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600 Chennault Circle
Maxwell AFB AL 36112-6010
email: JIPA@au.af.edu

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SENIOR LEADER PERSPECTIVE

Fortifying Stability in Space

Establishing the US Space Force

Lt Gen Nina M. Armagno, US Space Force

No, the US Space Force (USSF) is not a joke. While many people negatively associate the USSF with former President Donald Trump and mock its existence in pop culture (thank you Netflix), the nation's newest service in more than 70 years is working diligently to fortify stability in space. When I joined the US Air Force, I never thought space would become a new service, and it came as a surprise to all of us when the USSF was established in 2019 with the enactment of the FY20 National Defense Authorization Act. The United States now, more than at any point in its history, depends on space systems for its national security—and much more so than any other country.[1] While the USSF was established in 2019, for the past 60 years, space capabilities have become increasingly essential to the way a modern military conducts operations. The Joint Force community relies on space for weather, surveillance, intelligence, communications, early warning, and positioning, navigation, and timing services. Space capabilities have many touchpoints with not only the military but also everyday citizens. When you wake up in the morning and check the weather on your smartphone, you can thank the USSF (among others) for that capability.

The USSF plays a crucial role in the comprehensive defense strategy of integrated deterrence, aimed at preventing conflicts through the coordinated utilization of all aspects of national power. This includes joint force actions across various domains, working in collaboration with our valued allies and partners.[2] In the early days of establishing the USSF, there was one member: the Chief of Space Operations (CSO). I had been asked to come over to help the new service, and I was wearing all the hats except the S1 (Personnel). So that was S2 (Intelligence), S3 (Operations), S4 (Logistics), S5 (Strategy and Requirements), S6 (Cyber and Communications), S8 (Plans and Programming), S9 (Analysis), and S10 (Nuclear). We had a lot of work to do to design the force, establish offices and processes—all to ultimately organize, train, and equip Guardians to maintain and preserve US freedom of operations in space. I had many roles in executing the CSO's Planning Guidance (CPG) that provided the first strategic direction for the USSF as a lean, agile, and

[1] Forrest E Morgan, Deterrence and First-Strike Stability in Space: A Preliminary Assessment (Santa Monica, CA: RAND, 2010), III, https://www.rand.org/.

[2] "Fact Sheet: 2022 National Defense Strategy" (fact sheet, DOD, 2022), https://media.defense.gov/.

innovative service—designed to move at a speed to stay ahead of adversaries.[3] Prior to 2014, there was little understanding of the threats posed by our adversaries in space. However, the announcement of the Space Enterprise Vision by the Air Force Space Command marked a significant turning point as it explicitly acknowledged and tackled vulnerabilities within the space architecture.[4] Prior to that point, the space domain was generally considered a benign environment, affording us the luxury of dedicating ample time to developing sophisticated satellites without prioritizing defensive capabilities. It proved surprisingly challenging to convey to Pentagon leadership the extent of vulnerability our systems faced from adversaries' threats. No, to be totally honest, it was like an explosive knife fight for funding, human resources, and even physical workspace within the Pentagon—all in the pursuit of modernizing our space capabilities.

In 2016, the knife fight began for me as we introduced concepts for a resilient space architecture to the Pentagon, initiating an extensive series of meetings to disseminate and discuss these ideas. Throughout this process, we engaged in hundreds of sessions to foster understanding and gather valuable feedback. Educating senior leaders that we had to adjust our acquisition strategies to create a space infrastructure that could take a punch and continue to operate under attack was met with brick-walled resistance. However, once we conducted a comprehensive cost-comparison analysis on adopting new technology, we successfully halted the acquisition of Space-Based Infrared System (SBIRS) satellites 7 and 8. This allowed us to redirect our focus toward acquiring the necessary technology for building resilient space capabilities.

The Space Force is now shifting away from the outdated SBIRS system and embracing a modernized approach. This entails developing a multi-orbit, distributed, and proliferated constellation of satellites that offer enhanced capabilities and improved survivability, all while achieving cost effectiveness. Specifically, the Next-Generation Overhead Persistent Infrared (Next-Gen OPIR) will serve as a direct placement for the existing SBIRS system, ensuring the continued provision of critical capabilities such as missile warning, missile defense, battlespace awareness, and technical intelligence. Designed to withstand and counter emerging threats from adversaries in space, Next-Gen OPIR offers enhanced survivability. Furthermore, this advanced system will not only track emerging infrared (IR) threats in space but also expand its scope to monitor and track emerging IR

[3] Chief of Space Operations' Planning Guidance (Washington, DC: USSF, 9 November 2020), https://media.defense.gov/.

[4] "Hyten announces Space Enterprise Vision," Air Force Space Command Public Affairs, 13 April 2016, https://www.af.mil/.

threats on land and in the air. This broader coverage contributes to bolstering our overall situational awareness and enables more effective response strategies.

In 2021, we established the Space Warfighting Analysis Center (SWAC) as a pivotal force in shaping our space acquisitions strategy. The SWAC's primary objective is to develop and deliver authoritative Force Design guidance to the USSF. These activities performed by SWAC are part of a larger capabilities development ecosystem that encompasses requirements generation, streamlined governance, unity of effort across acquisitions, and integrated test and evaluation.

Despite facing criticism from Congress as a potential redundancy, the SWAC core responsibilities involve conducting analysis, modeling, wargaming and experimentation. These efforts are essential in formulating operational concepts and providing crucial Force Design guidance.[5] Force Design serves as the framework to identify and integrate a comprehensive suite of capabilities that fulfill our key responsibilities, which include preserving freedom of action in space, enabling Joint Force lethality, and offering independent technology options.

Furthermore, the SWAC plays a vital role as an innovation expediter facilitating partnerships with industry to accelerate our modernization efforts. Employing a model-based systems engineering (MBSE) approach, SWAC enables comprehensive assessments of system and architecture description, concept designs, and affordability analyses throughout the lifecycle of Force Design. This systematic approach ensures informed decision-making and efficient resource allocation.[6]

From my perspective, a potential conflict with China could manifest without traditional shots being fired and instead take the form of a purely cyber and space war. Congress now recognizes China as a pacing threat in the space domain, and both China and Russia consider space as a critical war-fighting domain. While the USSF's USD 30-billion budget doubled from FY20 to FY24, and the USD 2.6-billion research, development, test, and evaluation (RDT&E) budget increased 16 percent, there are challenges to rapidly acquiring technology that the US Air Force has been working on for years. Recognizing these challenges, the Honorable Frank Calvelli, Assistant Secretary of the Air Force for Space Acquisition and Integration, released a memorandum on 31 October 2022.[7] The memorandum aims to solidify the Department of the Air Force's priorities, philosophy,

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[5] Theresa Hitchens, "Space Force Vice Argues Value Of Embattled Analysis Center," *Breaking Defense*, 28 July 2021, https://breakingdefense.com/.

[6] "USSF SWAC Business Fair," Sam.gov, 10 September 2021, https://sam.gov/.

[7] "Air Force President's Budget FY24," Financial Management & Comptroller, 2023, https://www.saffm.hq.af.mil/.

and tenets for space acquisition.[8] It emphasizes the need to prioritize speed in acquisitions, establish resilient space architectures, and integrate the space domain with other domains to provide the Joint Force with a strategic advantage against potential adversaries.

In addition to energizing our acquisitions efforts, we have embarked on strategic partnerships with like-minded countries to enhance our space capabilities. As one example, in November 2022, I had the amazing opportunity to travel to Australia and engage with our esteemed Australian counterparts.[9] During this visit, I was honored to be invited as a speaker at the Australian Strategic Policy Institute's Space Masterclass and National Security Space Dinner, held at the iconic Sydney Opera House. The audience comprised representatives from Australia, Japan, Canada, the United States, and the United Kingdom, and I had the privilege of discussing defense perspectives on the significance of space.

An essential component of the successful partnership between the United States and Australia is the Space Surveillance Telescope (SST) program. In 2013, both countries agreed to relocate the SST from White Sands Missile Range in New Mexico to Naval Communication Station Harold E Holt in Western Australia. This move not only added a new vantage point for space domain awareness in the Southern Hemisphere but also solidified the collaborative efforts between our nations in enhancing space surveillance capabilities.[10]

As we press ahead in the space domain, the international community increasingly recognizes the importance of space to military operations. Space underpins NATO's ability to navigate and track forces, maintain robust communications, detect missile launches, and ensure effective command and control. Notably, more than half of active satellites orbiting the Earth belong to NATO members or companies based within their territories.

In 2019, NATO adopted the organization's *Space Policy*, acknowledging space as a distinct operational domain, alongside air, land, maritime and cyberspace.[11] This policy serves as a guiding framework for NATO's approach to space and ensures the Alliance receives vital space-based support for its operations and missions, including areas such as communications, navigation, and intelligence.

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[8] Frank Calvelli, Assistant Secretary of the Air Force, to Department of the Air Force Space Acquisition Workforce, memorandum, subject: Space Acquisition Tenets, 31 October 2022, https://www.safsq.hq.af.mil/.

[9] Secretary of the Air Force Public Affairs, "Space Force Builds Partnership with Australia," *MilitarySpot.com*, 6 December 2022, https://www.militaryspot.com/.

[10] Sandra Erwin, "Space surveillance telescope developed by the U.S. begins operations in Australia," *SpaceNews*, 30 September 2022, https://spacenews.com/.

[11] North Atlantic Treaty Organization, "NATO's overarching Space Policy," 17 January 2022, https://www.nato.int/.

During the February 2023 Defence Ministers' meeting, 16 NATO allies, together with NATO invitees Finland and Sweden, agreed to develop the Alliance Persistent Surveillance from Space (APSS) initiative. This significant step will foster enhanced cooperation among NATO members in the realm of space-based surveillance, ultimately supporting the implementation of NATO's overarching *Space Policy*.[12]

Discussing the international community and space would be incomplete without addressing the situation in Ukraine. Our dedicated Guardians work tirelessly around the clock to ensure that our space capabilities remain operational not only for our nation and the Joint Force but also for the entire world. It is well understood by our potential adversaries that space plays a critical role in empowering military operations, as evidenced by the targeted attacks on space capabilities during the ongoing conflict in Ukraine.

To support Ukraine, the United States, along with its allies and partners, has been providing Kyiv with various GPS-enabled weapon systems. The utilization of space capabilities, including commercial ones, has played a crucial role in alerting the world to imminent attacks, maintaining communication networks within Ukraine, and sharing intelligence to strengthen the resolve of our alliance.

Meanwhile, Russia is actively pursuing space attack capabilities with the aim of neutralizing or denying space-based services, both military and commercial. Moscow perceives space-enabled information collection and transmission as pivotal in deciding the outcome of conflicts. Indeed, the Russian invasion of Ukraine commenced with a Russian cyberattack targeting a commercial satellite network. Furthermore, Russia has attempted to counter Ukraine's use of GPS, communications, and radars through the application of electronic warfare systems. These developments underscore the fact that modern warfare, even in the context of a significant land-based conflict in Eastern Europe, is now multi-domain, incorporating various domains such as cyber, space, and electronic warfare.

The USSF has been presented with an extraordinary opportunity to collaborate with partners in advancing common values, establishing behavioral norms, fostering shared capacity, and aligning military space efforts. Through these partnerships, we aim to create an environment in the space domain that promotes security, stability, and sustainability for all responsible actors.

One of the key ways in which the USSF contributes to shaping norms is by building stronger international partnerships and setting a positive example

[12] North Atlantic Treaty Organization, "16 Allies, Finland and Sweden launch largest space project in NATO's history," 15 February 2023, https://www.nato.int/.

through responsible operations.[13] In February 2022, the United States, alongside Australia, Canada, France, Germany, New Zealand, and the United Kingdom, jointly released the *Combined Space Operations Vision 2031*. This initiative addresses the overarching imperative of promoting responsible space utilization, acknowledging the challenges to space sustainability, the threats posed by technological advancements, and the increasingly comprehensive and aggressive counterspace programs of other nations.

The Vision outlines the overarching purpose of the initiative and highlights its guiding principles. These principles encompass the freedom of use of space, the responsible and sustainable utilization of space, the importance of partnering while respecting national sovereignty, and the commitment to upholding international law. By adhering to these principles, the USSF and its partners strive to shape a cooperative and rules-based framework for space operations that benefits the international community as a whole.

To maintain and preserve US freedom of operations in space, the USSF has established dedicated components to support commanders in regions where potential threats arise. In a ceremony held on 22 November 2022, at Camp H.M. Smith, the USSF officially activated and assigned US Space Forces, Indo-Pacific (USSPACEFOR-INDOPAC) to the US Indo-Pacific Command (USINDOPACOM).

The primary role of USSPACEFOR-INDOPAC is to provide USINDOPACOM with a team of highly skilled space experts. These experts collaborate with allies and partners to integrate space activities into shared operations, activities, and investments. By doing so, USSPACEFOR-INDOPAC enhances the security landscape extending from the Indian Ocean across South and East Asia to the western coast of the United States. Moreover, USSPACEFOR-INDOPAC plays a pivotal role in promoting regional stability and advancing US partnerships within the Indo-Pacific region.

In addition to the establishment of USSPACEFOR-INDOPAC, the USSF has also created two component field commands specifically tailored for US Central Command and US Forces Korea. These commands provide dedicated support and expertise in space-related matters to their respective commands, ensuring the effective integration of space capabilities and operations into their overall strategies and activities.

Space has now taken center stage, and it is truly an exciting time. I am grateful for the opportunity to shed light on how the USSF was established. The impact

[13] "DoD and Partners Release Combined Space Operations Vision 2031" (press release, DOD, 22 February 2022), https://www.defense.gov/.

of space on our daily lives is undeniable, and ensuring the protection of this vital realm is a matter of great importance to me.

However, I would like to circle back to the Netflix series about the Space Force. I must admit that the first few episodes were quite hilarious. Interestingly, it seemed to poke fun at the US Coast Guard more than the Space Force itself. I found it ironic that the show depicted a rivalry between the US Air Force and the Space Force because in reality, the Space Force emerged from the Air Force, and we rely on the Air Force for numerous aspects of our operations. It is truly a genuine partnership within the Department of the Air Force, where collaboration and cooperation are integral to our success. ✪

Lt Gen Nina M. Armagno, US Space Force

Lieutenant General Armagno is the Director of Staff, Headquarters, US Space Force, the Pentagon, Arlington, Virginia. In this role, she synchronizes policy, plans, positions, procedures, and cross functional issues for the US Space Force headquarters staff.

Lieutenant General Armagno earned her commission and graduated from the US Air Force Academy in June 1988. She is a career space operator with more than 35 years of operational experience. She is the first lieutenant general commissioned in the USSF and is the only person to have commanded both launch wings in the US Air Force. Prior to her current assignment, she was the Director, Space Programs, Office of the Assistant Secretary of Defense for Acquisition. She directed the development and procurement of space programs for the Air Force and crafted program strategies for representing Air Force positions to Headquarters US Air Force, the office of the Secretary of Defense, Congress, and the White House. She has also served as Director of Plans and Policy, US Strategic Command, Offutt Air Force Base, Nebraska. She was directly responsible to the USSTRATCOM Commander for the development and implementation of national security policy and guidance, military strategy, and space and nuclear weapons employment policy and concepts. In addition, she has held command positions at multiple levels, including squadron, group, wing, and installation as well as staff assignments at Headquarters US Air Force, Headquarters Air Force Space Command, Headquarters 14th Air Force and the 381st Training Group, and has served as an Air Force Legislative Fellow in the Office of Congresswoman Ellen Tauscher. Lieutenant General Armagno is a member of the Council on Foreign Relations

SENIOR LEADER PERSPECTIVE

Space Force Service Components Join the Fight

Brig Gen Anthony Mastalir, US Space Force

Abstract

In its third year of existence, the US Space Force fielded combat-ready forces in the presentation of service components assigned to combatant commanders. On order of the Secretary of Defense, US Space Forces Indo-Pacific was the first of these component commands to activate and begin integrating across all domains to maintain a free and open Indo-Pacific. However, the value proposition of activating space components extends into building better partnerships with allies and partners in the region—as well as new ventures in the commercial space industry.

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Over the past three years, the United States has placed increased emphasis on the space domain, making bold investments at the start of what President Biden has called the "decisive decade" with strategic competitors around the globe.[1] This flurry of organizational change within the Department of Defense kicked off with the 2020 National Defense Authorization Act, which immediately launched the US Space Force (USSF) into existence. The service's mission is to organize, train, and equip Space Forces to protect US and allied interests in space and *to provide space capabilities to the joint force.* Consistent with the other services, the USSF has created new component field commands to present forces to combatant commanders, the first of which the Secretary of Defense assigned to US Indo-Pacific Command (USINDOPACOM) late last year. The new command is called US Space Forces Indo-Pacific (USSPACEFOR–INDOPAC) and is headquartered at Joint Base Pearl Harbor–Hickam, Hawaii.

The USSF's contribution to the war fighters in USINDOPACOM could not come at a more critical juncture in US national security affairs. China has made unprecedented investments in its on-orbit capabilities over the past three years, launching more than 160 new satellites in 2022 alone and developing orbital and suborbital spaceplanes. While many strategists are rightly concerned about China's (and Russia's) fielding of antisatellite weapons—designed to degrade or destroy US satellites in space—it is important to note that much of China's space

[1] National Security Strategy (Washington, DC: White House, October 2022), preface, https://www.whitehouse.gov/.

investment enables its long-range precision strike capability within the first and second island chains. Space has become a critical enabler to People's Liberation Army (PLA) forces, which are tasked with backing China's rising challenge to the rules-based international order. As a result, it is increasingly likely that USSF Guardians will need to defeat China's space capabilities to secure US interests and protect the lives of Soldiers, Sailors, Airmen, Marines, and Guardians assigned to USINDOPACOM. In his statement to Congress earlier this year, Gen B. Chance Saltzman, USSF's Chief of Space Operations (CSO), explained, "the Space Force has two fundamental missions: to provide essential services to the joint force and to protect the joint force from adversary hostile uses of space systems. The ability to perform these missions is at risk today and that risk is increasing over time."[2]

The activation of a USSF component in Hawaii is a significant step toward achieving the national security priorities and objectives in the Indo-Pacific. It provides the commander of USINDOPACOM with a subordinate commander who can focus on the space domain and further synchronize operations across all war-fighting domains. At a minimum, the new command must optimize space effects across all the other service components operating in the area of responsibility, including satellite communications, overhead persistent infrared missile warning, precision navigation and timing, and weather.

While these capabilities are essential to the daily operations of our war fighters, establishing and maintaining space superiority over the terrestrial battlespace becomes imperative if competition escalates to crisis or conflict. The component plays an important role in articulating the combatant command's requirements back to the service, as Guardians in-theater are immersed in the mission and know better than anyone what the requirements are to get the job done. In demonstrating the ability to execute, the component becomes an important aspect of integrated deterrence.

A USINDOPACOM Space Force component also has the potential to enhance partnership capacity. The CSO refers to this as *Partnering to Win*, and civil space has a rich history of international collaboration. The Apollo program is a notable example, with allies and partners providing significant assistance, such as Canada providing the landing gear for the Eagle lunar lander and Liechtenstein designing the protective coating used by the Apollo astronauts and their equip-

[2] *Department of the Air Force Posture Statement, Fiscal Year 2024, Department of the Air Force Presentation, Before the Committees and Subcommittees of the United States Senate and the House of Representatives*, 118th Cong., 1st sess., (2023) (statement of Frank Kendall, Secretary of the Air Force; Gen Charles Q. Brown, Jr., Chief of Staff, USAF; and Gen B. Chance Saltzman, Chief of Space Operations, USSF), 3, https://www.appropriations.senate.gov/.

ment. Australia hosted the ground station that received the footage of Neil Armstrong's first steps on the moon. The International Space Station is another prominent example of what can be accomplished when nations collaborate in space. Currently, 15 countries (plus the European Space Agency) participate in the program, with an increasing number of commercial companies providing support as well.

Since its inception, the USSF has been committed to collaborating with like-minded nations interested in national security space. This commitment was underscored by the recent International Space Chiefs Forum hosted by the CSO, where space chiefs from 17 nations gathered in April 2023 to discuss collaboration. During the forum, General Saltzman highlighted the benefits of establishing subordinate commands around the world to enhance cooperation with allies and partners.

The USSPACEFOR–INDOPAC has moved out expeditiously, meeting with military leaders from 12 nations across the Indo-Pacific to advance international cooperation and collaboration efforts to address security concerns in the region. To further strengthen the ironclad alliance with the Republic of Korea, US Space Forces Korea, a subordinate unit, was established to support US Forces Korea. In the recent Freedom Shield exercise, efforts to better integrate space have significantly bolstered security and stability on the Korean Peninsula and across Northeast Asia.

