seriously. Pence's words have hints of the nationalistic rhetoric of the space race with the U.S.S.R. However, this time it is not about being the first to plant a flag—it is about controlling material sources for competitive advantage. It is still unknown how much this new era of exploration will tip the balance, and many commercial enterprises are still high-risk

86 Namrata Goswami, "China Has a Head Start in the New Space Race," The Diplomat (May 19, 2019). Accessed February 24, 2020. https://thediplomat.com/2019/05/china-has-a-head-start-in-the-new-space-race.

87 Jeff Foust, "Pence calls for human return to the moon by 2024," *Space News* (March 26, 2019). Accessed February 24, 2020. https://spacenews.com/pence-calls-for-human-return-to-the-moon-by-2024.

investments. But it is also worth to keep in mind that sailing to the west to reach the Indies was also a highly risky and uncertain endeavor before 1492.

The previous paragraph illustrates the fact that, although China's space strategy cannot be overlooked, it would be equally detrimental to approach it under exclusively competitive terms and threat contention. After all, China's white paper on space activities fully dedicates one of its five chapters to international exchanges and cooperation, and mentions 12 times in the entire document its intention to utilize outer space for peaceful purposes and peaceful uses to "benefit the whole of mankind." This is a message that China has tried to convey from the beginning, when Yang Liwei waved a U.N. flag along with the Chinese flag during the first manned mission in space. Thus, this would be a good moment for a renewed effort to take on the task to set international rules for outer space (ones that also take into account the defense and security uses of space), along with revising the existing space treaties (which are clearly outdated and were enacted 50 years ago under completely different circumstances). The European Union issued a Code of Conduct for Outer Space Activities in 2008, but without the participation of other stakeholders in the draft, it has not received much traction. While such initiatives are always welcome, it is an effort that must be undertaken under an international setup in order to secure support and adherence.

The strategic importance of space will only keep growing. In the security and defense domain, NATO formally declared space as an "operational domain" in November 2019. In the civil domain, NASA is leading an international effort to build a station orbiting the moon. And in the commercial domain, private development of space has been exponential since 2009, the year that marks the beginning of the so-called "Entrepreneurial Space Age."[88] Meanwhile, other countries like India are also acquiring capabilities that will put them in the group of the leading space-faring nations. In this environment, China's comprehensive approach to space should be a wake-up call for the international community to work on new treaties. Otherwise, it is conceivable to think that space will sooner or later become a domain for great power competition.

Due to its position as the dominant space power, the role of the U.S. will determine how events will evolve in space. Under the current conditions—absent of collaboration, with ITAR restrictions, and minimal dialogue—the most likely scenario is one of confrontation. While there are legitimate concerns about potential espionage activities and the scope and nature of China's space activities, a total shutdown prevents beneficial outcomes. There is room for collaboration in specific activities without compromising security, and the U.S. could consider relaxing the stringent rules on Chinese cooperation; for example, allowing Chinese taikonauts into the ISS. Space activities can play an important role in conducting informal diplomacy, as seen during

88 According to the last *Space Investment Quarterly,* Q4 2019 from Space Angels, in 2019 $5.9 billion of venture capital went to companies in the space industry, with 5% of it going to Chinese companies. Before 2009, the annual investment had never exceeded $100 million.

the Cold War between the U.S. and the U.S.S.R., best represented by the historic handshake between NASA astronaut Tom Stafford and Soviet cosmonaut Aleksey Leonov in the 1975 Apollo–Soyuz docking.

The Challenge of Integrating Space and Cyber into U.S. Security Thinking

Benjamin Bahney and Jonathan Pearl

The Trump Administration's 2017 National Security Strategy (NSS) and 2018 National Defense Strategy (NDS) describe a theory of success for military affairs in the new era of great power competition, centered on the three broad tasks of competing, deterring, and winning. These documents provide important guiding principles on how to think about the importance of the space and cyber domains in the future security environment. But as high-level documents, they do not explain *how* to integrate space and cyber capabilities into broader military planning or *why* this integration is necessary for achieving the goals set out by the NSS and NDA. This short chapter elaborates on the need for such integration, and offers some guiding principles for thinking about how to integrate them to advance U.S. and allied security.