The planning for a similar unit to augment US Forces Japan is currently underway, which aims to increase space participation in key exercises like Keen Edge and better facilitate collaboration on projects of mutual interest. One such project is Japan's Quasi-Zenith Satellite System Hosted Payload (QZSS–HP), which is designed to place US space domain awareness (SDA) sensors on Japan's premier precision navigation satellites. Collaborating with Japan's new Space Operations Group, which is focused on SDA, will create opportunities to set the conditions to ensure US forces maintain a readiness posture to successfully execute regional operations.

Collaborative efforts in the space domain with Australia were already strong even before the unveiling of the Australia–United Kingdom–United States (AUKUS) alliance, and the pace has only increased. Space integration with Australia in exercises such as Pacific Sentry is on track to reach an unprecedented level of allied cooperation. Australia's support for acquisition programs like the Deep Space Advanced Radar Capability (DARC) remains critical to enhancing SDA from locations in the Southern Hemisphere. Moreover, Australia's recent *Defence Strategic Review* calls for structural changes within the nation's Defence Space Command, as well as

a defined career path for space professionals. Both changes will facilitate increased cooperation with USSPACEFOR–INDOPAC Guardians.

India represents a potential growth area for increased cooperation and collaboration in national security space initiatives, particularly in the areas of SDA. The United States and India held their first strategic space dialogue in 2015, and India's interest in space security has continued to increase in subsequent years. In 2019, India conducted its first direct-ascent antisatellite (ASAT) test for deterrent purposes, marking a significant departure from its previous policy of primarily focusing on maintaining the peaceful use of space. India, like many Indo-Pacific allies and partners, has recognized that simply demonstrating an ASAT capability is insufficient to defend against China's expanding space weapons arsenal. As like-minded, space-faring nations continue to explore international norms of behavior in space, definitions of hostile intent or hostile acts, and the inherent right of self-defense, India's contributions to the dialogue will be crucial.

The CSO's *Partnering to Win* strategy also encompasses commercial space, which has gained a steadily increasing market share over the past five years. Much of this success can be attributed to SpaceX, whose early efforts to reduce the cost of access to space coincided with the United States' decision to eliminate its dependency on Russian-made RD-180 engines. SpaceX's Falcon Heavy, which was put into service in 2018, now provides the most economical spacelift ever available, at a mere USD 1500/kg to low Earth orbit. This price point has enabled business cases once deemed impossible, resulting in an explosion of new commercial space opportunities that have fundamentally altered the paradigm under which we operate.

Consider that at the start of Russia's invasion of Ukraine, it was widely believed that Russia entered the conflict with space superiority, with a significant advantage over its adversary in every category. However, in a matter of months, no less than eight different commercial space companies answered Ukraine's call for support. As a result, some argue that Ukraine effectively achieved space parity without launching a single rocket, thanks to the contributions of commercial vendors.

The USSF components play a vital role in leveraging commercial space capabilities. Since activation, USSPACEFOR–INDOPAC has engaged with numerous commercial companies to explore how their offerings can address the unique war-fighting challenges in the Indo-Pacific. This effort is likely to lead to various demonstrations and exercises aimed at bolstering US and allied efforts to maintain a free and open Indo-Pacific. For example, commercially available tactical remote–sensing capabilities can ably augment existing collection strategies, providing redundancy for high-value collection. Multiple concepts are under development to perfect rocket cargo or just-in-time logistics provided by a deorbiting

platform. The concept of responsive launch, which has eluded military programmers for more than a decade, may finally have a viable business case. On-orbit refueling options will fundamentally change the way we think about maneuvering within the space domain. In addition, developments in applied materials and additive manufacturing are likely to render ideas and concepts previously dismissed a reality. The commercial space market is on a trajectory to revolutionize the way we think about capability acquisition.

The decision to integrate USSF components into combatant commands was the logical step toward normalizing operations across the Joint Force. For far too long, space operators and planners have operated independently of their terrestrial war-fighting counterparts, hidden away in a top-secret vault. With the commander of USSPACEFOR-INDOPAC now seated alongside counterparts in the air, land, and maritime domains, we can enhance the integration of capabilities at the operational level of war. This will enable us to fully exploit the combat capabilities derived from space-based assets. The value proposition for the USSF components is even greater when we partner across the components, including our allies and partners in the region, and explore opportunities brought about by commercial space ventures, USSPACEFOR–INDOPAC stands ready to make an impact on the US ability to compete and, if necessary, prevail in crisis or conflict. Semper Supra! ✪

Brig Gen Anthony Mastalir, US Space Force

Brigadier General Mastalir is the first commander of US Space Forces Indo-Pacific, headquartered at Joint Base Pearl Harbor–Hickam, Hawaii. The component field command plans, coordinates, supports, and conducts employment of space operations across the full range of military operations and security cooperation in support of US Indo-Pacific Command objectives. Brigadier General Mastalir earned his commission as a distinguished graduate of the Northwestern University Air Force Reserve Officer Training Corps. He is a credentialed Guardian, having completed a series of operational, staff, and command assignments in spacelift and range operations, satellite command and control, space electronic warfare, space policy, space security and defense, legislative affairs, and joint operations. He has commanded at the Air Force squadron, group, and wing levels and at the Space Force delta level, and has deployed in support of Operations Inherent Resolve, Freedom's Sentinel, Spartan Shield, and Allies Refuge.

FEATURE

Small States in Space

Space Club Relevancy and National Interest Influence

Wing Commander Mark Waters, Royal New Zealand Air Force

Abstract

This article analyzes how small states can enhance their importance within the "space club" and improve their capacity to attain national objectives. The study assesses the approaches taken by five successful small states to achieve their space-related interests and evaluates their effectiveness. The research demonstrates that small states can gain relevance within the space community by leveraging their unique attributes or identifying gaps in the space ecosystem. This relevance can help small states gain improved access to space services, enhance security, drive economic growth, and have a stronger voice in international space forums. The research provides valuable insights for small states seeking to participate in the space club and aims to inspire them to believe that they too can gain relevance within the space community and advance their national interests through space. This article is relevant to scholars and policy makers interested in space diplomacy and the role of small states in global governance.

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By all but the narrowest definitions, most of the world's states are small states.

—Tom Long

Reliance on space is integral to almost every facet of life on Earth, from communication, navigation, finance, and weather monitoring to national security–focused applications such as surveillance, missile warning, and command, control, communication, and information (C3I) services. Historically a limited number of nations have dominated access to, and the use of, space, but the evolution of technology has lowered the barriers of entry into space. Because of this trend, the world is now experiencing an exponential increase in interest and utilization of space by states of different sizes and development levels.[1] According to the Union of Concerned Scientists' satellite database, the number of active satellites in space has increased from 217—primarily owned and operated by the European Space Agency (ESA), United States, Russia, and China—at the

[1] *Challenges to Security in Space* (Washington, DC: Defense Intelligence Agency, January 2019), 7, https://www.dia.mil/.

end of 2005 to more than 5,465 operated by more than 74 countries currently, as a result of the national opportunities that space provides.[2]

In her book *The Power of the Space Club*, Deganit Paikowsky coined the term *space club*. She argued that membership in this club was limited and controlled by a small number of states who held relevancy in space due to their capabilities, technologies, or previous accomplishments.[3] She proposed that membership in this space club was not automatic and required certain capabilities—such as manufacture of satellites, launch capability, and human spaceflight—before recognition and acceptance of membership by the other members. In the Cold War period, membership in the space club consisted primarily of the Soviet Union and the United States, who were the first nations to possess the above space capabilities. At a lower tier were "nations with a collective capability to develop, maintain and control their satellites, such as members of the ESA."[4] More recently, advancements in technology, changes in geopolitics, and commercial interest in space have progressively made access to space and the ability to design and manufacture space technologies easier. The result is increased membership in the space club.[5]

India, for example, has formally targeted space as a mechanism to achieve its socioeconomic, security, and prestige interests both nationally and on the global stage. With a focus on partnering with and providing cheap launch capabilities for other nations, India has also invested in developing a sovereign space industry capability. This investment in space has seen India launch more than 350 satellites and even conduct an antisatellite (ASAT) test in its efforts to become a recognized member of the space club with relevancy and the ability to influence and enhance New Delhi's terrestrial and space interests.[6] While India has clear reasons for pursuing a sovereign space capability and a leadership stake in the space club, other nations also considering or pursuing a stake in space do not have comparable size or resources. Despite this, small states continue to pursue and invest in space capabilities. This raises the question of why states, particularly small states, would seek to invest in space capabilities.

While prestige, economic growth, and enhancement of national security are commonly touted reasons for states to invest in space, this article proposes that the surge in states seeking to create space capability is being driven by a desire to

[2] "Satellite Database," Union of Concerned Scientists, 2023, https://www.ucsusa.org/. The total number of states operating satellites in space in 2005 was 23.

[3] Deganit Paikowsky, *The Power of the Space Club* (Cambridge, UK: Cambridge University Press, 2017).

[4] Paikowsky, *Power of the Space Club*, 22.

[5] Paikowsky, *Power of the Space Club*, 23.

[6] Ajey Lele, "India in Space: A Strategic Overview," in *Handbook of Space Security Vol. 1*, ed. Kai-Uwe Schrol (New York: Springer, 2020), 574, https://doi.org/.

gain relevancy in the space club and to use those capabilities and relevancy to positively influence their own national interests.

What Is a Small State in the Context of Space?

When considering the hierarchy of states and their power, it is common to consider their instruments of power—political, economic, military, or information—and rank or apportion each state and its influence accordingly. While there is general agreement on which nations can be considered great powers, delineation of middle and small powers (or states) is not as simple. The concept of *small state* has therefore "typically been based on the amount of resources the small state possesses, that is, not very many."[7] Often, small states may not have attained higher status due to imbalanced sources of power, such as large territories or resource bases, but small populations (as is the case with Australia or Canada) or, conversely, having large populations within a small geographic area (such as Japan and Singapore). These conflicting sources of power also typically have an impact on the economic performance of the state and ultimately make it difficult for such states to exert their influence globally. Any influence that is gained is predominantly developed through relationships with larger states. These relationships bring the "great power politics, institutionalization, economic governance, and the normative environment" set by those great powers, which typically shapes how those relationships function.[8]

Similarly, "the systemic level of analysis, particularly as linked to structural realism, has tended to emphasize great powers, and obscure the role of small states" in guiding global events and actions.[9] Small states have been effectively relegated to a second tier of international relations scholarship, leading to a lack of research or consensus on what defines a state as small or medium.[10] More importantly, there is little research on how such states can increase their relevance and influence to "box above their weight" globally and gain a voice in international forums, bilateral relationships, and interstate engagement. This lack of attention also applies to the space environment, where small states are often overlooked despite their potential to contribute significantly to the space industry.

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[7] Tom Long, "Small States, Great Power? Gaining Influence through Intrinsic, Derivative and Collective Power," *International Studies Review* 19, no. 2 (June 2017), 188.

[8] Tom Long, *A Small State's Guide to Influence in World Politics* (New York: Oxford University Press, 2022), 15.

[9] Long, *A Small States Guide*, 17.

[10] Long, *A Small States Guide*, 2.

Historically, great powers have dominated space, and this remains the case today. This situation is evolving and an increasing number of small and medium states are developing space capabilities as they recognize the significance of space for their futures. However, there is little research and guidance available on how these small states can shape their space programs to achieve national interests and increase their relevance in future space developments and activities.

To simplify the categorization process, this article focuses on two levels, small and large, instead of the traditional small, medium, and large categorizations. A *large spacefaring state* is defined as one with multiple satellites in orbit, extensive ground stations, and a history of achievements in space at the highest levels—i.e., manned spaceflight, exploration, sovereign design/manufacture capability, and so forth. Examples of such states include the United States, China, and Russia. Also included in this category are India and Japan, which are rapidly advancing their space capabilities. Conversely, a *small state* is one with no or limited sovereign space capability and a limited space presence compared to the large states.

Using this definition, this article identifies several small states that for varying reasons are actively seeking to create or increase their capabilities and presence in space. The approaches taken by these states are identified as examples or models for other small states to consider and emulate. These small space states selected for this article are the United Kingdom, Canada, Australia, Norway, and the United Arab Emirates (UAE).[11] For differing reasons, each of these states has adopted unique approaches and capability sets to become more relevant in space and to successfully achieve their national interests.

Small State Approaches to Space

The United Kingdom

After World War II, the United Kingdom approached space with caution, even though London recognized the importance of launching satellites and operating in the space domain as a symbol of great power. In 1963, the United Kingdom initiated a space program, but its primary focus was on capitalizing on commercial opportunities and maintaining its relevance with the United States, which was leading the Western states in the space race. Key among these opportunities was British expertise in rocket engineering, which London focused on ahead of any space aspirations. But such was the United Kingdom's apathy toward space that

[11] The United Kingdom has been included as a small state due to the impacts its recent exit from the European Union have had on its space capabilities.

its eventual launch of its Prospero satellite on a British Black Arrow rocket in 1971 "was the first and last launch by Britain."[12]

By 1973, London had signed a deal with Washington that provided access to launch services in the United States. Furthermore, in 1975, the United Kingdom joined the ESA, formalizing their approach to engaging in space capabilities rather than directly developing their own national space capabilities.[13] This approach remained in place for nearly 30 years until the British government reevaluated its space policy in 2007, resulting in a renewed "space policy aimed at stimulating the domestic [space] industry."[14] In 2010, a national space agency was created with the aim to "foster innovation and help companies . . . drive long-term growth."[15]

The Brexit vote shifted the United Kingdom's position within the global space hierarchy. Despite remaining a member, the ESA terminated or reduced the United Kingdom's participation in several European Union–funded programs, including Galileo, the European Geostationary Navigation Overlay Service (EGNOS), and the EU Space Surveillance and Tracking (EUSST) program.[16] The potential loss of these capabilities raised security concerns for the United Kingdom and highlighted the need for independent space capabilities.[17] As a result of the Brexit vote, the United Kingdom suddenly became a *small state* in terms of its space capability.

The 2021 *National Space Strategy* formalized London's recognition and intention to create a world-leading space capability, as well as the goal of shifting from a "Global Britain" to a "Galactic Britain," as stated by then–Prime Minister Boris Johnson.[18] The *National Space Strategy* identified the United Kingdom's vision for space and five national goals to achieve that vision (fig. 1), with a key focus on the dual role of both the Ministry of Defence and the United Kingdom Space Agency (UKSA) in achieving the set vision and goals.

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[12] Paikowsky, *Power of the Space Club*, 96–99.

[13] Paikowsky, *Power of the Space Club*, 99. The prevailing view was that ESA participation, along with its US ties, removed the need for an autonomous space program. See also, "RAF Stations," Royal Air Force, 2023, https://www.raf.mod.uk/. As part of the collaborative approach the United Kingdom also signed intelligence-sharing agreements with the United States to allow Ballistic Missile Early Warning System (BMEWS) sites and global SDA sites to be established at RAF Base Fylingdales and Ascension Island.

[14] Paikowsky, *Power of the Space Club*, 99.

[15] Paikowsky, *Power of the Space Club*, 100.

[16] Department for Business, Energy and Industrial Strategy, "UK Involvement in the EU Space Programme," 27 August 2021, https://www.gov.uk/.

[17] Omkar Nikam, "British Space Industry: Challenges and Opportunities after Brexit," *WestEastSpace* (blog), 4 June 2020, https://medium.com/.

[18] *National Space Strategy* (London: Government of the United Kingdom, September 2021), 2, https://www.gov.uk/.

Figure 1. Visions and goals of the United Kingdom's 2021 National Space Strategy[19]

In June 2022, the UKSA published its *Corporate Plan 2022–2025*, outlining how the agency intended to meet the government's goal of becoming "one of the most innovative and attractive space economies." The plan focuses on three key elements: catalyzing investment, delivering missions and capabilities, and championing space.[20] Despite having a relatively strong economic and technical foundation, the British space industry still needed to address a significant capability rejuvenation challenge to align with its Western allies (and potential competitors) and achieve its aspiration of becoming a relevant and influential space power.[21]

To achieve such a transformation, the United Kingdom has maintained its focus on several key areas, including developing small satellite launch capabilities (both vertical and horizontal),[22] upstream satellite manufacturing (with a particu-

[19] *National Space Strategy*, 6.

[20] *UK Space Agency Corporate Plan 2022-25* (London: UK Space Agency, 18 July 2022), https://www.gov.uk/.

[21] Nikam, "British Space Industry."

[22] "What is the difference between a horizontal and vertical launch," *Orbital Today*, 3 February 2020, https://orbitaltoday.com/. Traditionally rockets are launched vertically from a ground platform. Because the

lar emphasis on small and nanosatellite design and production), increased investment in research and development (R&D), continued participation in the ESA where possible, collaboration with international partners, and advocating for behavioral norms in space within the United Nations (UN).[23] Recent assessments of the health and growth of the space industry have confirmed that the British space sector is outperforming other sectors. The United Kingdom has attracted 40 percent of the global small satellite market and is leading in almost all metrics compared to other British industries, including new entrant growth, investment, employment, GDP, and productivity.[24]

The Ministry of Defence is acting on the responsibilities outlined in the *National Space Strategy* to protect and defend national interests. In April 2021, the UK Space Command was established, and in February 2022, the Ministry of Defence published its inaugural *Defence Space Strategy*. This strategy pledged to invest GBP 1.4B over 10 years in various capabilities, including a British Global Surveillance Satellite System; a sovereign satellite navigation capability; continued investment in a sovereign positioning, navigation and timing (PNT) system; secure laser-based space communications; and the UK Skynet communications satellite network to enhance joint operations.[25] To accomplish this, and acknowledging its constraints regarding resources, cost, and schedules, the Ministry of Defence has adopted a pragmatic "own, collaborate, or access" framework. This approach allows the ministry "to get best value for money, [by] critically assess[ing] what capabilities [must be owned] on a sovereign basis, those for which [they] can

initial velocity is zero, vertical launches require considerable amounts of fuel to achieve desired orbits. Typically, this requires between one and three rocket stages, collectively propelling the payload into space. Horizontal launch utilizes an aircraft to lift the rocket (and payload) to a high altitude and deploys the rocket from there. Horizontal launch offers the advantage of reduced fuel requirement (as it is launching from a high altitude and the aircraft also provides much of the energy needed) and an ability to launch from different locations, allowing different orbits to be obtained. Due to the limitations of aircraft used for horizontal launch, however, this method does have rocket and payload weight limitations.

[23] Britain has taken a lead role in driving United Nations Resolution A/RES/75/36: "Reducing Space Threats through Norms, Rules and Principles of Responsible Behaviors."

[24] Bryce Tech, *Size and Health of the UK Space Industry 2021* (London: UK Space Agency, 2021), https://assets.publishing.service.gov.uk/.

[25] *Defence Space Strategy: Operationalising the Space Domain* (London: Ministry of Defence, February 2022), https://assets.publishing.service.gov.uk/. See also, Bleddyn Bowen, "Allies in US Space Strategy: An Agenda for Space in Post-Brexit Britain," in *Space Strategy at a Crossroads: Opportunities and Challenges for 21st Century Competition*, ed. Benjamin Bahney, (Livermore, CA: Lawrence Livermore National Lab, 2020), https://www.osti.gov/. The United Kingdom's requirement for investing in a sovereign GNSS has been subject to questioning due to the high costs associated with its development and operation, as well as the perceived unnecessary nature of such an investment considering the expected availability of both the US GPS and EU Galileo systems, particularly during times of conflict.

collaborate with allies and partners . . . and those [that can be accessed] via the commercial market."[26] This strategy enables the United Kingdom to become "more operationally independent in space, [but] not strategically autonomous."[27] Such an approach is critical for any small state with limited resources seeking to join the space club.

The United Kingdom is steadily progressing toward achieving its national space strategy goals, including establishing a launch facility in Cornwall, planning the launch of the Prometheus 2 mission with UK-manufactured CubeSats from that facility—marking the first satellites to be designed, built, and launched in the United Kingdom—and space-related industries seeing positive growth across most gross value added (GVA) segment measures.[28]

Brexit presented the United Kingdom with challenges; however, it also provided an opportunity for the country to assert itself as an independent and invested space nation.[29] While many of the ambitious goals detailed within the *National Space Strategy* have yet to be realized, the United Kingdom has made significant progress in a very short time, establishing genuine sovereign space capabilities and elevating its status in the global space community. This progress is evidenced by the growth and investment in the UK commercial space industry, as well as the adoption of a pragmatic own, collaborate, access procurement model. The United Kingdom serves as a compelling case study for how a state, which has historically relied on collaboration and partnership, can increase its relevance in space forums and enhance its ability to achieve national interests. In the case of the United Kingdom, these interests include enhancing its security, boosting economic performance, and achieving prestige as a launch nation once its capabilities are fully operational.

Canada

Canada's approach to space capability and relevancy in the space club differs from that of the United Kingdom. While London has focused on developing sovereign capabilities across all aspects of space activity, Ottawa has adopted a cooperative approach with other nations and focused internally on niche space

[26] *Defence Space Strategy*, 7.

[27] Bleddyn Bowen, *The Integrated Review and UK Spacepower: The Search for Strategy* (London: Freemans Air and Space Institute, 2019), 5, https://www.kcl.ac.uk/.

[28] Tech, *Size and Health of the UK Space Industry*. From a launch perspective, it is noted that the United Kingdom is focusing on small satellite-launch capabilities into LEO only; it is still reliant on partners for launch to GEO as per the own, collaborate, access model.

[29] Nikam, "British Space Industry."

technologies. This approach has allowed Canada to make significant contributions to international space programs and regional security, which have earned it a seat at the space club table. As a result, Canada enjoys considerable relevancy and inclusion in future partner space activities, leading to amplified success in meeting its domestic economic and security interests.

Like many nations, Canada was initially prompted to take an interest in space following the Soviet Union's launch of Sputnik. This event highlighted the potential for Canada to meet its domestic needs, given its large landmass and dispersed population. Additionally, the potential for the Soviet Union to access or attack the United States over Canadian airspace raised security concerns. As a result, Canada invested in cooperative programs with the United States, which led to "the development and launch of the first Canadian satellite, Alouette 1, on an American launcher."[30]

In 1966, after Canada's initial entry into space under the guidance of the United States, the Canadian government commissioned the *Chapman Report* to provide guidance on the future direction of its space program. The report recommended that Canada avoid investment in an extensive sovereign space capability and instead concentrate on cooperative efforts with other countries. Furthermore, the report suggested that Canada should concentrate on those capabilities that directly contributed to its unique domestic needs associated with its geography and dispersed population.[31]

Following the recommendations of the *Chapman Report*, Ottawa strengthened its strategic relationship ties with the United States and, later, the ESA. This led to the development of a space industry with the ability to domestically design, develop, and construct niche communication and Earth observation satellites. These capabilities allowed Canada to provide services to its dispersed population and monitor its northern borders.[32]

These initial space capabilities ultimately evolved into Canada identifying additional niche opportunities in space technologies to fill international capability gaps. One of the most significant of these niche technologies is the Canadarm,

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[30] Paikowsky, *Power of the Space Club*, 118.

[31] John Chapman et al, *Upper Atmosphere and Space Programs in Canada*, Special Study Number 1 (Ottawa: Science Secretariat Privy Council Office, 1967), 3–4, https://archive.org/.

[32] Canadian Space Agency, "Canadian Space Agency (CSA) - Space Science & Space Technology," 29 February 2012, https://www.asc-csa.gc.ca/. In November 1972, the Canadian communications satellite Anik A1 was launched into geostationary orbit (GEO), making Canada the first country to have a domestic communications satellite in GEO. The launch of a second communications satellite, Anik A2, in 1973 further improved the network radio, TV, and telephone services for Canadians living in the North.

which was developed as part of the US space shuttle program.[33] The Canadarm's success led to the development of advanced robotic systems such as Dextre, which have been used to reduce the requirement for human space walks.[34]

(photo taken by CSA astronaut David Saint-Jacques, May 13, 2019)

Figure 2. Canadarm2 and Dextre working on the International Space Station[35]

As a result of Canada's successful partnership with NASA and the development of the Canadarm technology, Canada was invited to send its own astronauts on the space shuttle missions. This invitation marked the beginning of the third element of Canada's space program: human spaceflight. Today, Canadian astronauts continue to be involved in the International Space Station (ISS). Canada's success and contribution in niche technologies are evident through its partnership with NASA in providing the Canadarm3 on the Lunar Gateway, and Canadian Space Agency (CSA) astronaut Jeremy Hansen will be part of NASA's Artemis II mission.[36]

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[33] Canadian Space Agency, "Space Science & Space Technology." The Canadarm is the robotic arm fitted in the equipment bay on the shuttles and enables shuttle crews to manipulate cargo to and from space.

[34] Canadian Space Agency, "Space Science & Space Technology." Following the development and introduction of the Canadarm, Canadian industry has continued to focus on advanced robotic capabilities, culminating in 2008 with Dextre, a highly dexterous robotic system that can be fitted to the Canadarm2 on the ISS to undertake exterior maintenance or repetitive tasks historically performed by astronauts.

[35] Canadian Space Agency, "Space Science & Space Technology."

[36] NASA, "Artemis," 2023, https://www.nasa.gov/. The Artemis II mission is the second scheduled mission of NASA's Artemis program. Artemis II will be the first crewed mission (four astronauts) to the moon since 1972 and aims to collect data and confirm readiness of the Artemis program to send people to the moon's surface. See also, "NASA Names Astronauts to Next Moon Mission, First Crew under Artemis" (press release, NASA, 3 April 2023), https://www.nasa.gov/.

After the initial success of the niche manufacturing and astronaut program, the Canadian government established the CSA in 1989 to govern its space activities. The CSA's mission is to "advance the knowledge of space through science and ensure that space . . . provide[s] social and economic benefits for Canadians."[37] Canada recognizes that its involvement in space and niche capabilities are strategic assets that serve its economic prosperity, security, and national identity, and therefore prioritizes scientific research. A focus on national identity is evident in the Canadian flag displayed on the Canadarms and in the astronaut program, which plays a critical role in achieving recognition and maintaining investment and growth in Canada's space industry.[38]

Rather than creating a space force like larger nations, the Royal Canadian Defence Force took a different approach to space security. In July 2022, Canada established the 3 Canadian Space Division as a subordinate organization of the Royal Canadian Air Force (RCAF).[39] This approach is common for smaller nations with limited national space assets; however, the creation of a dedicated space division with responsibility for military space capability shows Canada's recognition on the role of space in supporting its national and regional security needs.[40] Canada's regional security requirements have also resulted in the development of niche surveillance capabilities through the Sapphire and RADARSAT satellite systems.[41] These systems contribute highly valued intelligence, surveillance, and reconnaissance (ISR) and civil earth observation contributions to larger alliance efforts. They also provide Canada with access to other security-related information, similar to Canadarm's participation and access to nonmilitary international space programs.[42]

Canada's space program and continued collaboration with the United States has been successful due to its focused approach toward niche commercial and

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[37] Canadian Space Agency, " Space Science & Space Technology."

[38] Paikowsky, *Power of the Space Club*, 122.

[39] Department of National Defence, "Establishment of 3 Canadian Space Division," 22 July 2022, https://www.canada.ca/.

[40] David Pugliese, "Canada's Answer to Space Force," *SpaceNews*, 20 April 2022, https://spacenews.com/.

[41] Canadian Space Agency, "Space Science & Space Technology." Sapphire is Canada's first military satellite and is designed to monitor space debris and satellites within an orbit 3,728 to 24,855 miles (6,000 to 40,000 kilometers) above Earth. The satellite has been providing data to the United States Space Surveillance Network since January 2014. The RADARSAT Constellation Mission (RCM) is a three-spacecraft fleet of Earth-observation satellites using synthetic-aperture radar (SAR) technology to provide data for climate research and commercial applications including oil exploration, fishing, and shipping.

[42] Theresa Hitchens, "Sapphire in the Sky: Space Domain Awareness Is Canadian Space Commander's Top Priority," *Breaking Defense* (blog), 8 November 2022, https://breakingdefense.sites.breakingmedia.com/.

military space capabilities. By investing in limited but highly visible capabilities, Canada has been able to maintain and enhance its relevance in space, thus achieving its national interests. Canada's approach has been consistent and reflects Ottawa's desire to assert a distinct Canadian identity in space, promote its space economy, and ensure security across its borders and the Arctic region in cooperation with the United States. Ottawa's strategy serves as an example for other small states with limited resources, demonstrating how a focused approach toward niche capabilities can help achieve national interests related to economic growth, territorial security, national identity, and prestige.

Australia

Like Canada, Australia initially considered space as the purview of the great powers and focused its involvement on collaborating with its historical allies and utilizing space technology for communication across its vast dispersed geography. Australia provided the United Kingdom and the United States with distinct advantages due to its unique geographical location and expansive unpopulated landmass, which could be used for rocket motor/missile testing and space monitoring and control. As a result of this collaboration, the Woomera Rocket Range was developed, and Australia entered the space club as an ally and support provider, rather than a sovereign developer of space capability.[43]

Despite initial successes in communication satellite systems, ionospheric research, and contribution to British and American projects, including weapons research and the Apollo missions, ongoing indifference by Australian governments ultimately limited the development of an Australian space program.[44] The prevalent view was that "developing indigenous capability was not . . . economical for a small country like Australia."[45]

It was only in the mid-1980s that Canberra recognized the potential of space, particularly for economic development. The *Madigan Report*, a review on space, emphasized the need for government leadership in developing space capabilities, specifically in ground-sector activities, remote-sensing technologies, and international collaboration.[46] This report resulted in increased funding toward building a space industry in Australia and the development of the Australian Space Office

[43] Paikowsky, *Power of the Space Club*, 135.

[44] Paikowsky, *Power of the Space Club*, 136. In 1979, Australia launched AUSSAT, one of the world's first national communication satellite systems. NASA also used Australian sites for sounding rocket and missile tests, as well as a communications site for the Apollo missions.

[45] Paikowsky, *Power of the Space Club*, 135.

[46] Paikowsky, *Power of the Space Club*, 136.

(ASO), which aimed to encourage space-related research and development and commercially viable space-related industries.[47] However, despite growing reliance on space applications, Australia failed to develop its own sovereign space capabilities. The ASO was eventually shut down a decade after its creation due to insufficient funding.

In 2008, the Australian Senate Economics Committee released a report calling for the establishment of an Australian Space Agency and emphasized the need for the country to reduce its reliance on other nations for space technology and capability.[48] The Australian government accepted the report, and subsequently established a Space Coordination Office and published policies and principles for space utilization.[49] These developments, however, did not represent a major change in Australia's overall strategy, which continued to prioritize "the utilization of space through international and commercial partnerships rather than the indigenous development of capabilities."[50]

The 2006 *Australian Government Space Engagement* report also reflected Canberra's approach to space: "Space is important to Australians—we are sophisticated users of space. [We] secure access to the benefits of space by participating in a range of international cooperative arrangements and by purchasing products and services."[51] Australia's cooperative arrangements were dual focused. The arrangements included hosting civilian (NASA) and military satellite ground stations for the United States. This security cooperation strengthened the political and military relationship. These arrangements also provided Australia with "unusual access to classified United States space data putting it into a small, privileged class in terms of participation in specific areas of defense support operations."[52] However, in contrast to its privileged access, Australia's level of influence and relevancy within the space community remained limited.

The Australian government has recently adopted a more active approach to space due to "domestic economic factors, a fear of relative technological backwardness within the Asian region, and Australia's security needs for space-derived

[47] The Senate Standing Committee on Economics, *Lost in Space?: Setting a New Direction for Australia's Space Science and Industry Sector*, (Melbourne: Analysis & Policy Observatory, 2008), 48, https://apo.org.au/.

[48] Senate Standing Committee on Economics, *Lost in Space?,* 66.

[49] Department of Industry, Innovation, Science, Research and Tertiary Education, *Australia's Satellite Utilisation Policy 2013*, (Canberra: Australia Government, 2013), https://www.industry.gov.au/.

[50] Paikowsky, *Power of the Space Club*, 139.

[51] *Australian Government Space Engagement: Policy Framework and Overview* (Canberra: Department of Industry, Tourism and Resources, November 2006), 1, https://www.aph.gov.au/.

[52] James Moltz, *Asia's Space Race: National Motivations, Regional Rivalries, and International Risks* (New York: Columbia University Press, 2018), 161.

information about its own territory."[53] The Australian Space Agency, established in 2018, is tasked with developing the Australian space industry, regulating space-based technology in support of national interests, and leading international collaboration. The agency's *Civil Space Strategy* outlines its goals, including strengthening its relationship with the United States, increasing investment in military and commercial space capabilities, and developing niche technologies in daytime ground-based radar and optical space situational awareness (SSA) capabilities.[54] These technologies include innovative daytime space domain awareness (SDA) observation solutions, such as optical event-based target tracking systems using neuromorphic imaging techniques and deployable SDA sensors (FireOPAL), which provide Australian and allied defense forces persistent space surveillance of up to 100 objects simultaneously.[55] Furthermore, Australia's unique geographical location provides optimal access to high-inclination (polar or sun-synchronous) orbits, and with vast regions of uninhabited ocean surrounding Australia, Canberra is also considering sovereign launch capabilities.[56]

[53] Moltz, *Asia's Space Race*, 163.

[54] Australian Space Agency, *Advancing Space: Australian Civil Space Strategy 2019–2028* (Canberra, Australia: Science and Resources Department of Industry, September 14, 2022), 15, https://www.industry.gov.au/. Observing and monitoring space objects is typically conducted at night to minimize the impact of light pollution on observations and take advantage of the reflection of sunlight on space objects, which makes them more visible. However, being able to conduct SDA operations during daylight hours is a significant capability that enables a nation to monitor space 24 hours a day when combined with traditional SDA methods.

[55] Nicholas Ralph et al., "Real-Time Event-Based Unsupervised Feature Consolidation and Tracking for Space Situational Awareness," *Frontiers in Neuroscience* 16 (2 May 2022): 1–4, https://www.frontiersin.org/; and Jason Lind, "Defence Space Situational Awareness: Opportunities for Australian Industry," *Journal & Proceedings of the Royal Society of New South Wales* 153 (2020), 110, https://www.royalsoc.org.au/.

[56] Scott Wallis, "A Sovereign Launch Capability for Australia," *The Strategist*, 7 June 2018, https://www.aspistrategist.org.au/; and Robbin Laird, "Next Step in Australian Sovereign Space Launch Capability," *Defense.Info* (blog), 1 December 2020, https://defense.info/.

Figure 3. FireOPAL units deployed in Australian outback[57]

From a national security perspective, similar to the United Kingdom and Canada, the Australian military has created an Australian Defence Space Command.[58] This command, which is part of the Royal Australian Air Force, has the responsibility for protecting, operating, and supporting current space-based infrastructure, and providing assistance for joint operations around the world when required. Additionally, the Defence Space Command facilitates better coordination and collaboration with allies, particularly in fulfilling its obligations under the multinational Combined Space Operations (CSpO) initiative.[59] This space governance structure is consistent with the aforementioned small states, and could serve as a suitable framework for other small states to consider. By separating national security space elements from their economic and diplomatic space ele-

[57] "Space Domain Awareness," Lockheed Martin, 2023, https://www.lockheedmartin.com/.

[58] The Australian Defence Space Command was created in January 2022.

[59] Royal Australian Air Force, "Defence Space Command," 2022, https://www.airforce.gov.au/; and "DoD and Partners Release Combined Space Operations Vision 2031" (press release, US Department of Defense, 22 February 2022), https://www.defense.gov/. CSpO provides information sharing across participating countries (United States, United Kingdom, New Zealand, Australia, Canada, France, and Germany) and recognizes that collaboration on space is a key force multiplier. Under a common vision, the nations agree upon guiding principles and lines of effort to improve combined military space operations, foster cooperation and coordination, and collective promotion of responsible behavior in space.

ments, this model enables small state governments to develop distinctive strategies for growth and capability despite their limited resources and population.

Australia's approach to space is considered typical of a small, late-starter state. Historically, Canberra was content to let larger nations drive space innovation and provide space services, but Australia has now reached an inflection point where it recognizes the contribution that space can provide to national interests and the need to ensure ongoing access to such services. Rather than trying to do everything, Australia has assessed how to leverage its unique advantages, specifically its strategic location and geography.[60] These aspects are unique to Australia and offer both sovereign and collaborative opportunities that can be used to advance its national interests. By capitalizing on its geographic advantages, Australia is quickly becoming a state that other countries collaborate with, particularly in SDA and launch. This use of its geography is also invigorating its national space economy while deepening its collaboration with traditional security partners, especially the United States. This strengthens Australia's relevance within the space club, enabling Canberra to influence its security and economic interests.

Australia's experience shows that other small states can identify and capitalize on their unique comparative advantages. Comparative advantage theory posits that "a comparative advantage occurs when a country can produce a good or service at a lower opportunity cost than another country" and that states should focus on such activities to succeed in competition with others.[61] This can also apply to space. When a small state identifies its unique strengths or advantages over others in relation to space—such as technological expertise, location, geography, knowledge, industry, and so forth—it can determine the most effective way to enter the space club and achieve a level of relevancy that enables it to influence its own national interests.

Norway

Like Australia, Norway has recognized and capitalized on its strategic location to create relevance within the space club. Norway has been involved in space since the 1960s, with its initial activities focused on sun-synchronous (polar) launch

[60] Australia's geographic location offers advantageous access to high-inclination orbits, including polar and sun-synchronous orbits, as well as vast regions of uninhabited oceans that provide enhanced launch safety. Moreover, the majority of Australia's population is situated along the eastern and southern coastlines. As a result, there are extensive unpopulated regions in Australia that experience minimal light pollution, presenting a unique opportunity for terrestrial space observation.

[61] The theory of comparative advantage is attributed to political economist David Ricardo, who authored the book *Principles of Political Economy and Taxation (1817)*. Referenced in, "Comparative Advantage," Corporate Finance Institute, 1 December 2022, https://corporatefinanceinstitute.com/.

capability and research conducted from Andøya in northern Norway, as well as high-latitude satellite communications.[62] This early investment in space helped Oslo establish Norway as a key international node for accessing polar orbits, receiving polar orbit data from satellites, and providing communication/internet capabilities across the Arctic region.

As a cofounding member of NATO located alongside strategic sea lanes, Norway has a vested interest in security within the High North and Arctic regions. This interest was reinforced within the 2019 Norwegian *High-flying Satellites and Near-Earth Purposes* space strategy white paper, which identified how important space was to security in the region and how further investment was required both in space and on the ground due to the regional infrastructure and situational awareness being "less developed than is the case in many other areas in which NATO operates."[63] The white paper also highlighted the need for "Norway [to] play a leading role among NATO countries . . . to support military capability in the High North and the Arctic [making] Norway a more attractive partner for international cooperation."[64] Such activity includes hosting the ESA's largest ground station for the Galileo global navigation satellite system and comprehensive data-sharing arrangements with NATO members for satellites in polar orbits. More recently, Norway has announced the development of the MicroSAR satellite system, a radar satellite system optimized for maritime surveillance in Norwegian areas of interest. This satellite system will provide an independent surveillance capability for the Norwegian armed forces and support international situational awareness of Russian and Chinese activities in the Arctic region.[65]

Associated with and in support of its security and domestic requirements, the Norwegian Space Agency (NOSA), established in 1987, has supported the development of a Norwegian space industry. In addition to working with the ESA, this space industry "consists of around 40 [Norwegian] large and small companies [which] develop and manufacture everything from satellite communication terminals, earth observation satellites, to sensors . . . and sell services worldwide."[66]

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[62] Rolleiv Solholm, "The Norwegian Space Program 50 Years," *Norway Post*, 18 July 2019, http://norwaypost.no/. More than 1,000 research rockets have been launched from Andøya, and Norway was the first country to utilize satellites for inland communications.

[63] Ministry of Trade, Industry and Fisheries, *High-flying Satellites and Near-Earth Purposes: A Strategy for Norwegian Space Activities (2019–2020)* (Oslo: Parliament of Norway), 11, https://www.government.no/.

[64] Ministry of Trade, Industry and Fisheries, *High-flying Satellites and Near-Earth Purposes*, 52.

[65] Dag Stølan, "Press Release Builds Radar Satellite System for Real-Time Maritime Surveillance," *Space Norway*, 26 August 2022, https://spacenorway.no/.

[66] Norsk Romsenter [Norwegian Space Centre], "Norge i rommet og i Europa," [Norway in Space and in Europe], Norwegian Space Centre, 2016, https://www.romsenter.no/.