Integration Requires Us to See Past the Silos

The Trump Administration's concept of "compete, deter, and win" includes competing with all tools of national power to gain lasting advantages, deterring actions at the local and strategic level that threaten us or our allies, and being capable of fighting and winning wars against all enemies while also achieving a sustainable and lasting peace. However, the emergence of new capabilities in cyber and space over the past two decades has radically altered the nature of competition and the requirements for designing and executing successful strategies to achieve these goals.

This new reality has spurred new research and analysis into the dynamics of cyber and space competition and its meaning for the broader strategic landscape. Cyber competition—introduced by the rise of Chinese cyber espionage, the emergence of tools like Stuxnet, hacking events into industrial control systems, and foreign election interference—has given rise to a burgeoning new literature on cyber security and cyber defense. The emergence of space as a warfighting domain and its critical role in supporting terrestrial operations is prompting a similar, though much more modest, effort to understand the ways in which anti-satellite weapons will reshape the competitive landscape. However, studies of cyber and space dynamics have been largely disconnected from discussions of broader national defense and military strategy, particularly as it relates to the evolving security challenges facing the U.S. and its allies in Europe and East Asia, and globally.

Cyber and space are newer policy areas, but the defense establishment's habit of placing technical challenges in discrete silos is not. Even the now 70-year-old enterprise of nuclear weapons strategy remains a largely separate domain of expertise in many ways. This trend toward silos as opposed to integrated strategy has

led some to argue that the U.S. should merge currently separate policy reviews for nuclear, missile defense, and other capability areas into a single document to steer us toward an integrated strategic future.[89]

The Challenges of Integrated Strategy

The logic for such an approach is strong and growing stronger. National power today depends on fully integrating space and cyber with the traditional mix of nuclear and conventional capabilities for military, diplomatic, and economic effect. The U.S. is only at the beginning stages of understanding how to integrate these complex and unlike means to advance our interests and those of our allies. Meanwhile, major power adversaries are developing their own space and cyber capabilities and are also attempting to integrate them for undermining U.S. and allied interests.[90] Our future security and that of our allies will depend on how well we identify and implement solutions to these challenges, and on whether we can do so before our adversaries figure it out.

The U.S. Department of Defense has already started building on the 2017 NSS and 2018 NDS to advance this goal from an operational standpoint. According to reporting, Vice-Chairman of the Joint Chiefs of Staff General John Hyten recently described the operational goal of integration in terms of needing to achieve "all-domain operations," or "the ability to integrate and effectively command and control all domains in a conflict or in a crisis seamlessly" and to do so against a "global competitor . . . at all levels of conflict."[91] At the direction of Defense Secretary Mark Esper, the services and the Joint Staff are currently drafting a new Joint Warfighting Concept for All-Domain Operations, which is scheduled to be completed by December 2020, and which, according to General Hyten, will "describe the capabilities and attributes necessary to operate" in an all-domain world. Meanwhile, the U.S. military has already initiated a Global Integration Exercise wargaming program to advance the Department's thinking on these issues.[92, 93, 94]

89 Brad Roberts, "It's time to jettison Nuclear Posture Reviews," *Bulletin of the Atomic Scientists* 76, no. 1 (2020), p31-36. Accessed March 25, 2020. https://doi.org/10.1080/00963402.2019.1701282

90 Defense Intelligence Agency, "Challenges to Security in Space" (February 11, 2019). Accessed February 24, 2020. https://www.dia.mil/Portals/27/Documents/News/Military%20Power%20Publications/Space_Threat_V14_020119_sm.pdf.

91 Colin Clark, "Gen. Hyten on the New American Way of War: All-Domain Operations," Breaking Defense (February 18, 2020). Accessed February 20, 2020. https://breakingdefense.com/2020/02/gen-hyten-on-the-new-american-way-of-war-all-domain-operations/?utm_campaign=Breaking%20News&utm_source=hs_email&utm_medium=email&utm_content=83536713&_hsenc=p2ANqtz-_hQ30i_4HGCHoIettV9EnTitMVukRwSN360Miedqhz9-al5tIsUOYxok4I4Lp_RhAElNHe_4CwIlcPi2sblkeknqoLpg&_hsmi=83536713.