According to the 2019 space strategy white paper, the Norwegian government continues its investment in space infrastructure, including continued focus on climate change research in the Arctic region and the Andøya Spaceport, which aims to be the first European launch site for small satellites into polar orbits.[67] As a result of this investment in space, Norway is viewed internationally as a key player in the High North and Arctic regions across civil research and security-focused space activities.[68]

Norway has leveraged its unique location in the Arctic region and proximity to important strategic sea lanes to develop niche space-based capabilities for persistent maritime patrol awareness and communication. These capabilities position Norway as a crucial provider of polar region communication and internet capabilities and polar maritime surveillance services for monitoring shipping, combating illegal fishing, search and rescue, and oil spill detection. The provision of such regionally focused space-based capabilities situates Norway as an important contributor to global security requirements, while also addressing its own national interests. Oslo's approach of focusing on unique geography and regional requirements to become relevant in space can serve as a model for other small and geostrategically located states, including those in the South Pacific and bordering Antarctica. By identifying and taking advantage of regional or global 'gaps' in space awareness or capabilities, small states can address their own national requirements and contribute to regional security.

United Arab Emirates

Like Norway, the UAE has taken a regional approach to its space program. This approach differs, however, in that it is focused on regional leadership rather than regional technical capabilities and awareness. In 2014, Abu Dhabi recognized an opportunity to diversify from the UAE's reliance on traditional sources of income and established the United Arab Emirates Space Agency (UAESA) with the explicit aim "to develop UAE as the regional hub for outer space activities in the Middle East."[69] As a small but stable and wealthy state due to its oil exports, the UAE has targeted the creation of a knowledge-based economy that particularly

[67] Ministry of Trade, Industry and Fisheries, *High-flying Satellites and Near Earth Purposes*, 33.

[68] US Department of State, "U.S. Relations With Norway," 2022, https://www.state.gov/; and US Department of State, "Space Cooperation: Agreement between the United States of America and Norway," 23 October 2006, https://www.state.gov/.

[69] Namrata Goswami and Peter Garretson, *Scramble for the Skies: The Great Power Competition to Control the Resources of Outer Space* (London: Lexington Books, 2020), 286.

incorporates space.[70] In conjunction with the economic opportunities offered by space, the UAE has also taken advantage of the prestige opportunities available from being the first Arab nation to focus on and develop space capabilities. Such exploitation of this opportunity within the Middle East has seen the UAE quickly develop a valuable space science and technology industry and a leading role in representing the Middle East in international forums and space activities. The UAE provides an excellent example of how a small state can become relevant in space by taking on and investing in a regional leadership role.

On announcing its intent to invest in space, the Abu Dhabi stated that it wished to use space and space technologies to "help resolve global issues . . . and problems arising from shrinking resources and climate change."[71] The core of the UAE National Space Program is the Mohammad Bin Rashid Space Centre (MBRSC) which has built, developed, and operated a number of Earth-observation satellites—including KhalifaSat, one of the world's most advanced remote-sensing satellites[72]—and engaged with other space scientific communities around the world.[73] The MBRSC was also UAE's lead agency for the successful Hope Mission, which sent the Hope Probe to Mars in 2021, and continues to be involved with space exploration through the upcoming Emirates Mars Mission and the Mars 2117 program, which aim to achieve significant advancements in the development of human life support, space settlement, and exploration technologies. The MBRSC is also involved in developing lunar technologies, including the Rashid Rover, which was launched in December 2022 as part of the joint Japan–Emirates lunar mission.[74]

Compared with other Arab nations, the UAE's approach to space is unique in its openness to diversification. As part of the Space2030 Agenda, the UAE actively supports the 17 Sustainable Development Goals (SDG), which includes

[70] Naser Al Rashedi, Fatima Al Shamsi, and Hamda Al Hosani, "UAE Approach to Space and Security," in *Handbook of Space Security: Policies, Applications and Programs*, ed. Kai-Uwe Schrogl (Switzerland: Springer International Publishing, 2020), 622.

[71] Goswami and Garretson, *Scramble for the Skies*, 286.

[72] "Khalifasat," Mohammad Bin Rashid Space Centre, 2022, https://www.mbrsc.ae/. The KhalifaSat satellite is a technologically advanced remote sensing earth observation satellite that has been 100% designed and manufactured in the UAE. It is capable of capturing and transmitting high-quality, detailed images of Earth to the Mohammed Bin Rashid Space Centre (MBRSC) in Dubai. These images are utilized for monitoring environmental changes, enabling effective urban management, and supporting disaster relief efforts, among other critical services for governmental and private organizations.

[73] "About MBRSC – MBRSC," Mohammad Bin Rashid Space Centre, 2022, https://www.mbrsc.ae/.

[74] "About MBRSC."

gender balance in the space sector.[75] The UAE is making progress toward this goal, with 42 percent of MBRSC employees being female in 2020. The UAE Astronaut Programme, established in 2017, has also achieved significant milestones in this regard, including sending an Arab astronaut into space aboard the ISS and graduating the first female Arab astronaut.[76] The inclusion of female engineers and technicians within the UAE space program highlights the country's progress and willingness to promote diversity in fields that are typically male dominated in Arab nations. This approach enhances the UAE's reputation and could attract investment and partnerships from other countries.

The UAE's focus on international engagement is a key element of its space program and can provide significant relevance for small spacefaring states. Unlike many other small states, the UAE has adopted a leading role in representing the Middle East in international space forums. As part of the Space2030 Agenda for Sustainable Development, the UAE actively participates in the United Nations Office of Outer Space Affairs (OOSA) and its Committee on the Peaceful Uses of Outer Space (COPUOS), the International Space Exploration Coordination Group (ISECG), and UNISPACE+50. The UAE not only participates in these forums but also hosts meetings and conferences, providing it with a seat at the table and recognition, as well as pathways to further collaboration with other space nations. Such active international engagement satisfies a key element of the UAE's space strategy.

The UAE is actively seeking agreements and arrangements with other nations, including Middle Eastern nations that wish to enter space. An example of current collaboration is the agreement between the UAE and Japan to transport and land the Rashid Rover on the moon as part of the Emirates Lunar Mission. This mission will result in "the UAE and Japan, together, [being] the next two nations to successfully put a spacecraft on the lunar surface behind the United States, Russia and China."[77]

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[75] National Committee on Sustainable Development Goals, *UAE and the 2030 Agenda for Sustainable Development 2017* (Dubai: Ministry of Foreign Affairs and International Cooperation, 2017), https://sustainabledevelopment.un.org/.

[76] Sarwat Nasir, "Emirati women are playing a central role in UAE's space sector," *The National News*, 28 August 2020, https://www.thenationalnews.com/; and "About MBRSC." In 2019, Hazzaa Al Mansoori became the first astronaut from the Middle East to undertake a scientific mission to the International Space Station (ISS). The UAE currently boasts four astronauts who have graduated from the "UAE Astronaut Program," including Nora Al Matrooshi, who is the first Arab female astronaut.

[77] Angel Tesorero, "UAE to Send Emirati-Made Lunar Rover 'Rashid' to the Moon next Year," *Gulf News*, 14 April 2021, https://gulfnews.com/. This mission was launched on December 11, 2022, and is currently en route to the Moon. The moon landing itself is programmed for April 2023, following the arrival of the HAKUTO spacecraft and completion of system checks.

In summary, the UAE provides an excellent example of how a small state can become a leader in space by identifying regional opportunities related to space utilization and by investing in its own space industry. By taking the lead within the Middle East, the UAE has diversified its economy while gaining an international leadership position for the region. This has resulted in significant prestige within the Arab community and globally, as well as an influential voice and relevance within the space club as humankind progresses in its capabilities, norms, and behaviors in space.

Summary

The small states discussed share common themes regarding their interests in space, but each has adopted a unique approach that has enabled them to become relevant members of the space club. As a result, each country has been able to influence the achievement of its national interests. Table 1 summarizes the five small states' reasons for pursuing space capabilities, the specific capabilities they have targeted, how they have achieved these capabilities, and the impact that increased space club relevance has had on their national interests.

The focus of this article will now shift to how the experiences of the five small states discussed can serve as examples for other small states, regardless of their size or wealth, when initiating or expanding their space programs. Specifically, this article will examine how each of these states has employed different approaches in their national space programs to achieve not only relevancy in the space club but also the platform to positively influence their national interests.

Opportunities and Considerations for Other Small States

While the states discussed in this article may be considered wealthy and advantaged in some way, the outcomes they achieved through their space programs are attainable by other small states, regardless of their size, location, or existing technological and industrial capabilities. Thus, this article is not intended to merely showcase the success of the exemplar states, but rather to encourage other small states to explore space opportunities. By highlighting the unique approaches taken by these small states, this article aims to inspire other nations to recognize their own strengths and potential for success in space. Many small states may believe they are too late, too small, or not equipped to benefit from space activities. However, this article challenges such assumptions by demonstrating how the five exemplar states provide a roadmap for any small state to achieve its national interests through space.

Table 1. Summary of small state approaches to space

	UK	Canada	Australia	Norway	UAE
Why	• Security • Economy	• National Identity • Security • Economy	• Security	• Security • Economy	• Prestige • Economy
What	• Launch (Polar) • Small Sat Manufacture	• Niche Tech Specializations • Astronaut Program	• Niche SDA	• Regional ISR • Launch (Polar) • Downlink Collection & Transfer • Polar comms	• Niche Tech Specializations • Astronaut Program
How	• Large Sovereign Capability Investment • Bilateral Cooperation • Intl Forums Focus • Creation of Civil & Military Space Agencies	• Sovereign Capability Investment • Bilateral Cooperation (US) • Creation of Civil & Military Space Agencies	• Sovereign Capability Investment • Bilateral Cooperation (US) • Creation of Civil & Military Space Agencies	• Sovereign Capability Investment • Creation of Civil Space Agency	• Sovereign Capability Investment • Regional Hub • Bilateral Cooperation • Intl Forums Focus • Creation of Civil Space Agency
Impact on National Interests	• Improved access to space services • Growth in space economy • Improved international credibility • Enhanced ability to defend national interests	• Improved access to space services • Growth in space economy • Improved international credibility • Enhanced ability to defend national interests	• Improved access to space services • Growth in space economy • Improved international credibility • Enhanced ability to defend national interests	• Improved access to space services • Growth in space economy • Improved international credibility • Enhanced ability to defend national interests	• Improved access to space services (regional) • Growth in space economy • Improved international credibility

Understanding the Why

When a state aims to develop space capability, it must carefully consider its national interests in relation to its diplomatic, information, military, and economic instruments of power. As depicted in table 1, space capability can offer small states a variety of potential national outcomes and the means to impact their instruments of power. However, the capacity of space capabilities to generate positive outcomes for a state is not automatic. Small states, in particular, must deliberately

consider what they aim to achieve from space and, most importantly, why. This "why" must be targeted explicitly because small states cannot afford to pursue lost causes or fail when attempting to enter the space club.

As illustrated in table 1, each of the small states discussed had a clear identification of their goals and the national interests they aimed to influence by developing or reinvigorating their space capabilities. These national interests include:

1. improving access to space-derived services;
2. enhancing the ability to defend their national interests;
3. providing for new or enhanced economic growth; and
4. improving international credibility.

Clarity on the "why" is crucial for any state contemplating establishment of a space capability, as the investment and costs involved are significant. Regardless of a state's size, it cannot afford to embark on a path that lacks clear linkages to, and influence of, its national interests.

The small states discussed sought to provide their populations with access to basic space-derived services such as communications, internet, and PNT services.[78] In the cases of Canada, Australia and Norway, these services were essential due to the dispersed and isolated nature of their populaces.

The states discussed also wanted to enhance their ability to defend their national interests. Investment in space-based ISR and communication capabilities provided each with improved situational awareness and the ability to act on the information provided. It is interesting to note that the small states discussed did not independently develop and operate such security-focused space capabilities. Instead, advancements in technology enabled each nation to contribute niche space capabilities as part of a collaborative, collective approach to security. This increased their relevance among larger state partners while facilitating access to a greater security apparatus and additional space-derived information. It is worth noting that the UAE had regional focus and did not prioritize security-focused space capabilities.[79]

The small states discussed had a common interest in economic opportunities provided by upstream and downstream space industries. They all recognized the

[78] In the case of the UAE, this focus was from a regional standpoint.

[79] Mohammad Barhouma, "The Reshaping of UAE Foreign Policy and Geopolitical Strategy," Carnegie Endowment for International Peace, 4 January 2022, https://carnegieendowment.org/. The UAE has adopted a "zero problem" policy approach in response to regional rivals. This approach focuses on diplomatic solutions and soft power to consolidate its economic interests and trade partnerships. The policy involves building bridges of communication, expanding diplomatic and mediation efforts, and avoiding all confrontations that may hinder UAE's efforts to boost its economy. Therefore, the UAE has refrained from investing in military or security space capabilities to date.

potential benefits of participating in the global space economy, which is currently valued at USD 469 billion and is projected to grow to more than USD 1 trillion by the 2040s.[80] This growth industry is attractive to states of all sizes, and even the UAE, which is blessed with natural oil and gas resources, recognized the need to diversify for future survival. By investing in the creation of a space economy, small states can find their place in this growing industry, as demonstrated by Canada and Norway, who focused their investment rather than making it broad or extensive.

National prestige is often considered a reason for nations to pursue space capability, but this does not seem to be a common driver for the smaller states discussed.[81] Unlike Russia, the United States, China, and more recently India, which saw space as a mechanism to prove ideological or national prestige, most small states view the prestige element of space as being a secondary benefit, rather than the primary reason for their activities. For example, the UAE is focused on being recognized as a hub for space across the Middle East, rather than seeking global prestige. Similarly, Canada, recognizes that prestige can be gained but is primarily concerned with recognition of its Canadian identity rather than being considered part of the United States space program. Across the small states discussed, there is a desire to improve their international credibility and have a greater say in international forums, which in turn impacts small nations' access to and use of space.

Gaining Relevance as a National Asset through Space

Several approaches become apparent for small states to consider when regarding entering the space domain and increasing their relevancy within the space club. These approaches include leveraging comparative advantages such as geography, resources, or existing technology capabilities; investing in niche technological capabilities; and focusing on regional requirements or opportunities. These approaches can be applied to any small state regardless of size, geographic location, wealth, or level of capability. Once the immutable characteristics of a state are accounted for, the possibilities and approaches available to small states are limited only by their analysis and imagination.

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[80] Space Foundation Editorial Team, "Space Foundation Releases the Space Report 2022 Q2 Showing Growth of Global Space Economy," *Space Foundation* (blog), 27 July 2022, https://www.spacefoundation.org/.

[81] Paikowsky, *Power of the Space Club*, 78.

Exploiting Comparative Advantages

Small states should seek out and exploit comparative advantages that are afforded to them based on their location, existing technological capabilities, industries, or resources. The comparative advantage argument contends that every nation has some form of advantage over others and should leverage it.[82] By focusing their efforts on niche areas for which they hold a comparative advantage over others, states can establish themselves as experts and differentiate themselves. This, in turn, creates relevancy for that state across the space club, opening collaboration and national interest influence opportunities that were previously unavailable. Canada's expertise in robotics, for example, has enabled it to participate in breakthrough space projects since the birth of the shuttle program. Norway and Australia have gained relevancy by focusing on space capabilities such as launch, ISR, space situational awareness (SSA) by leveraging their locational advantages. Notably, the capabilities created to exploit such locational advantages do not necessarily have to be in space or related to launches. Australia's large open deserts and clear skies make it an ideal location for ground daytime observation and data-collection capabilities. Similarly, Norway has leveraged its high-latitude location to increase SSA and data-transfer capabilities for polar-orbit satellites. These ground-based capabilities provide both states with significant relevancy within the space club due to their uniqueness and other nations' reliance on accessing these capabilities instead of creating their own.

As demonstrated by the small states discussed, all states have opportunities to identify and leverage their unique comparative advantages provided by location, existing expertise, or resources. Such advantages are not impacted by the size or wealth of a state; they exist by virtue of the state itself and its uniqueness. By developing capabilities based on those unique advantages, states can position themselves as prime providers in a given capability and create a reliance within the space club on that capability.

Investing in Niche Capability

States can target niche space capabilities by identifying and exploiting their unique advantages. All of the small states discussed have taken this approach. By specializing in a specific capability, a state can open cooperative teaming opportunities with other spacefaring states. Canada, for example, is known for its niche robotics capabilities such as the Canadarm and Dextre, which have led to Cana-

[82] CFI Team, "Comparative Advantage," Corporate Finance Institute, 3 May 2023, https://corporatefinanceinstitute.com/.

dian involvement in the shuttle program, the ISS, and the Artemis program. Canada's contribution has also opened doors for its astronaut program and other robotic markets outside of the space sector.[83] Similarly, the United Kingdom is targeting a leading niche capability in small satellites, which will contribute to its growing space economy and increase the likelihood of cooperative partnerships with other nations interested in this technology.

States can establish space club relevancy and contribute to the global space community by offering unique products or capabilities. The small state niche capabilities discussed earlier are just a few examples of the vast potential for innovation and niche capabilities within the space community. For instance, Italy has created a GoPro-like capability (Light Italian CubeSat for Imaging of Asteroids [LICIACube]), which has supported the Double Asteroid Redirection Test (DART) mission and the Artemis I mission.[84] This capability, previously unavailable in space, provides a unique perspective and the ability to record space activities in a new way.

Very small or economically challenged states can also benefit from the niche approach to space, as it often requires limited investment. For example, Bulgaria focused on providing food to support the Russian space program during the 1980s and 1990s.[85] By specializing in this niche area and developing the Svet (light) greenhouse automated plant growth facility, Bulgaria gained access to the Soviet MIR space station and supported Soviet cosmonauts.[86] The success of Bulgaria's niche focus and space-based experimentation on the MIR, which included over 400 experiments during its 15 years in orbit, eventually led to international recognition. In 2002, a third-generation greenhouse—known as the Lada Validating Vegetable Production Unit—was included in the Zvezda module on the Russian section of the ISS.[87]

Small states have numerous niche opportunities to target. The international space landscape is constantly evolving, presenting new challenges such as space

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[83] Sean Silcoff, "Canadarm-Maker MDA Has Strong Growth Prospects and Will Likely Go Public, Investors Say as $1-Billion Takeover Closes," *Globe and Mail*, 8 April 2020, https://www.theglobeandmail.com/.

[84] Tricia Talbert, "First Images from Italian Space Agency's LICIACube Satellite," NASA, 27 September 2022, http://www.nasa.gov/. Fifteen days prior to impact, the Light Italian CubeSat for Imaging of Asteroids (LICIACube), which is a CubeSat companion of DART, was deployed from the DART spacecraft. LICIACube captured images of the impact and the asteroid's resulting cloud of ejected matter. These images will be used to examine the impact's effectiveness in deflecting the Dimorphos asteroid.

[85] Tania Ivanova, "Space Farming on Mars: Greenhouse aboard MIR shows plants can thrive in Space," *21st Century* (Summer 2002), 42–49, http://21sci-tech.com/.

[86] The Russian word "svet" translates to "light" in English.

[87] Ivanova, "Space Farming on Mars," 45.

debris, overcrowding, climate change monitoring, and the growing militarization of space. These challenges create opportunities for small states to specialize in areas related to these concerns. Moreover, addressing natural space-based challenges like the South Atlantic Anomaly and solar flares are also potential areas for small states to explore and potentially resolve.

Small states can consider several approaches to identify niche space capabilities that can be leveraged to create relevancy. One such approach is the facilitation and development of New Space economies. *New Space* refers to "a rapidly growing, global community of entrepreneurs and private actors contributing to a new era of space-related activity."[88] This activity is characterized by private investment, competitiveness, agility, innovation, and acceptance of risk with expectations of considerable future profit opportunities.[89] By encouraging and supporting the expansion of existing commercial capabilities and the continued development of a New Space community, small states can identify gaps in the space ecosystem and fill niche demand gaps to their own benefit. This approach also allows small states to utilize the New Space market economy to weed out false starts and avoid investment losses, a key consideration and concern for many small states seeking entry into the space economy. New Zealand is an excellent example of a small state that has actively supported the New Space ecosystem.

The concentration of New Space capability in New Zealand has been largely driven by the success of Rocket Lab, a publicly traded aerospace manufacturer and launch service provider, as well as New Zealand's economic freedoms.[90] With a well-educated population known for innovation and receptiveness to technology, New Zealand has developed a concentrated high-tech space manufacturing and space applications subsector that supports upstream and downstream space activities both domestically and globally. According to a 2019 Ministry of Business, Innovation and Employment report, the New Zealand space economy is worth NZD 1.75B (USD 1.17B) and includes 104 small- to medium-sized companies,

[88] Deloitte Access Economics, *New Zealand Space Sector: Its Value, Scope and Structure* (Wellington, New Zealand: Ministry of Business, Innovation and Employment, November 2019), 10, https://www.mbie.govt.nz/.

[89] Deloitte, *New Zealand Space Sector*,10.

[90] "About Us," *RocketLab*, 2023, https://www.rocketlabusa.com/. Rocket Lab was founded in New Zealand by Peter Beck, who believed that space could be made more affordable. However, due to the opportunities and funding available in the US space and defense sectors, Rocket Lab ultimately became a registered company in the United States. Rocket Lab has a subsidiary in New Zealand, which achieved a significant milestone in 2009 by becoming the first private company in the Southern Hemisphere to reach space with the launch of Atea 1 (which means "space" in Māori). Currently, Rocket Lab operates New Zealand's first commercially owned launch facility at Mahia, located on the east coast of the North Island.

32 of which operate primarily in the space sector.[91] In addition to Rocket Lab, there are several other success stories emerging from New Zealand's New Space economy, including Dawn Aerospace, which has created a growing market for its nontoxic, hydrazine-free small satellite propulsion systems and is currently developing same-day reusable launch vehicles—the Aurora series—designed to take off and land on standard airfields alongside normal aircraft.[92]

Small states can take a page out of New Zealand's book and leverage New Space to strengthen or create new space-related economies. To attract and support start-ups and research-based companies, host states must create an economic environment conducive to such enterprises. In addition to researching and developing new technologies, these companies often specialize in niche space capabilities. By supporting such research, small states can identify and sponsor sought-after niche capabilities with less risk. Those that prove successful can be developed into national capabilities—similar to the examples discussed in this article—thus, increasing the state's relevancy in the space community. With the predicted growth of the global space economy, this presents an exciting opportunity for small states to establish themselves as major players in the space club.

Regional and Collaborative Approaches

Small states have the option to consider a regional or collaborative approach to space capabilities or programs as another approach to establish relevancy. The UAE's regional approach is a good example of how this can be achieved, with a focus on establishing relevance across the Middle East and globally. Similarly, Norway has increased its relevance across its partners by focusing on providing space services in the Arctic region, particularly in the areas of security and ecological research related to climate change. Both examples demonstrate how small states can take ownership and responsibility for a previously underrepresented aspect of space-related growth or security issues, and establish themselves as relevant players in the space industry.

Like the UAE and Norway, taking a regional perspective can help small states increase their global relevance in the space industry. By identifying and filling regional gaps in capability or service, small states can gain recognition and entry into the space community, increasing their relevance. This approach presents op-

[91] Deloitte, *New Zealand Space Sector*, 20.

[92] "Dawn Aerospace," Dawn Aerospace, 2023, https://www.dawnaerospace.com. The Aurora Mk-II space vehicle is currently undergoing flight testing. It is the latest vehicle in a series intended to deliver satellites and assets to space, as well as return them. The Mk-III, which is the next vehicle in the series, will be based on the Aurora Mk-II design but will be much larger and capable of delivering 250-kg satellites to orbit.

portunities for small states of all sizes and wealth levels, particularly those in isolated or underserved regions. For instance, small states could leverage space-based observation to monitor Antarctica or establish a regional security approach to surveil the South Pacific Ocean. They could also create regional space security architectures by pooling resources to develop such capabilities. In the South Pacific, border states such as Chile, New Zealand, Australia, and Pacific Island states could invest in dedicated satellites and ground stations to enhance situational awareness and security in the region.

Peru has taken a unique approach to leveraging its PeruSAT-1 satellite by adopting an "orbit market" strategy.[93] Although the high-capability imagery satellite only passes over Peru a few times a day, the Peruvian Space Agency (CONIDA) has created a downstream imagery market with other countries in the orbit path to maximize economic benefits.[94] By becoming a provider of very high-resolution satellite images, Peru has gained relevancy with regional states and global customers. This has not only boosted the country's economy but also created downstream spin-off benefits and markets for satellite image processing and interpretation. This successful venture into satellite imagery has elevated Peru's standing within the space club.

Taking a regional or collaborative perspective on space capability and identifying space gaps can provide significant opportunities for small states to increase their relevancy. By approaching space programs from a regional lens, states can address their own requirements and national interests, while also contributing to regional and global interests at a minimal individual cost. These regional approaches can also help alleviate the burdens of larger partner states or collective organizations within the region, as they can access these capabilities without creating their own.

Relevancy Summary

The approaches discussed above provide several options for small states to initiate a value-added space program that can extend tangible national benefits. These options are not presented as the only ones available. Small states have a wide range of choices and approaches available to them, which are limited only by their

[93] Avid Roman-Gonzalez and Natalia Vargas-Cuentas, "Spotlight on Peruvian Space Activities and Market," *New Space* 9, no. 4 (December 2021), 228–31, https://doi.org/. The PerúSAT-1 provides very-high-quality imagery (1.2m-0.7m resolution). The satellite has applications for homeland security and border monitoring, coastal surveillance, combating illegal trafficking, mining, geology, hydrology, disaster management, and environmental protection.

[94] Roman-Gonzalez and Vargas-Cuentas, "Spotlight on Peruvian Space Activities."

own analysis and imagination. As illustrated in this article, small states can identify strategies to gain considerable relevancy by scanning capability gaps and demand signals across the global space community. This relevancy can then be employed internally by those states to positively influence their own national interests.

Increased Relevancy Creates Influence

The achievement of relevancy in the space club is a significant milestone for small states, but it should not be seen as the ultimate objective. The true value of such relevancy lies in its ability to translate into soft-power influence to advance national interests. These interests can range from providing better services to the population to more far-reaching goals such as improved security outcomes, a stronger economy, or the attainment of desired international objectives and norms. The specifics will vary from state to state.

Table presents the national interests that were commonly impacted by the five small states discussed in this paper. The selected approaches resulted in increased relevancy within the space club, enabling these states to access additional services and to influence local interests and challenges.

Improved Access to Space Services

This article highlights that creating relevancy in the space club has enabled the discussed states to access space services that were previously unavailable to them. With an improved position, these states were able to engage in collaboration arrangements with other nations to further their national interests. For example, Canada and the UK have benefited from the launch capabilities of the United States for the past 30 years, providing access to launch capabilities for sovereign space-service satellites that would not have been possible without their investment and relevancy in the space club. The implementation of targeted investments and space programs has allowed small states to better provide space-derived services to their populations, contributing to their national interests, including security.

Enhanced Ability to Defend National Interests

Similar to accessing space-derived services, small states can also benefit from increased national security by leveraging their relevance in the space club. The small states discussed in this article were able to access additional security information by sharing and integrating sovereign space data and assets with other states, leading to acceptance into allied security architectures. This increased collaboration and information sharing has enabled states such as Norway, Canada, and Australia to improve their military security architecture and provide regional

security products to allies. This collaboration has resulted in increased confidence in the defense of national interests through the provision of space-derived information and other sources of information.

The increased relevance of small states in the space club can also help to address various non-defense security concerns. These concerns range from environmental security, such as climate change, to internal security issues like transnational crime and illegal migration. By leveraging their access to space-derived data and technologies, small states can better understand and address these complex security challenges and, in turn, improve their ability to protect and promote their national interests.

Climate change is a significant security concern for many small states, as rising sea levels, changing weather patterns, desertification, and extreme weather events pose increasing challenges for all nations. However, these challenges typically impact small states more severely due to their limited resources and infrastructure to prepare, survive, and recover from such trends or events. The small states discussed in this article have invested in space research and Earth observation capabilities related to climate change and its effects. This investment includes collaborative efforts and information sharing with other nations to improve awareness and enable the adoption of national approaches to reduce the impact of climate change security challenges.

One example of a non-defense security focus is the UAE's efforts to tackle water security challenges using its DubaiSat and KhalifaSat satellites to monitor and track water levels and access to clean water in the Middle East.[95] These satellites generate water area maps for seawater, lakes, and pools in the region and monitor changes in these waterbodies. This regionally available information, combined with the UAE Research Program for Rain Enhancement Science (UAE-REP), enables the region to plan and coordinate water security research and solution projects.[96]

Relevance within the space community, as demonstrated by the small states discussed, has enabled them to improve both their defense and non-defense re-

[95] Youssef Wehbe, "Tracking Water Resources from Space: Challenges for the MENA Region," Middle East Institute, 15 February 2023, https://mei.edu/. In collaboration with South Korea, UAE MBRSC engineers developed their first two observation satellites, DubaiSat-1 and DubaiSat-2, which were launched in 2009 and 2013, respectively. These earth observation satellites were followed by the KhalifaSat in 2018, which was the UAE's first 100-percent domestically designed and manufactured Earth observation satellite. With its sophisticated capabilities, the KhalifaSat solidified the UAE's position as one of the world's leading space technology manufacturers and highlighted its role in contributing valuable satellite imaging data to the international scientific community.

[96] Wehbe, "Tracking Water Resources from Space."

lated security. This improvement allows these states to access capabilities and information that would otherwise not be available to them due to factors such as cost, complexity, or national limitations and priorities. This is particularly important for small states that may lack the significant security apparatus required.

Growth in Space Economy

As previously noted, the development of upstream and downstream space capabilities can provide small states with economic opportunities that can create new industries and revitalize existing ones. This economic growth is often a critical requirement for the survival of small states. The small states discussed in this article provide evidence of such growth. For example, in its 2018 *State of the Canadian Space Sector* report, Ottawa highlighted that the Canadian space sector generated CAD 5.7 billion (USD 4.2 billion) in revenues and contributed CAD 2.5 billion (USD 1.9 billion) to the Canadian economy, with further growth predicted in the coming decade.[97] Similarly, the United Kingdom's space economy produced GBP 16.5 billion (USD 21 billion) in income in 2019–20, and employment in the space industry increased by 6.7 percent from the previous year to 47,000 workers.[98]

These space-related economic opportunities are available for any state, regardless of size, wealth, or population. Such opportunities are limited only by the imagination, policies, and drive of those states and their industries to identify unique approaches that create relevancy and influence within the space club. Meagan Crawford from the SpaceFund highlights several space markets that she considers ripe for investment.[99] She challenges states and companies to consider options beyond the saturated launch market and to identify space markets that are being underserved or not served at all.[100] These are the markets that can boost or create a space economy within a state, regardless of its size. Examples provided by Crawford include satellite products and services such as in-orbit services, constellation management, cislunar services, smallsat capabilities beyond low-Earth orbit (LEO), alternative navigation services, and Earth-observation apps, data overlays,

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[97] *State of the Canadian Space Sector Report 2019* (Saint-Hubert, Quebec: Canadian Space Agency, 2020), https://www.asc-csa.gc.ca/.

[98] Tech, "Size and Health of the UK Space Industry," ii.

[99] "SpaceFund: Funding the Future," *SpaceFund*, 2023, https://spacefund.com/. Founded in 2018, SpaceFund is an investment company focusing on supporting new startup businesses and markets in the new space ecosystem.

[100] Meagan Crawford, "Don't Start a Launch Company: Other Space Sectors Need Innovation," *SpaceFund*, 2023, https://spacefund.com/.

and user interfaces beyond government markets.[101] These are the type of markets that small states could consider. As discussed previously, openness to the New Space trend can also provide a low-risk option for small states to exploit when looking to create or grow their economies.

A Voice in International Forums

The final aspect highlighted by the states discussed in this article is the increased influence that small states can gain within international forums because of their membership and relevancy within the space club. All told, "small states constitute majorities in most global and regional international organizations."[102] This means that small states have an asymmetric en-bloc influence within international forums. By working together, their interests can shape the future of space.

In organizations such as the UN General Assembly, the one-state one-vote system provides small states with the ability to influence decisions and considerations of larger states. Additionally, "international organizations provide [small states with] a forum to amplify concerns, generate publicity, and coordinate with potential allies" to achieve desired outcomes.[103] In the context of space, small states can gain greater influence, international credibility, and a stronger voice in international forums by becoming valued members of the space club. They can use this influence to shape decisions within organizations such as the United Nations Office for Outer Space Affairs (UNOOSA) and its various assemblies, regarding the weaponization of space, use of antisatellite weapons (ASAT), resource exploitation, and technology usage, to better serve or support their national interests.

Small states can progressively influence global space norms through their influence within international forums. Ironically, small states exercising their increased voice in international space-related forums could control and influence the discourse on global space norms. For example, the UK has championed the submission of United Nations Resolution A/RES/75/36, which attempts to break the impasse of larger space club disagreements surrounding updating the Outer Space Treaty (OST) and other new proposals to establish future legal and regulatory frameworks to govern space activities. Although larger states within the space club have yet to adopt or ratify this "behavioral norms in space" resolution, the fact that it has been developed and championed by small states indicates that by banding together, small states can influence larger space club states in the future.

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[101] Crawford, "Don't Start a Launch Company."
[102] Long, *A Small State's Guide*, 2.
[103] Long, *A Small State's Guide*, 29.

Therefore, small states' influence, although individually smaller than the larger space powers, can cumulatively have an impact in international forums. This influence is further amplified by possessing capabilities that are relevant to the space club, which can enhance the ability of small states to better serve and support their own national interests.

Conclusion

When we act, we create our own reality.

—Unnamed President George W. Bush staffer

"By all but the narrowest definitions, most of the world's states are small states."[104] In his discussion on how small states can influence world politics, Tom Long points out that the asymmetric nature of small state relationships with other states should not be seen as limiting. According to him, small states "can develop their own material, social and ideational resources to pursue their goals."[105] This is especially true within the space club, where small states can identify and invest in niche technologies, comparative advantages, or gaps in space-related capabilities or regions, small states or regions to achieve and influence national and global interests.

Each of the states discussed in this article can be seen as exemplars for other small states seeking to enter the space arena, as they offer divergent approaches to their national space programs. Small states can leverage their comparative advantages, such as their geography, existing technology capabilities, or resources, invest in niche technological capabilities, or identify gaps in the existing space ecosystem to compete and gain relevancy within the space club. This relevancy provides a platform for small states to improve their access to space services, enhance their security, promote economic growth, and amplify their voices in international space forums.

This research provides valuable insights for small states seeking to gain entry to the space club while determining which approaches are most effective in achieving outcomes in line with their national interests. It is hoped that this paper will encourage all small states, regardless of their size, wealth, and resources, to believe that they too can establish relevancy within the space club and influence the realization of their national interests. Small states can exploit their unique characteristics or identify gaps in the space ecosystem, as exemplified in this report, to create national opportunities for leveraging and exploitation. By taking selective action in space, small states can empower themselves, reduce reliance on others,

[104] Long, *A Small State's Guide*, 2.
[105] Long, *A Small State's Guide*, 4.

and influence global space decisions, developments, and norms of behavior in line with their interests.

The research and examples presented in this paper offer small states of all sizes and capacities food for thought and the confidence to consider developing a targeted space program. The New Space trend is shaking the status quo in space, creating opportunities for small states to challenge the old model of space control by larger space club nations.

As the opening quote in this section suggests, small states can create their own reality in space. By understanding their national interests and determining the best way to shape space capabilities to achieve those interests, small states can gain relevancy in the space community and influence the realization of their national interests. They have the potential to create their own reality and future, both on Earth and in space. ✪

Wing Commander Mark Waters, Royal New Zealand Air Force

Wing Commander Waters is assigned to the Air War College (AWC), Air University, Maxwell AFB, Alabama. He joined the RNZAF in 1989 as an avionics technician. As a technician, he worked across various RNZAF bases before being commissioned from the ranks in 1997 as an engineering officer. As an engineering officer, Wing Commander Waters has developed his career across various operational and technical support roles. Key senior roles include maintenance flight commander in support the Royal New Zealand Navy fleet of SH-2G(NZ) Seasprite aircraft, Executive Officer to the Logistics Commander (Air), an operational deployment to South Korea as part of the United Nations Command Military Armistice Commission (UNCMAC), three years as the senior engineering officer on RNZAF Base Auckland, and prior to AWC, Deputy Director Aerospace Delivery within the New Zealand Defence Force Capability Branch. In 2015, he graduated as the top student on his New Zealand Defence College Advanced Command and Staff Course (Joint). Wing Commander Waters holds a Bachelor of Business Studies (Honors) and a Master of International Security from Massey University, and a Master of Engineering Management with First Class Honors from the University of Auckland.

FEATURE

NATO's Role in Space

How and Why NATO Member States Should Expand Their Purpose and Capabilities in Space

Lt Col Emma Palombi, Italian Air Force

Abstract

This article argues that NATO should expand its purpose and capabilities in space to effectively address the security threats that extend to and from space. The collective security of NATO member states in space can be strengthened through the pooling of satellite capabilities, diversifying the use of satellites, developing niche space specializations, and increasing the number of launching sites. Such cooperation will also enhance the relationship between NATO's European allies and the United States, the international system's hegemon. Integration of the space domain is essential for NATO to successfully improve its deterrence strategy in space and extend collective defense into outer space. Ultimately, how NATO responds to and integrates space in its daily operations will determine its relevance in the space domain and the success of its relationship with the United States.

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The importance of space has increased tremendously in the international arena, impacting states' national power and security policies. As a military alliance, NATO must prioritize the security of its members and recognize the significance of space in achieving that goal. Although NATO has acknowledged the importance of space, it still has much to do to integrate space into its mission and operations. This article argues that NATO must expand its role in space via its European member states, who can collectively increase their space assets and launch sites while developing niche space capabilities and technologies. This will contribute to the alliance's security and strengthen NATO's relationship with the United States, the current hegemon in the unipolar international system and the leading space power. The article examines the literature to explain when states are more likely to cooperate in international relations via military alliances. It also traces the evolution of NATO and introduces the concept of the *alliance security dilemma* that the European allies face vis-à-vis the United States. The article presents its main argument and explains the methodology, which includes qualitative case-study discussion and quantitative data. The findings confirm that NATO must expand into space to extend its collective defense function and provide tangible support to the United States. The article concludes by outlining

important parameters for NATO's space expansion and key observations to guide future implementation.

Cooperation in International Relations

In international relations, the concept of cooperation among states has been extensively discussed, particularly by the neorealist and neoliberal schools of thought. Both agree that states exist in an anarchic environment, lacking a higher authority to arbitrate relations between them, leading to inherent uncertainty.[1] However, neorealists view interstate relations as more conflictual than neoliberals, with disagreement on whether institutions can mitigate this uncertainty. In this environment, states' primary goal is survival.

In general, neorealists see interstate relations as more conflictual than neoliberals, but they are divided on how states should ensure their survival in this anarchic international environment. Offensive realists argue that states must maximize power by any means necessary, including territorial conquest which often results in unavoidable wars.[2] On the other hand, defensive realists emphasize maximizing defensive security postures, such as forming alliances or developing retaliatory military capabilities, to ensure state survival, and argue that not every security dilemma is bound to escalate into a conflict.[3] In 1950, John H. Herz introduced the concept of the *security dilemma*, arguing that the increase of security and strength of one state causes fear in other states, which in turn increases their security and alarms the first state further, creating a spiraling and antagonistic dynamic.[4] In the context of the security dilemma, defensive realists claim that only when a state faces another state whose approach appears expansionist and threatens the status quo is conflict likely to occur. If both states are satisfied with the status quo and no expansionist will is perceived, defensive realists predict the mitigation of the friction coming from the security dilemma and the opportunity for states to cooperate.[5]

Defensive realists are generally more optimistic than offensive realists about the potential for cooperation among states.[6] They view the specificity of the situation,

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[1] Robert Jervis, "Realism, Neoliberalism, and Cooperation: Understanding the Debate," *International Security* 24, no. 1 (Summer 1999), 43, https://www.jstor.org/.

[2] John J. Mearsheimer, *The Tragedy of Great Power Politics* (New York: W.W. Norton & Company, 2001), 3, https://is.cuni.cz/.

[3] Jervis, "Realism, Neoliberalism, and Cooperation," 48–49.

[4] John H. Herz, "Idealist Internationalism and the Security Dilemma," *World Politics* 2, no. 2 (January 1950), 157, https://www.jstor.org/.

[5] Jervis, "Realism, Neoliberalism, and Cooperation," 50.