92 Ibid.

93 Theresa Hitchens, "OSD & Joint Staff Grapple With Joint All-Domain Command," Breaking Defense (November 14, 2019). Accessed February 20, 2020. https://breakingdefense.com/2019/11/osd-joint-staff-grapple-with-joint-all-domain-command/.

94 Theresa Hitchens, "Navy, Air Force Chiefs Agree to Work on All-Domain C2," Breaking Defense (November 12, 2019). Accessed February 20, 2020. https://breakingdefense.com/2019/11/exclusive-navy-air-force-chiefs-agree-to-work-on-all-domain-c2/.

These top-down activities aimed at operational integration must be paired with additional efforts to advance integrated thinking in strategic planning. Of particular importance during these early stages of the process is revisiting and clearly defining the boundaries of competition, deterrence, and winning in the coming decades.

We believe that a useful agenda for thinking through this problem set should begin with at least the following questions:

- Which forms of space or cyber competition will complement U.S. military, diplomatic, or economic objectives and help to advance U.S. goals or interests against major power challengers like China and Russia, or regional revisionists like Iran or North Korea? Of these, which are complementary to existing or developmental capabilities or initiatives, and so could act as force multipliers?
- Which types of competition should we seek to avoid, because they don't advance our strategic objectives?
- How can space and cyber tools be integrated with other capabilities to support strategic and tactical deterrence objectives at both the global and regional levels?
- Which capabilities are likely, by contrast, to weaken deterrence and increase first strike instability if they are proliferated widely?
- Finally, how should we measure victory in future competition, and which types of space and cyber tools will be useful and necessary first for prosecuting the war and then for securing the peace?

The answers to questions like these should ultimately inform approaches to both acquisitions and operations, and so must be pursued in tandem with each.

Beyond that, bottom-up challenges abound. Expertise in defense issues remains highly stovepiped, both in terms of functional and regional expertise, meaning that we have precious few incubators for encouraging thinking about how to systematically integrate the full scope of new and advanced technologies into strategy at the regional and global levels. This problem is particularly acute in space and cyber issues because of the veil of secrecy over them, which limits the interactions and cross-fertilization that foster creative thinking and winnows out weaker ideas. One way to solve this problem is to develop integrated teams of regional-functional experts that are embedded in the combatant commands, like the Space Operations Force concept proposed by the U.S. Department of Defense in 2018.[95]

Efforts to integrate strategic planning should be pursued in parallel with efforts to integrate space and cyber policy planning, to ensure that capabilities and organization

95 U.S. Department of Defense, Report to Congressional Defense Committees, *Final Report on Organizational and Management Structure for the National Security Space Components of the Department of Defense* (August 9, 2018). Accessed February 20, 2020. https://media.defense.gov/2018/Aug/09/2001952764/-1/-1/1/ORGANIZATIONAL-MANAGEMENT-STRUCTURE-DOD-NATIONAL-SECURITY-SPACE-COMPONENTS.PDF.

at the policy level advance at a similar pace as operational capabilities. Placing space and cyber under the same policy management construct as other areas that are key for long-term competition and deterrence, like nuclear and missile defense policy, may be a promising near-term option in this regard. Though this may not represent the ideal long-term solution, the construct as of late 2019—where space and cyber fell under the Assistant Secretary of Defense for Homeland and Global Security, while nuclear and missile defense policy were the purview of the Assistant Secretary of Defense for Strategy, Plans and Capabilities—is probably not conducive to developing a fully integrated policy planning process.[96] The current plan as mandated in the 2019 NDAA to establish a separate Assistant Secretary of Defense for Space Policy is important for elevating the level of attention and resources devoted to space, but it remains questionable as to whether this shift is optimal for furthering the goal of integrating space policy and strategy development.[97]