[6] Jervis, "Realism, Neoliberalism, and Cooperation," 47.

the degree of transparency, and other states' objectives as key factors in enabling cooperation. Defensive realists advocate for states to pursue security through the build-up and accrual of defensive measures, such as alliances and retaliatory measures, which they believe can help to reduce the likelihood of conflict in the international system.[7] In contrast, offensive realists regard cooperation solely as a temporary tool that states can use "to improve their relative power position vis-à-vis their main adversary."[8] Furthermore, neorealists assert that states only see institutions as valuable when they facilitate the achievement of goals that would otherwise be too difficult or costly to attain alone.[9]

While neoliberals agree that the international environment is anarchic, with no sovereign ruler to govern over states, they disagree with neorealists that it is inherently conflictual and argue that there is room and potential for cooperation among states.[10] Neoliberals argue that despite the anarchic nature of the international environment, cooperation among states is possible, and that international institutions—which are formal expressions of such cooperation—play a crucial role in facilitating it.[11] By supplying information, reducing transaction costs, creating conditions for iterated interactions, generating expectations among members, and providing credible deterrents for defectors, neoliberals contend that international institutions enhance the chances of cooperation between states.[12]

In summary, the study of state cooperation is a subject that has been extensively examined by neorealists and neoliberals, who offer different approaches to understanding the conditions that foster cooperation and the role of institutions in promoting it. Alliances, a type of institution, are crucial in understanding NATO, a military alliance that both neorealists and neoliberals recognize as an example of state participation. The subsequent section will define military alliances.

What Is a Military Alliance?

Etymologically, the word *alliance* comes from the Latin verb *alligare*, which means "to bind" or "to connect." In this article, the definition proposed by Stefan Bergsmann in his 2001 work *The Concept of Military Alliance* is adopted. Bergs-

[7] Kenneth N. Waltz, "The Emerging Structure of International Politics," *International Security* 18, no. 2 (Autumn 1993): 51-54, https://www.jstor.org/stable/2539097.

[8] John J. Mearsheimer, "A Realist Reply," *International Security* 20, no.1 (Summer, 1995): 85, https://www.jstor.org/stable/2539218.

[9] Jervis, "Realism, Neoliberalism, and Cooperation," 54.

[10] Jervis, "Realism, Neoliberalism, and Cooperation," 47.

[11] Jervis, "Realism, Neoliberalism, and Cooperation," 54.

[12] Charles Lipson, "Is the Future of Collective Security Like the Past?," in *Collective Security beyond the Cold War*, ed. George W. Downs (Ann Arbor: University of Michigan Press, 1994), 114.

mann defines an alliance as "an agreement among states in the realm of national security in which the partners promise mutual assistance in the form of the substantial contribution of resources in the case of a certain contingency the arising of which is uncertain."[13] According to this definition, only states can enter into an alliance since they hold the power exclusivity in matters of national security. Bergsmann's precise language excludes other forms of security arrangements, such as alignments, coalitions, unilateral guarantees, and treaties of neutrality. *Alignments* are informal groups that lack explicit agreements, while *coalitions* are formed to address expected circumstances, whereas alliances require unexpected events to trigger mutual assistance between states. *Unilateral guarantees* do not involve reciprocity assistance, and *treaties of neutrality* do not promise a defensive intervention as required by alliances.[14]

Bergmann's definition effectively captures the scope and nature of NATO by defining a military alliance narrowly. NATO is classified as a military alliance because its member states meet the following criteria: (a) they have signed the founding treaty of NATO, (b) they "are resolved to unite their efforts for collective defence," and (c) they will take measures to assist any other NATO member state in the event of an armed attack, including the use of armed force if necessary.[15] The following section examines the purpose and evolution of NATO.

Focus on NATO as a Military Alliance: Purpose and Evolution

To understand the role NATO, as a military alliance, may play in space, it is first necessary to outline the reasons behind NATO's foundation and the ways in which it has evolved.

NATO's Origin and Evolution During the Cold War

NATO was established on 4 April 1949 as a collective defense military alliance with 12 founding member states: Belgium, Canada, Denmark, France, Iceland, Italy, Luxembourg, Norway, the Netherlands, Portugal, the United Kingdom, and the United States.[16] The initial main rationale behind NATO's creation was to respond to the threat posed by the Soviet Union after World War II. However, NATO's purpose expanded to include responding to three distinct needs in Eu-

[13] Stefan Bergsmann, "The Concept of Military Alliance," in *Small States and Alliances*, ed. Erich Reiter and Heinz Gärtner (Heidelberg: Physica-Verlag HD, 2001), 21, https://www.bundesheer.at/.

[14] Bergsmann, "The Concept of Military Alliance," 28–29.

[15] "The North Atlantic Treaty," NATO, 4 April 1949, https://www.nato.int/.

[16] "Founding Treaty," NATO, 4 April 1949, https://www.nato.int/.

rope: constraining Soviet expansionism, impeding the formation of new regional militarism, and helping European nations' political integration.[17]

NATO's various purposes are codified in several articles of its founding treaty. Article 2 of the North Atlantic Treaty emphasizes nonmilitary cooperation among its members, encouraging economic collaboration through the development of international institutions.[18] Article 3 of the Treaty addresses military cooperation, directing member states to "maintain and develop their individual and collective capacity to resist armed attack."[19] Article 5 of the Treaty invokes Article 51 of the U.N. Charter, providing for collective self-defense: in the event of an armed attack against one or more NATO member states in Europe or North America, all NATO allies will assist the attacked state, even "with the use of armed force, to restore and maintain the security of the North Atlantic area."[20] These three articles of the Treaty summarize the original needs that NATO's constitution sought to address.

The aftermath of World War II had a significant impact on the evolution of the Alliance. The war left Europe with devastating economic and social outcomes and a sense of insecurity as the Soviet Union supported communist parties in various countries. Military cooperation, coupled with the economic aid of the Marshall Plan, was intended to help restore the political and economic stability military security in Europe.[21]

Initially, NATO did not have a well-defined military command structure, but the need to establish a clear chain of command became evident in 1949 when the Soviets detonated their first atomic bomb and again in 1950 when the Korean War began. As a result, the Alliance established its Supreme Headquarters Allied Powers Europe (SHAPE) in the vicinity of Versailles, France, and its civilian secretariat in Paris, France. In response, the Soviet Union and seven Central and Eastern European countries signed the Warsaw Pact in May 1955, a collective defense treaty that was the ideological opposite of NATO.[22]

In a Cold War bipolar international system with two main powers, NATO was a military institution that grouped states aligned with the United States. The Alliance's strategic concept, the Massive Retaliation doctrine, reflected the harshness of international bipolarism. If the Soviet Union had attacked one of the NATO members, the Alliance would have responded using all means necessary,

[17] "A Short History of NATO," NATO, 3 June 2022, https://www.nato.int/.
[18] NATO, "The North Atlantic Treaty."
[19] NATO, "The North Atlantic Treaty."
[20] NATO, "The North Atlantic Treaty."
[21] NATO, "A Short History of NATO."
[22] NATO, "A Short History of NATO."

including nuclear weapons. Such a posture, given the catastrophic risks associated with a potential nuclear war, was intended to discourage any type of aggression by the Soviets and their allies.[23]

The stability obtained through the counterbalance of threat and opposing forces is the beneficial effect that defensive neorealist Kenneth Waltz recognizes in a bipolar system like the US–Soviet one. According to Waltz, "In a multipower world . . . dangers are diffused, responsibilities unclear, and the definition of vital interests easily obscured," while "the bipolar world of the postwar period has shown a remarkable stability."[24] Due to the lack of peripheral states, everything converges on the interests and intentions of one of the two actors, and crises are better addressed and solved internally, within the two dominant powers' spheres of influence.

Waltz also points out that successful alliances require a leading state but not equality among members.[25] This argument may explain NATO's success, as its member states have accepted and recognized US preeminence and influence since the very beginning of NATO. The allies had an interest in keeping a strong bond with the United States, which, in turn, had an interest in having each member state politically stable and militarily strong enough to counter regional Soviet interference.[26]

In the 1960s, the stability achieved on the European continent was challenged by the Cuban missile crisis and the Vietnam War. NATO survived those tensions, and at the end of the decade, a détente in US–Soviet relations took place.[27] Washington and Moscow established direct lines of communication, and an acceptance of the status quo led to a change in NATO's military strategy. From its initial strategy *of* Massive Retaliation, NATO transitioned to Flexible Response, based on a conventional armament defense.[28]

From a diplomatic perspective, this phase was well expressed by the so-called "Hammel Report" (*Report of the Council on the Future Tasks of the Alliance*), a document produced in 1967 by Belgian Foreign Minister Pierre Harmel. Acknowledging a change from the 1949 scenario, the report recommended that NATO combine deterrence with détente and facilitate a dialogue with the War-

[23] NATO, "A Short History of NATO."

[24] Kenneth N. Waltz, "The Stability of a Bipolar World," *Daedalus* 93, no. 3 (1964), 882–84, http://www.jstor.org/.

[25] Waltz, "The Stability of a Bipolar World," 881.

[26] Waltz, "The Stability of a Bipolar World," 880.

[27] Joseph S. Nye and David A. Welch, *Understanding Global Conflict and Cooperation: An Introduction to Theory and History*, 10th ed. (Boston: Pearson, 2017), 164–72.

[28] NATO, "A Short History of NATO."

saw Pact countries. In essence, the Harmel Report pointed out that NATO had a twofold role: military and political.[29]

Evidence of the rapprochement between the West and the East was the 1975 Helsinki Final Act signed by all European NATO countries, Canada, the United States, the Soviet Union, and all the states of the Warsaw Pact. In the Helsinki Final Act, all signatories pledged to respect their citizens' fundamental rights and promote détente between the East and the West.[30]

In 1987, the United States and the Soviet Union signed the Intermediate-Range Nuclear Forces (INF) Treaty, agreeing to dismantle intermediate nuclear and conventional ground-launched ballistic and cruise missiles. During the 1980s, communist governments faced economic decline. In 1989, the fall of the Berlin Wall marked the end of the Cold War and the dissolution of the Warsaw Pact.[31] This also marked the end of bipolarism, where "two states or two blocks overshadow all others" and marked the beginning of U.S. unipolar hegemony.[32] What did this mean for the future of NATO?

NATO after the Cold War

Political scientist Stephen M. Walt highlights that "the advent of unipolarity has had profound effects on the nature of contemporary alliances." This has led to a lack of consensus among scholars on the real impact of unipolarity on international alliances.[33] One of the key questions arising from this impact is the role of NATO after the dissolution of the Soviet Union, which can explain why realist predictions of NATO's demise did not come true.

Since the end of the Cold War, NATO has intervened militarily in four main crises: the First Gulf War, the Balkans, Afghanistan, and Iraq. Professor Galia Press-Barnathan's analysis suggests that these military conflicts reflect changed dynamics among European NATO countries due to the shift toward a unipolar, US-led international order.[34] The new security environment was marked by an increase in the number and types of threats and the emergence of an "alliance security dilemma."[35]

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[29] "Harmel Report," NATO, 1 July 2022, https://www.nato.int/.

[30] NATO, "A Short History of NATO."

[31] NATO, "A Short History of NATO."

[32] Waltz, "The Stability of a Bipolar World," 887.

[33] Stephen M. Walt, "Alliances in a Unipolar World," *World Politics* 61, no.1 (January 2009): 86–87, https://www.jstor.org/stable/40060222.

[34] Galia Press-Barnathan, "Managing the Hegemon: NATO under Unipolarity," *Security Studies* 15, no. 2 (June 2006): 275, https://www.tandfonline.com/doi/abs/10.1080/09636410600829554?journalCode=fsst20.

[35] Press-Barnathan, "Managing the Hegemon," 273.

Since the beginning of unipolarity in 1991, the threat perception among NATO allies has increased. During the Cold War bipolar system, the threat was identified exclusively with the Soviet Union. In contrast, unipolarity is marked by the lack of a single main opponent and the emergence of potential threats. Additionally, the shift to a unipolar system has led to a diversification of threats. While the hegemon's concern is directed toward global threats, weaker allies must concentrate on geographically closer threats that arise on a regional scale. In Europe, such threats could include a spread of Russian nationalism or imperialistic desires, as well as crises in the Balkans. Those new threats warrant a prolongation of security alliances like NATO. Furthermore, the difference in threat perception between the hegemon and the other allies generates an alliance security dilemma. In practical terms, the smaller and weaker allies want to keep the security arrangements that the NATO alliance provides but face the dual "risk of abandonment and entrapment" from the newly established hegemon, the United States.[36] Under the alliance security dilemma, allies fear either being abandoned by the hegemon at the onset of regional crises or being trapped and forced into the hegemon's strategic plans. To counter such a dual risk, the allies can adopt two strategies: (1) try to restrain the hegemon through pacts and (2) create a division of labor. This second strategy aims to gain unique capabilities that will increase the allies' bargaining power over the hegemon either individually or as a group, as well as increase their operational independence in managing regional threats.[37]

This alliance security dilemma has been evident in the four conflicts of the Gulf, the Balkans, Afghanistan, and Iraq. European allies first perceived it during the 1991 Gulf War, when they realized their power disparity compared to the United States. Relying on its superior power, the United States could abandon its allies or impose its will on them. The European NATO members recognized the need for European integration and unity to internally balance the United States during the Gulf War. The alliance security dilemma was highlighted again in the 1999 Balkan conflict when the Allies faced the abandonment–restraint challenge. They required US military support in Europe but were cautious not to become dependent on US leadership. European NATO members applied the dual strategy described earlier by developing a division of labor through a European provision of forces and leveraging NATO's ties to restrain the United States to guarantee its military intervention in the Balkan conflict.[38]

[36] Press-Barnathan, "Managing the Hegemon," 273–79.
[37] Press-Barnathan, "Managing the Hegemon," 273–74.
[38] Press-Barnathan, "Managing the Hegemon," 306–07.

A similar dynamic occurred in Afghanistan, where NATO allies feared that the United States would concentrate all its efforts on that conflict, potentially abandoning its other security commitments elsewhere. The Global War on Terror posed a clear risk of entrapment, as supporting the Bush administration's doctrine could have bound the European NATO member states to US strategic goals. Such a risk of entrapment became evident again in 2003 during the postconflict phase of the Iraq War, when allies felt pressure to help rebuild Iraq.[39] In the years that followed the end of the Iraq War, European countries applied a strategy of restraint by leveraging preexisting NATO decision-making procedures and agreements. They also concentrated their efforts on a division-of-labor strategy within the context of the European Union (EU), planning to integrate their military capabilities under the EU's umbrella. While this strategy required a long time to implement fully, it could have helped the European allies become more independent militarily and provide support if needed.[40] It would have mitigated fears of abandonment and increased their ability to restrain the hegemon, if required, through concessions or denial of support.

Overall, since the dissolution of the bipolar order, NATO has been essential for European allies to manage the internal alliance security dilemma by employing the division-of-labor and restraint strategies.[41] While NATO European allies have been successful in managing their relationship with the US hegemon, modern-day developments and the evolving security environment necessitate that NATO expand its mission and operations into space to continue playing an essential role. The next section outlines the primary reasons why NATO must expand its operations and presence in space.

NATO Must Expand into the Space Domain

Considering the increasing and critical role that space plays in providing security on the ground, this article argues that NATO must expand its military capacities into the space domain. This would enhance the security of all NATO member states and provide crucial support to the United States, the current hegemon with which NATO has a vital interest in maintaining a strong relationship.

Specifically, the article proposes that (a) NATO extends its collective self-defense capabilities to outer space, (b) the European NATO countries collectively increase their space capabilities and assets by pooling their space resources, and (c)

[39] Press-Barnathan, "Managing the Hegemon," 307–08.
[40] Press-Barnathan, "Managing the Hegemon," 308.
[41] Press-Barnathan, "Managing the Hegemon," 308.

the allies diversify their space specializations and technologies to provide niche services to the United States. Before the article demonstrates the validity and necessity of this argument, it first discusses the significant role space plays in national and international security.

Why the Space Domain?

Space is a domain that is crucial for national security, and it is heavily relied upon by most countries, including all NATO member states. It plays a vital role in various essential activities, such as military operations, economic transactions, communication, weather monitoring, banking, and agriculture. In the military sector, space-based assets are indispensable for early warning, intelligence, surveillance, and reconnaissance (ISR), as well as position, navigation, and timing (PNT), and secure communications capabilities. NATO's "operations and missions, including collective defense, crisis response and counter-terrorism" are similarly dependent on space-based resources.[42] However, this dependence also creates a vulnerability for NATO member states, as outer space has become an increasingly congested, contested, and competitive domain, with multiple actors operating, often with competing interests.[43]

Outer space poses unique challenges that affect NATO's operations and member states. Issues like orbital debris and accidental collisions can seriously impact ground military capabilities, while the use of dual-use technologies and nuclear capabilities in space presents further risks to state security. These challenges not only affect individual NATO states but also the Alliance's ability to preserve the security of its member states by preventing, deterring, and responding to crises.

NATO faces ground challengers like China and Russia who possess antisatellite capabilities and can conduct hostile activities toward the United States and NATO allies by degrading or denying their space-enabled military capabilities.[44] For instance, in 2019, Norway accused Russia of "harassing" communications systems during a NATO exercise, which affected NATO's GPS signals and secure communication. The incidents were traced and attributed to Russian sites.[45]

Space has become a crucial element for states as a multiplier of national power and an enabler of security policies. NATO, as a state-centered military organiza-

[42] "NATO's Approach to Space," NATO, 12 April 2023, https://www.nato.int/.

[43] Sandra Erwin, "Space Force Leaders Questioned on Their Plans to Invest in Technology and Workforce," *SpaceNews*, 4 May 2022, https://spacenews.com/.

[44] "NATO's Overarching Space Policy," NATO, 17 January 2022, https://www.nato.int/.

[45] Frank A. Rose, "NATO and Outer Space: Now What?," *Order from Chaos* (blog), 22 April 2020, https://www.brookings.edu/.

tion, must develop capabilities in space if it wants to remain relevant and keep up with the United States.[46] To strengthen the NATO–US relationship, the Alliance must expand its role in space and be capable of restraining the United States if needed.. The next section discusses what functions NATO must assume to achieve this goal.

Considerations for NATO in Space

There are two main points to consider when examining NATO's role in space. First, the Alliance must fulfill its primary function as a collective defense alliance. As many threats and security challenges now extend to and from space, NATO must expand its collective self-defense capabilities to outer space. This requires acquiring military capabilities that enable NATO to deter and defend against threats in space to guarantee the security of all its member states.

Second, the current international system is still a unipolar order, where the United States enjoys power preponderance, particularly in the military realm.[47] Since the collapse of the Soviet Union, the United States has enjoyed hegemony, and NATO has had to reshape its relationship with Washington. European NATO member states have a vested interest in remaining in the Alliance to benefit from its security provisions and protection.[48] However, the relationship with the United States poses two risks to other NATO members—the fear of being abandoned by the hegemon and concern of being entrapped by Washington's strategic plans.

As discussed above, NATO members have adopted two strategies toward the United States since the end of the Cold War: (1) restraining Washington through the bonds of the Alliance agreements, and (2) providing support in specific military sectors.[49] Today, military threats and national security interests are moving into space, which is becoming an increasingly important "element of national power" and a "security policy tool" for states.[50] European NATO members should be prepared to apply the same two strategies toward the United States in the space domain. Specifically, the they should collectively increase their space capabilities and assets and diversify their space specializations and technologies to provide niche services to the United States. The combined space capabilities of

[46] Tale Sundlisaeter, "Space Power in the High North—Perspectives from the Kingdom of Norway" (PhD thesis, University of St Andrews, 2022), 8–15, https://research-repository.st-andrews.ac.uk/.

[47] Nuno P. Monteiro, *Theory of Unipolar Politics* (New York: Cambridge University Press, 2014), 3.

[48] Press-Barnathan, "Managing the Hegemon: NATO under Unipolarity," 308.

[49] Press-Barnathan, "Managing the Hegemon: NATO under Unipolarity," 308.

[50] Sundlisaeter, "Space Power in the High North," 8–15.

NATO states, along with their individually specialized and unique support, will impact the United States as both a restraining and a supportive tool. This approach will help the Alliance achieve the threefold effect of expanding its military capabilities in space, extending its collective defense to all domains, and continuing its vital relationship with the United States. The next section outlines the methodology used to demonstrate the validity of this article's argument before presenting the results on how NATO can best develop its space capabilities.

Case Study and Quantitative Data

To support the thesis that NATO should expand its purpose and capabilities in space, this article utilizes both a case-study approach and quantitative data. The case study relies on primary and secondary sources, including NATO publications, official NATO representatives' statements, and institutional changes adopted into NATO's structure, to determine which space capabilities NATO should prioritize. Additionally, a quantitative analysis of NATO member states' space assets in different orbital regimes is conducted to evaluate how their combined space capabilities can support the Alliance's collective security purpose. The Union of Concerned Scientists' Satellite Database, which is available online, is used to group, analyze, and assess the current space assets of NATO member states.[51] The data provided in this analysis is valid as of 1 May 2022.