Further, efforts to understand the ways of employing space and cyber capabilities in a fully joint and integrated fashion to offset the advantages of our competitors remain inchoate. The defense community has done a good job of focusing on how adversaries think about the cyber and space domains and how their activities are likely to challenge U.S. interests, but little has been written openly about strategic concepts for effectively competing, deterring, and winning against capable adversaries by developing or leveraging space and cyber in conjunction with other capabilities for combined effect. Indeed, the taboos surrounding the potential development and use of offensive capabilities in space, and to a lesser extent in cyber, arguably inhibit even preliminary debate about which potential future capabilities would be appropriate and useful, let alone how to effectively integrate them in a regional or global security context.[98] In this regard, it is worth noting that although the Assault Breaker concept of the 1970s may be in the early stages of being updated by study groups like the Defense Science Board, the role of cyber and space in these updates, and how they will be integrated for combined effect, remains unclear.[99]

Increasing opportunities for deliberation, interaction, and debate is essential because defense strategists and planners face highly complex challenges, for which the answers are far from clear. For instance, capabilities designed to advance one objective may in turn undermine others. Integrated strategy therefore requires not only balancing capability development for effect in a crisis or conflict, but balancing the

96 U.S. Department of Defense website, Office of the Under Secretary of Defense for Policy. Accessed March 25, 2020. https://policy.defense.gov/

97 Joe Gould and Valerie Insinna, "Congress Creating Space Force with Limited Head Room," Defense News (December 10, 2019). Accessed March 25, 2020. https://www.defensenews.com/congress/2019/12/10/congress-creating-space-force-with-limited-head-room/.

98 Karl P. Mueller, "Totem and Taboo: Depolarizing the Space Weaponization Debate," *Astropolitics* 1, no.1 (2003), p4-28. Accessed March 25, 2020. https://doi.org/10.1080/1477-760391832499

99 U.S. Department of Defense, Defense Science Board, 2017 *Summer Study on Long Range Effects* (June 2018). Accessed February 20, 2020. https://dsb.cto.mil/reports/2010s/LRE%20Executive%20Summary__Final.pdf.

interaction between capabilities across levels of crisis and conflict. A specific example should help to elaborate this challenge. Some space and cyber weapons, for instance, may carry inherent first strike advantages in cases where defense is not possible or where our capabilities are not resilient to attack. This could make a proliferation of such weapons highly destabilizing because there might be a strong incentive to use them early in a crisis. By contrast, a focus on reversible capabilities might augur in the direction of increased stability if they hamper an adversary's ability to prosecute aggressive actions. But preparing for competition at every level of escalation may require somewhat of an "all-of-the-above" approach to capability development. Thus, efforts to prepare to fight and win a conflict could also impact the risk that a low-level crisis would rapidly escalate due to first strike instability. Although such risks would probably be balanced by a strategy that fully integrates means and ends, as well as deterrence and warfighting, there is no clear solution at present for how to do so.

Conclusion: Toward an Integrated Strategy

This chapter has laid out some of the core challenges facing defense policymakers and planners in thinking about strategic competition in the 21st century, specifically the challenge of integrating space and cyber capabilities with our traditional military tools and operations. Over the next year, we at the Center for Global Security Research will focus on advancing thinking on multi-domain integration, specifically focusing on space and cyber. We will consider the implications of the different choices that defense policymakers will be faced with, including the key issues of the arms race and first strike stability. An essential part of this effort will be connecting with and connecting defense thinkers and planners to build the community necessary for advancing these goals.

“The U.S. military space community has been slow to develop the strategic thought needed for this new era—dangerously so. New strategic thought requires an understanding of the unique characteristics of the space environment and of military practice and national policy, both past and present. But it requires so much more: a sound understanding of the nature of long-term competition, potential 21st century conflicts and their potential escalation dynamics, and the intersection of technological change and operational art. Lawrence Livermore National Laboratory has carved out a role as a catalyst for this kind of thinking and as an honest broker of the relevant communities of interest, including the private sector and U.S. allies. This latest contribution adds important new insights to our understanding of the requirements of successful long-term competition in space.”

Jay G. Santee
Major General, United States Air Force (retired)

Lawrence Livermore National Laboratory