Case Study: NATO's Evolving Approach to Space

NATO's official policy on space reflects its awareness of the complex challenges associated with space. This attention to space is not new, as evidenced by NATO's development of its own satellite system in the 1970s.[52] However, in the 2000s, the Alliance abandoned the idea of having its own satellites and instead relied on France, the United Kingdom, and Italy for its space assets. This approach, known as "SATCOM 2000," became NATO's program for satellite communications.[53] Since 2019, the program has also received contributions from US satellites. Today, while the Alliance does not own satellites, it relies on its member states "to provide space data, products, services, or effects . . . required for the Alliance's operations, missions, and other activities."[54]

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[51] Readers can access the database at https://www.ucsusa.org/.

[52] NATO, "NATO's Approach to Space"; and "NATO, We Have Lift Off!," NATO, 12 February 2019, http://www.nato.int/.

[53] Victoria Samson, "Nato And Its Changing Approach To Space," *Turkish Policy Quarterly* 20, no. 2 (September 2021), 76, http://turkishpolicy.com/.

[54] NATO, "NATO's Overarching Space Policy."

At the London Summit in December 2019, NATO leaders recognized space as an "operational domain, after air, land, sea, and cyberspace."[55] According to scholar Victoria Samson this definition indicates that NATO's focus is "on the integration and interoperability of assets belonging to different member states . . . as enablers of military operations . . . rather than those with the capacity of denying space to adversaries."[56] This aligns with NATO Secretary General Jens Stoltenberg's statement that the Alliance's approach to space is defensive and does not support the deployment of weapons in outer space. Given that NATO was founded as a defensive alliance, extending its defensive posture to space is a logical continuation.[57]

Another significant step in the Alliance's approach to space was taken at the Brussels Summit in June 2021, when NATO leaders agreed to invoke Article 5 if "attacks to, from, or within space present a challenge to the security of the Alliance."[58] This means that an attack against any NATO member state in or from space will trigger the collective defense clause of Article 5. NATO's 2022 *Strategic Concept* reiterates the Alliance's commitment to play a role in space it recognition of the challenges and threats in this evolving domain.[59]

On 22 October 2020, the Alliance established the NATO Space Centre at Allied Air Command in Ramstein, Germany, which serves as a focal point for NATO commanders to address matters related to space-enabled access and data sharing. NATO recognizes the importance that space has in deterrence and defense and emphasizes the need for space situational awareness (SSA) and access to space services.[60] SSA involves tracking and predicting objects' position and trajectory in space, and the Alliance is investing in a Strategic Space Situational Awareness System (3SAS) to integrate space in planning, training, and emerging space technologies.[61] Additionally, NATO members are making significant investments in providing their military assets with more resilient and efficient satellite communication services.[62]

As a defensive alliance, NATO recognizes space as an operational domain that plays a vital role in enhancing the defense and collective security of its member states.

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[55] NATO, "NATO's Approach to Space."

[56] Samson, "Nato And Its Changing Approach To Space," 79.

[57] "Press conference by NATO Secretary General Jens Stoltenberg ahead of the meetings of NATO Ministers of Foreign Affairs" (Brussels, NATO, 19 November 2019), https://www.nato.int/.

[58] NATO, "NATO's Approach to Space."

[59] NATO, "NATO's Approach to Space."

[60] NATO, "NATO's Approach to Space."

[61] Space Foundation Editorial Team, "Space Situational Awareness," September 2019, https://www.spacefoundation.org/.

[62] NATO, "NATO's Approach to Space."

While the Alliance has taken several specific steps to integrate space into its mission and operations, there are still gaps that NATO needs to consider. This article identifies these gaps and presents them in the discussion section, following a quantitative examination of each NATO state's contributions in terms of orbital assets.

Quantitative Data: Space Assets of NATO Member States in Various Orbital Regimes

This section presents the results of a quantitative research study that collected space data from US NATO allied states. The data are presented in table 1 and include:

- number of satellites owned by each US NATO allied member state;
- users of satellites—civil, government, commercial, or military;
- purpose of each satellite: earth observation, communication, navigation/global positioning, or other;
- location, or class of orbits of satellites: elliptical, low Earth orbit (LEO), medium Earth orbit (MEO), or geosynchronous orbit (GEO); and
- spaceport capability—by state.

Regarding the collection and computation of the data, the following is specified:

- Satellites are recorded by state ownership. In other words, the states listed are the official owners of the respective satellites.
- In case of multiple owners/users/purposes of a specific satellite, only the first reported owner/user/purpose was considered and counted.[63]

[63] "Satellite Database," Union of Concerned Scientists, 1 May 2022, https://www.ucsusa.org/.

Table 1. NATO satellites and spaceports. (Sources: Union of Concerned Scientists Satellite Database; All of the World's Spaceports on One Map).

STATE	TOTAL SATELLITES	USERS				PURPOSE				ORBIT				Spaceport/ Launch site
		Civilian	Government	Commercial	Military	Earth observation	Commercial	Navigation	Other	ELLIPTICAL	LEO	MEO	GEO	
Belgium	2			2			2						2	
Bulgaria	2	1			1		2				1		1	
Canada	56	8	5	42	1	5	42		9	2	22		32	1 in development[64]
Czechia	4	1	2		1	3			1	1	3			
Denmark	4		1	1	2	1	2		1		1		3	
Finland	18	2		16		16			2		18			
France	22	2	2	18		2	15	5		1	4	4	13	1 in development for mini satellite
France + other states	9			9				9		1		8		
Germany	45		28	15	2	29	1	14	1	3	25	14	3	
Greece	2		1		1		1		1		2			
Greece + UK	1		1						1		1			
Hungary	1		1						1		1			
Italy	15		4	10	1	5	10				14		1	
Lithuania	2			2			2						2	
Luxemburg	42		15	23	4	31	9		2	4	29		9	
Netherlands	14		14				14				14			
Norway	9		9				9				9			1+1 in development [65]
Poland	5		5				5				5			
Poland + UK	1		1				1				1			
Slovenia	2	1			1	1			1		2			
Spain	26			26		26					26			

[64] "Canada's First Commercial Spaceport," Maritime Launch, 7 March 2023, https://www.maritimelaunch.com/.

[65] "The Norwegian Government Has Approved the Building of a New Spaceport," *SatNews*, 12 October 2021, https://news.satnews.com/.

STATE	TOTAL SATELLITES	USERS				PURPOSE				ORBIT				Spaceport/ Launch site
		Civilian	Government	Commercial	Military	Earth observation	Commercial	Navigation	Other	ELLIPTICAL	LEO	MEO	GEO	
Turkiye	10			10		10					10			
UK	486	17	60	319	90	101	270	34	81	12	378	55	41	7 in development [66]
UK + other states	2			2			2				2			
TOTAL	780	32	149	495	104	230	387	62	101	24	568	81	107	

The collected data leads to the following observations:

- US NATO allied states collectively own 780 satellites (excluding 56 Canadian satellites, European allied states own 724 satellites). These assets could be utilized to augment the 3,433 operational satellites that the United States currently operates, resulting in an overall 22-percent increase in capacity, all other things being equal. However, the specific increase in capacity would vary depending on the type of satellite and orbital regime.
- The US NATO allies with the highest number of satellites are the United Kingdom, Canada, and Germany.[67]
- The predominant users of NATO allied states' satellites are commercial actors.[68]
- The most frequent purpose of satellites owned by NATO allied states is communication.[69]
- Most satellites of NATO allied states are located in LEO.[70]
- Eleven NATO European allies do not have any space assets. Those are Estonia, Finland, Iceland, Latvia, Romania, Slovakia, Slovenia, Albania, Croatia, Montenegro, and North Macedonia.[71]

[66] Dhara Patel, "UK Spaceports—Making British Spaceflight History," National Space Centre, 17 February 2022, https://spacecentre.co.uk/.

[67] Union of Concerned Scientists, "Satellite Database."

[68] Union of Concerned Scientists, "Satellite Database."

[69] Union of Concerned Scientists, "Satellite Database."

[70] Union of Concerned Scientists, "Satellite Database."

[71] Union of Concerned Scientists, "Satellite Database."

- Only the United Kingdom (Orbex LP1 at Kinloss) and Norway (Andøya Space Center), among the NATO allied countries, have orbital spaceports on their territory.[72] France is working on building at least one mini/micro launcher by 2026.[73]

Discussion and Recommendations

The satellite data points to two important conclusions. Firstly, NATO allies collectively own a substantial number of satellites that could increase the space capabilities of the US by at least 23 percent of its current capabilities. While the US is currently the dominant space power, owning 63 percent of all satellites in space, or 3,433 out of 5,465 total operating satellites, the combined space capabilities of NATO allies,[74] which is a total of 780, can augment US space capabilities even further, particularly in the low Earth orbit (LEO), where NATO allies have a combined total of 568 operating satellites. LEO is crucial for communications, military reconnaissance, spying, and other imaging applications, and having more satellite redundancy and resilience in LEO is essential. Therefore, combined NATO member states' satellite capabilities can help achieve this objective. However, achieving full pooling of NATO member states' satellites may face opposition from some nations, such as France, which is proud of its space capabilities and may not want to let NATO use all its satellites in service of the US. The Alliance may have to come to terms with nations willing to allow only selected space capabilities while developing policies that discourage such nationalistic positions.

Additionally, the disproportional concentration in a few countries , with the UK alone owning more than half of the 780 satellites of the US NATO allies, suggests that more NATO member states should be encouraged to develop their own space capabilities. This consideration is further supported by the fact that 10 NATO European allies do not have any satellites.

Additionally, the low number of orbital launch sites in European NATO member states indicates another capability that should be developed. More spaceports should be built to serve as a backup in case of unavailability of any US site. Currently, Norway has one active spaceport and another in development, while the

[72] Nick Routley, "All of the World's Spaceports on One Map," *Visual Capitalist*, 18 October 2022, https://www.visualcapitalist.com/.

[73] Ministere de l'Enseignement Superieur et de la Recherche, "France 2030 : présentation des premiers lauréats du volet spatial et signature du contrat d'objectifs et de performance du CNES" [France 2030: presentation of the first winners of the space component and signature of the CNES objectives and performance contract], 6 October 2022, https://www.enseignementsup-recherche.gouv.fr/.

[74] Union of Concerned Scientists, "Satellite Database."

United Kingdom has approved seven spaceports to be built. The European Space Agency (ESA) also has one active spaceport in French Guiana. Currently, the United States has six active spaceports, with more in development.[75] By building more launch sites, European NATO member states can enhance US launch avenues, giving the United States the option to launch from different sites worldwide and achieve various orbits.

Both conclusions focus on the critical topic of enhancing the resiliency of space assets, primarily through increased redundancy. *Resiliency* refers to a system's "robustness and survivability," or to the capacity of a system to withstand or recover quickly from difficulties.[76] This can be achieved through increased *redundancy*, defined as the multiplication of or the inclusion of extra components and assets in a network of satellites to prevent failure, damage, or service interruption. Increased redundancy leads to increased resiliency, aimed at keeping a system "operable, should one or more of its parts be attacked."[77] Furthermore, resiliency can "minimize adversary incentives to carry out first strike in space," since the enemy may not consider the cost-effectiveness of such an attack.[78] Even if the enemy's attack could destroy or degrade a space asset, an equivalent asset would be available to replace it, nullifying the attacker's efforts.

Resilience is fundamental to space deterrence and partnerships can contribute tremendously to strengthening it by sharing resources and capabilities.[79] By enhancing resiliency, NATO can develop its own deterrence strategy while also supporting the US defense strategy in space through the multiplication and sharing of space assets by European Allies.[80]

On the practical level, NATO member states can contribute to collective security of the Alliance in space not only by increasing the number of satellites and launching sites but also by diversifying the use of their satellites and developing niche space technologies. These niche specializations in space activities by NATO

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[75] Thomas G. Roberts, "Spaceports of the World," *Aerospace Security*, 31 January 2023, https://aerospace.csis.org/.

[76] Andrea Console, "Space Resilience—Why and How?" Joint Air Power Competence Centre, 2 December 2018, https://www.japcc.org/; and Muhammad Raza, "Resiliency vs Redundancy: What's the Difference?," *BMC Blogs*, 10 September 2019, https://www.bmc.com/.

[77] "Resilient Space: The Real Star Wars," Aerospace Corporation, 27 November 2017, https://aerospace.org/.

[78] Zack Cooper and Thomas G. Roberts, "Deterrence in the Last Sanctuary," *War on the Rocks*, 2 January 2018, https://warontherocks.com/.

[79] Ryan Schradin, "Resiliency, Redundancy and Partnerships to Protect Global Commons of Space," *GovSat*, 22 July 2020, https://sessd.com/.

[80] Sandra Erwin, "U.S. National Defense Strategy Calls for 'Resilient, Redundant' Space Networks," *SpaceNews*, 27 October 2022, https://spacenews.com/.

European countries would create new ties with the United States and promote strategic constraint within the Alliance if needed.

An example of such an approach is France's "Graves" program, which specializes in "space intelligence gathering capability."[81] Introduced in 2005 and modernized in 2016, Graves is a "ground-based . . . space-surveillance system."[82] It is capable of tracking "satellites and objects in orbit at 400 to 1000 km above the Earth." The French Air and Space Forces use it to "track foreign spy satellites."[83] The program's success has made it an appealing partner for the United States, which in 2015 signed an agreement with France to share military classified intelligence information.[84] Graves exemplifies how specialized space programs can foster partnerships and cooperation with the United States, an objective that European NATO countries should pursue collectively under the NATO umbrella to maintain a strong bond with the US hegemon in the space domain.

After analyzing NATO's evolution in space and collecting data on US allies' current satellites in space, the next section will focus on additional important issues that NATO must address to enhance its role in the space domain.

Additional Issues that NATO Needs to Address

Until today, NATO has shown awareness of the crucial role that space plays in modern military operations. Consequently, NATO has institutionalized certain changes, such as the creation of the NATO Space Centre at Allied Air Command in Ramstein, Germany, and the NATO Space Center of Excellence in Toulouse, France. However, NATO still needs to develop a clear strategic plan for integrating space in a meaningful way to remain a credible collective security alliance in defense of its member states and continue to be useful to the United States.

NATO's response to and integration of space in its daily operations will determine whether it can achieve a relevant role in space and manage its relationship, as an alliance, with the United States. If NATO fall behind, the United States may abandon it and form more convenient unilateral, bilateral, or multilateral joint ventures with other partners.

This study's results demonstrate that NATO can uniquely contribute to its collective security mission and U.S. space assets by increasing the latter's resiliency in various orbital regimes. NATO allies can do so through their collective and indi-

[81] Pierre Tran, "Deal Breathes New Life into France's Space-Surveillance Radar," *Defense News*, 12 December 2016, https://www.defensenews.com/.

[82] Tran, "Deal Breathes New Life."

[83] Tran, "Deal Breathes New Life."

[84] Tran, "Deal Breathes New Life."

vidual space assets. Additionally, the Alliance must concentrate its efforts on integrating the space domain successfully into several additional areas.

First, NATO's official space policy does not include a defined deterrence strategy or a plan for implementing such deterrence in space.[85] NATO must clearly outline how to integrate space within its defense plans and operations.[86] This task will be challenging as NATO will need to reconcile its position on space with the differing views of its member states. For example, NATO views space as an operational domain, whereas the United States regards it as a war-fighting domain "where offensive and defensive military operations take place."[87] Furthermore, while NATO has declared its intention not to deploy weapons in space, some of its members, such as France and the United States, have conducted tests and studies on various space-based weapons systems technologies.[88] Such conflicting views could potentially increase in future, considering that more nations could become interested in further developing space weaponization technologies. This scenario raises questions for NATO, including how to reconcile its members' differing perspectives and whether it will be necessary to redefine NATO's definition of outer space.

A second important issue concerns the North Atlantic Treaty's Article 5, which forms the foundation of the Alliance's collective defense.[89] Victoria Samson has highlighted the vagueness of NATO Secretary General Jens Stoltenberg's approach to addressing the cases covered by Article 5 during a November 2019 press conference.[90] This ambiguity was reinforced at the 2021 Brussels summit, where Alliance leaders stated that "the invocation of Article 5 would be taken by the North Atlantic Council on a case-by-case basis."[91] This highlights the need for NATO to define a clear threshold for triggering Article 5 and establish the domain in which a response will take place.[92] Additionally, the U.S. has taken a firm position to respond to attacks "in time and place of its choosing," further complicating matters for NATO to address.[93]

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[85] NATO, "NATO's Overarching Space Policy."

[86] Rose, "NATO and Outer Space."

[87] Congressional Research Service, *Space as a Warfighting Domain: Issues for Congress*, IF11895 (Washington, DC: CRS, 2021), 1, https://crsreports.congress.gov/.

[88] Hanneke Weitering, "France Is Launching a 'Space Force' with Weaponized Satellites," *Space.com*, 2 August 2019, https://www.space.com/; and Theresa Hitchens, "Exclusive: Pentagon Poised To Unveil, Demonstrate Classified Space Weapon," *Breaking Defense* (blog), 20 August 2021, https://breakingdefense.com/.

[89] NATO, "The North Atlantic Treaty."

[90] Samson, "NATO And Its Changing Approach To Space," 81.

[91] NATO, "NATO's Approach to Space."

[92] Samson, "NATO And Its Changing Approach To Space," 81.

[93] Samson, "NATO And Its Changing Approach To Space," 82.

A third area concerns Article 6 of the North Atlantic Organization Treaty, which states that "the allies may only invoke collective defense in response to armed attacks against territory, vessels, forces, or aircraft stationed on allied territory, in the Mediterranean Sea, or in the Atlantic north of the Tropic of Cancer."[94] In a 2020 article entitled "NATO's Return to Space," researcher Benjamin Silverstein points out that Article 6, written in this way and with such "geographic limits," excludes the possibility of invoking collective defense also in response to an armed attack against a satellite. According to Silverstein, "Expanding the parameters of Article 6 would send strong signals to adversaries that threats to space-based assets will not be tolerated," and it would be "an opportunity to blanket allied space assets with Article 5 protections."[95] In all, NATO should consider changing its language, to be able to assume a collective defense posture also in space. To address those challenges, this article proposes that NATO adopt the following recommendations.

First, NATO faces the challenge of designing a realistic deterrence strategy for space, which requires its members to agree on accepted norms of behavior in space. The absence of clear norms of behavior in space provided by the outer space legal regime makes it even harder to define what constitutes a threat and how to apply collective defense. The 1967 UN Outer Space Treaty (OST), which is the primary legal reference for space activities, is vague and too broad.[96] Although it prohibits the use of nuclear and mass destruction weapons in space, it does not explicitly limit the placement of other types of armaments.[97] To address this issue, in 2020, the UN General Assembly adopted the 75/36 resolution, which encourages the reduction of "space threats through norms, rules, and principles of responsible behaviors."[98] NATO could contribute to defining norms of behavior in space by hosting a discussion forum of allied states. Reaching a common ground on norms of behavior in space, shared definitions of the use of force, and agreed-upon arms control measures will be essential for NATO's future.[99] NATO should

[94] NATO, "The North Atlantic Treaty."

[95] Benjamin Silverstein, "NATO's Return to Space," *War on the Rocks*, 3 August 2020, http://warontherocks.com/.

[96] Office for Outer Space Affairs, United Nations, "Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies," 19 December 1967, https://www.unoosa.org/.

[97] Victoria Samson and Brian Weeden, "Enhancing Space Security: Time for Legally Binding Measures," *Arms Control Today*, December 2020, https://www.armscontrol.org/.

[98] "75/36 Reducing Space Threats through Norms, Rules and Principles of Responsible Behaviours," United Nations Disarmament Yearbook (New York: United Nations, 12 July 2020), 1, https://doi.org/.

[99] Stephen van Evera, "Offense, Defense, and the Causes of War," *International Security* 22, no. 4 (1998): 14–22, https://doi.org/.

therefore accelerate the creation of codes of conduct in space, upon which the Alliance can build its framework of deterrence and collective defense more easily.

Second, to effectively act on its ambitions in space, the Alliance must recognize the crucial role of outer space and give it real visibility within NATO's structure, rather than treating it "as merely a 'novelty item."[100] As suggested by Frank Rose, key NATO offices such as the Assistant Secretary General for Defense Policy and Planning or the Assistant Secretary General for Defense Investment should address space-related matters at the strategic level.[101] At the operational level, the Allied Command Transformation should integrate space capabilities into every NATO exercise and wargame to increase preparedness against possible attacks on NATO's space assets. Moreover, NATO should establish a close dialogue with the US Space Force and the US Space Command and work together with them. It would be desirable for NATO personnel to participate regularly in the US Schriever Wargame. Similarly, cooperation should occur on the EU side, and NATO should serve as a bridge between US and EU capabilities, thus expanding the range of usable space services and leveraging resiliency, as discussed in a previous section of this article. One example could be the Public Regulated Service (PRS), which is an encrypted navigation capability of the European global navigation satellite system Galileo. Making it accessible to all state members of the Alliance would provide a valid substitute for GPS in case the latter is jammed or rendered unusable.[102]

Conclusion

NATO was established as a collective defense military alliance after World War II to confront the threat posed by the Soviet Union. The end of the Cold War led to a unipolar international system, which brought about an increase in the number and types of threats and the emergence of an alliance security dilemma. European NATO members desire to maintain the security provided by the alliance but are faced with the dual risk of abandonment and entrapment by the United States. To counter this, since 1991, European NATO members have aimed to gain unique capabilities that increase their bargaining power and operational independence.

However, space has added new dimensions and challenges to NATO's role and purpose. As a state-centered military organization, NATO has recognized the importance of space in enabling national power and security policies. Yet, the Alliance's efforts to integrate space into its mission have been limited to institu-

[100] Rose, "NATO and Outer Space."
[101] Rose, "NATO and Outer Space."
[102] Rose, "NATO and Outer Space."

tional changes. To remain a credible collective security alliance in defense of its member states and useful to the current ground and space hegemon, NATO needs to develop a clear strategic plan on how to play a meaningful role in space.

This article examines NATO's evolving perspective on space and presents quantitative evidence showing how NATO can enhance the collective defense of its members, including the United States, in and from space. The case study and data presented here demonstrate that NATO member states can contribute to collective security in space by pooling their space assets and developing niche space capabilities. This will enable NATO to continue to be a useful alliance to the United States in space and provide European members with tools to restrain US hegemony if necessary.

In addition, NATO must focus on two key areas to successfully integrate the space domain. Firstly, the Alliance must clearly define its deterrence strategy for space and integrate it into its defense plans and operations. Secondly, NATO should clarify what invoking Article 5 in response to an armed attack against a satellite would entail for the extension of collective defense into outer space.

If NATO fails to respond promptly to the challenges posed by the space domain, its role and strategic relationship with the United States could be undermined. ✪

Lt Col Emma Palombi, Italian Air Force

Lieutenant Colonel Palombi is an Italian Air Force flight instructor pilot. She joined the Italian Air Force Academy in 2000 when the first female cadets were admitted. After graduating in with a degree in political science and being promoted to the rank of second lieutenant, in 2005 she completed her pilot training at Sheppard AFB, Texas. As a first lieutenant, in 2006 she was assigned to the 46th Airlift Brigade in Pisa, Italy, where she served until 2011 flying the Hercules C130J. During her service in Pisa, she accomplished several out-of-area flight operations and was deployed multiple times in Afghanistan, as a C130J crew member.

In 2009 she was promoted to the rank of captain. From October 2011 to March 2018, she served at the 31st Wing in Ciampino AFB (Rome), where she operated as a flight commander and instructor pilot on Dassault Falcon 900 EX and Falcon 900 Easy. According to the 31st Wing's mission, Palombi conducted several hospital flights and state flights. In 2017 she was promoted to the rank of major. In March 2018 she was posted to the 70th Wing in Latina Air Base, where she qualified as a flight instructor on the trainer aircraft T-260B. From September 2021 until September 2022, Lieutenant Colonel Palombi was appointed commander of the 207th Squadron, being responsible for the selection and flight training of the Italian Air Force and other Armed Forces' cadets. From September 2021 to May 2022, she held the position of the Chief of the Operations branch of the 70th Wing. In 2021, Palombi was promoted to the rank of lieutenant colonel. She is currently a student at the Air War College, Air University, Maxwell AFB, Alabama.

Pushing Boundaries

Can the Indian Military Transform?

Air Vice Marshal (Dr.) Arjun Subramaniam, Indian Air Force, Retired

Abstract

The article argues that any discussion on the transformation of a nation's military must consider the conflict environment in which this transformation takes place. From an Indian perspective, the possibility of large-scale conventional wars, limited wars, and subconventional conflicts in varied terrain, including vast maritime spaces under a nuclear shadow, remains distinct. As a result, India needs to maintain its continental posture and a large standing army to maintain credible deterrence against external adversaries and to plug internal fissures and cracks. The need to maintain a large navy and air force is also necessary for deterrence, latent coercive capability, and support for the expansion of interests and influence. However, the article argues that India needs to consider restructuring and integrating its army, navy, and air force to meet contemporary challenges and pool capabilities with partners, particularly in the Indo-Pacific, where China is steaming ahead. Failure to do so will leave India open to sustained pressure on multiple fronts. The article concludes by highlighting the need for India's military to confront uncertainties and emerge as the sword arm of Indian statecraft in its quest for leading power status.

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Notwithstanding its ancient civilization and inherited wisdom, India remains somewhat tentative and unsure about the use of power.

—Admiral Arun Prakash, retired

Continued threats, constant stress, and periodic conflicts over seven decades across the 6,000-kilometer land frontiers with Pakistan and China have significantly shaped India's military force structure. The proliferation of internal armed conflict along India's land periphery and the widespread employment of the Indian Army (IA) in counterinsurgency (COIN), counterterrorism (CT), and internal stability operations over the past six decades have resulted in an army-centric, reactive, and manpower-heavy approach to war fighting—with suboptimal emphasis on innovation and a combined arms approach.[1]

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[*] An earlier version of this work appeared as a chapter in Ashley J. Tellis, Bibek Debroy, and C. Raja Mohan, *Grasping Greatness: Making India a Leading Power* (Gurugram, Haryana, India: Penguin Random House India, 2022), 527–70.

[1] Abhijnan Rej and Shashank Joshi, 'India's Joint Doctrine: An Opportunity Lost', ORF Occasional Paper #139, January 2018.

However, in recent years, there have been incremental changes in the way India's political establishment is willing to look at its armed forces as an effective instrument of statecraft. There is also a willingness to move from an overall posture of *reactive deterrence* vis-à-vis India's adversaries to one that can at best be termed as *proactive deterrence*. From an Indian perspective, while the former refers to a propensity to react to a crisis with excessive caution and only consider military responses after a crisis has unfolded, such as the Parliament attack of December 2001 and the Mumbai terrorist attacks of 2008, the latter signals a willingness to respond with firmness to restrict the adverse impact of a perceived act of aggression, as what happened in Doklam. India's current military posture does not exactly suggest a muscular shift, as argued by some—it merely reflects a willingness to move in that direction.[2] However, it is seriously hampered by a lack of capability and adequate synergy between various stakeholders of national security. Some changes in the realm of alignments and partnerships and a realization that new challenges like the emergence of contested strategic spaces in the Indo-Pacific now present opportunities to accelerate integration and synergy within India's armed forces. Consequently, a shift from a predominantly continental and conventional war-fighting mind-set to a more holistic and contemporary one that focuses on the maritime, aerospace, and cyber domains in full-spectrum operations is inevitable, as issues such as influence and protection of interests gain traction, particularly in the maritime domain.

This article examines how elements of a transformed Indian military could further Indian political objectives in the Indo-Pacific strategic space over the next two decades, given a conservatively linear growth in capability and a defense budget that would strain to cross 2 percent of GDP unless a black swan event—like the Kargil conflict, or a prolonged continuation of the current face-off with China in Eastern Ladakh—forces greater allocation of resources.[3] There is little doubt that China's increasing assertiveness in the Indian Ocean region (IOR) over the past few years, and its current belligerence in Eastern Ladakh, has forced India to strengthen its security relationship and engagement with not only the United States but also with Japan, Australia, Taiwan, Korea, Singapore, and Vietnam, thereby expanding its footprint from the IOR to a wider expanse that has now been conveniently termed as the Indo-Pacific. To focus exclusively on the India–

[2] Sumit Ganguly and S. Paul Kapur, "Is India Starting to Flex its Military Muscle?," *Foreign Policy*, 17 October 2017, http://foreignpolicy.com/. It can be argued that events following the Doklam incident do not support this proposition.

[3] For a microscopic analysis of the 2018–19 Defence Budget, see Laxman K. Behera, "Defence Budget 2018–19: The Imperative of Controlling Manpower Cost," *IDSA Issue Brief*, 2 February 2018, https://idsa.in/.

US dimension of the Indo-Pacific is restrictive and deflects from the larger issue of India's security challenges.[4]

Other significant drivers that have necessitated transformation are a recognition of the need to create force structures that are lean, rapidly deployable, and adaptable to the swiftly changing nature of contemporary conflict in a volatile security environment under squeezed budgetary conditions. The critical driver of transformation to cope with these changes, however, will have to be political decisiveness and the courage to initiate structural reforms, while also demanding greater accountability from all stakeholders of national security, including India's military-scientific-industrial complex. As Ashley Tellis argues, one of the key determinants of India acquiring great power status will be "acquiring effective military capability for power projection coupled with wise policies for their use."[5]

The Contemporary Strategic Landscape

Considering that the Indo-Pacific as a security construct is here to stay as long as it remains an area of strategic contest between two of the world's preeminent powers, the United States and China, and the emergence of India as a leading power of some consequence in the same region, a survey of some geo-military challenges and assumptions from an Indian military perspective is in order. China and Pakistan would continue to pose significant conventional military challenges under the protective umbrella of their nuclear arsenals. The collusive nature of the China–Pakistan relationship, Pakistan's proxy strategy in Jammu & Kashmir (J&K) and sporadic border face-offs and skirmishes would ensure that the IA remains deployed in large numbers in its current profile.[6] Consequently, it would continue to resist any major shift away from a continental focus on war fighting. India's demographic challenges will be significant,[7] and, despite a concerted top-down approach at creating leaner structures, the inability to productively harness its huge youth bulge could well mean that a large standing military will remain a

[4] Richard A. Bitzinger, "The Chinese People's Liberation Army in Transition: Implications for Indian Defence," in *Defence Primer: An Indian Military in Transformation*, ed. Harsh Pant and Pushan Das (New Delhi: Observer Research Foundation, 2018), 22. Bitzinger argues forcefully that China's military footprint in the Indian Ocean region has been disquieting.

[5] Ashley J. Tellis, *India as a Leading Power* (Washington, DC: Carnegie Endowment for International Peace, 2016), 1.

[6] For an interesting and structurally sound argument on various possibilities in Jammu & Kashmir, see Paul Staniland, "Kashmir since 2003: Counterinsurgency and the Paradox of Normalcy," *Asian Survey* 53, no. 5 (October 2013): 931–57.

[7] Tellis, *India as a Leading Power*, 7.

developmental imperative that will change only when India's population inversion commences in the middle of the current century.

However, as alluded to earlier, the Indo-Pacific—with emphasis on the IOR—would drive India's maritime focus and force it to develop joint war-fighting capabilities for out-of-area contingency (OOAC) and expeditionary operations.[8] This would also bring to the fore the importance of aerospace power as an enabling force multiplier in full-spectrum operations. The Indian Navy (IN) and Indian Air Force (IAF) would continue to struggle with budgets, capabilities, and numbers to meet India's rising power-projection aspirations. While the navy would largely benefit from its focus on indigenization, the IAF would remain afflicted with acquisition woes and seek to compensate with high levels of training, operational preparedness, and interoperability with Western and partner air forces like those from the United States, France, Singapore, and the United Kingdom.[9]

Military capability development in China and India over the next two decades would be linear and in line with current trends. Consequently, the existing differential will widen discomfortingly and force India to review its strategic options and deepen military synergies with strategic partners and possible allies like the United States, Japan, Vietnam, and France. The military dimension of the India–US strategic partnership would continue to be robust and emerge stronger than many current alliances that the US military has a stake in. Technology transfer and coproduction of cutting-edge platforms could see India emerge as a modest hub for defense production in the Indo-Pacific. The India–France security and technological collaboration will be robust as India seeks to hedge its strategic partnership with Russia against a downside, as one prominent strategic commentator has argued.[10] It is expected that a *Strategic Defence Review*, *National Security Strategy*, and *International Defence Engagement Strategy* will provide the necessary vision for synergized single-service and joint military doctrines.[11]

The four strategic drivers that can play a key role in the operational transformation of India's military and service its aspirations for leading power status are: management of rapid power shifts, proactive deterrence, active protection of overseas interests, and operational conversion of existing and emerging capabilities.

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[8] India's strategic establishment has always been chary of the term *expeditionary operations*, preferring to use the term *out-of-area contingency operations*.

[9] A reflection of this approach has already sunk in with the IAF conducting its exercise Gaganshakti in April 2018 with an intensity seldom seen in the past.

[10] C. Raja Mohan, "France: India's New Russia?," *Indian Express*, 9 March 2018, https://indianexpress.com/.

[11] Sushant Singh, "NSA will chair panel set up for new security roadmap; Foreign, Defence Secys its members," *Indian Express*, 19 April 2018, https://indianexpress.com/.

Servicing a Leading Power Role

Managing Rapid Power Shifts

In a talk at the Munich Security Forum held at New Delhi in 2014 soon after Prime Minister Narendra Modi came to power, India's National Security Advisor Ajit Kumar Doval spelled out with some clarity what he perceived to be his greatest concerns about global security.[12] Foremost among them were rapid power shifts and the need to restore equilibrium through swift collaborative action. Flowing from this concern, signs of a subtle shift in India's approach to deterrence have prompted commentators to ask whether an era of effective deterrence and paradigm shift in the way security is understood in the country has commenced.[13] Addressing military commanders aboard INS *Vikramaditya* months later in December 2015, Modi advised them to reform their "beliefs, doctrines, objectives and strategies." He continued, "[A]t a time when major powers are reducing their forces and relying more on technology, we are still constantly seeking to expand the size of our forces. Modernization and expansion of forces at the same time is a difficult and unnecessary goal. We need forces that are agile, mobile and driven by technology, not just human valour."[14] The language and intent were right, but whether they would translate into perceptible shifts in doctrine would ultimately dictate the pace of reform in the Indian military. The French *Defence and National Security Strategic Review 2017* articulates five strategic functions that India would do well to emulate if it wants to convert policy drivers into effective operational strategies. These are deterrence, protection, knowledge and anticipation, intervention, and prevention.[15]

Proactive Deterrence

India's approach to deterrence over the years has primarily revolved around denial strategies that sought to blunt an adversary's capacity to cause significant damage through resilience and then push back with strength. Doval's speech at the Munich Security Forum promised that deterrence mechanisms in India would demonstrate an environmental adaptability that catered to new actors, new means

[12] Excerpts from a talk delivered by India's National Security Advisor Ajit Kumar Doval, 21 October 2014, https://securityconference.org/.

[13] Abhijit Iyer Mitra, "Era of Effective Deterrence," *Daily Pioneer*, 31 October 2014, http://www.dailypioneer.com/.

[14] R. Chandrashekhar, "Shekatkar Committee report's key principle: Armed Forces must replace tradition with pragmatism," *FirstPost*, 5 September 2017, https://www.firstpost.com/.

[15] Defence and National Security Strategic Review 2017, https://espas.secure.europarl.europa.eu/.

of warfare, and new contexts. Though there has been an attempt by the present government to showcase that the cross- border strikes against Naga rebels along the Indo-Myanmar border, the "surgical strikes" across the Line of Control (LoC) with Pakistan, the IA's push back at Doklam, and the IAF's preventive air strikes at Balakot are indicators of this newfound assertiveness, the situation on the ground is a mixed bag of results. Nagaland has been quiet since the 2016 strikes, and the proxy war in J&K has shown signs of waning after the Indian security forces eliminated the largest number of terrorists in 2018 in an eight-year period and the government followed that with the abrogation of Article 370 and 35A in 2019.[16] One could also argue that the IA's assertive stance in Doklam further validated this shift, as did the Balakot air strikes. However, the People's Liberation Army's (PLA) infrastructure building effort continues barely a few kilometers to the east of the contentious areas in Bhutanese territory.[17] Making matters even more complicated was the PLA's swift aggression in the summer of 2020 when it transgressed widely in disputed areas of Eastern Ladakh, an action that sparked fears of a limited conflict between the two Asian powers and triggered a reactive but firm response from India over the next few months.[18] It is in this complex environmental milieu that India's emerging position of proactive deterrence remains a work in progress.

Though preemptive, preventive, or coercive strategies were never the first choice of India's strategic establishment in the past, the fierce response to Chinese provocation at Nathu La, a high-altitude pass in the Sikkim sector, in 1967; the occupation of the Saltoro Ridge, which dominates the Siachen Glacier in 1984; and a swift brigade-sized heli-landed operation at Sumdorong Chu (Arunachal Pradesh) in response again to Chinese incursions in the region are some examples of India seizing the operational initiative. An assessment of all three operations points at isolated and personality-orientated decision making, involving assertive military leaders being able to convince the political leadership of the necessity to seize the initiative. However, continuous political instability in the 1980s and 1990s and serious financial constraints led to an inability to clearly enunciate preemption and prevention as

[16] A Suryaprakash, "Abrogation of Articles 370 and 35A has created possibilities of development," *Indian Express*, 5 August 2020, https://indianexpress.com/; and Bharti Jain, "223 terrorists killed in Jammu and Kashmir this year, the highest in eight years," *Times of India*, 9 December 2018, https://timesofindia.indiatimes.com/.

[17] For a detailed discussion document on the continued Chinese buildup in the Doklam area, see Anirudh Kanisetti and Prakash Menon, "Takshashila Discussion Document: The Doklam Imbroglio'," https://takshashila.org.in/.

[18] Ashley Tellis, "India's Response to Chinese Aggression in Ladakh has been very good, says scholar Ashley Tellis," *The Print*, 7 November 2020, https://theprint.in/.

a doctrinal underpinning despite the scaling up of the ongoing proxy war waged against India in J&K by Pakistan and increasing Chinese assertiveness along the Line of Actual Control (LAC).[19] Nine years into the present Bharatiya Janata Party–led government's gradually transforming deterrence posture, which Sumit Ganguly and S. Paul Kapur have likened to flexing of military muscle, there is a clear willingness to induce some heft to deterrence.[20] However, in a clear strategic divide, skeptics of force application and technology-driven force structures have been cautioning the government against escalation along the LoC and "blindly buying into the optical power of technological innovation."[21] The punitive strikes along the Myanmar border against the National Socialist Council of Nagaland–Khaplang (NSCN–K) in June 2015 were the first calibrated step on the part of Prime Minister Modi's national security team in testing the deterrence and escalation ladder. It allowed Indian Special Forces to gain self-belief in their already--proven capabilities and went one step further in 2016 by testing the response of an irrational adversary during a series of shallow cross-border strikes against terrorist camps/shelters/staging areas in Pakistan-occupied Kashmir (PoK). Notwithstanding the fact that such operations were conducted in the past, the present set of well-executed tactical operations have had a positive impact on the morale of India's armed forces like rarely before; they have demonstrated improved short-of-war military capabilities and allowed the government to explore "harder options" when the intended outcomes were not forthcoming. The IAF strike at Balakot was a result of this exploratory process and resulted in the Indian strategic establishment having to navigate through uncharted territory ever since. Apart from gaps in capability that need urgent attention, the IAF's spirited air defense response the next day to counter a powerful Pakistan Air Force (PAF) package signals a willingness to push boundaries of robust deterrence. Questions on whether Prime Minister Modi's government will follow through with its articulated posture that "this will be the new normal" were put to rest when the air strikes were followed by the abrogation of Article 370 and 35A in J&K, a move that sucked the oxygen out of the Pakistan-led secessionist proxy war. Some signs of a realization that Pakistan's deep state seems

[19] Jonathan Renshon, *Why Leaders Choose War: The Psychology of Prevention* (Westport, CT: Praeger, 2009), 149. Also see 87–106. All the conditions that support preventive and preemptive action by India against Pakistan existed (declining power of Pakistan vis-à-vis India, inherent bad faith between the two, a widespread belief that war was inevitable, a knowledge that only a "short window was available to act," a situation that favored an offensive) and yet India chose to be reactive during the period 1988–2017.

[20] Ganguly and Kapur, "Is India Starting to Flex its Military Muscle?," 2017.

[21] Prakash Menon, "The Toll of Revenge," *Indian Express*, 7 March 2018, https://indianexpress.com/; and Prakash Menon, "Military Power and the Allure of Technology," *Pragati*, 28 March 2018, https://www.thinkpragati.com/.

to be reflecting on a sane conclusion that waging a covert war against India hurts its own society more than that of its adversary have led to some recent "green shoots" in the peace process through a renewed ceasefire agreement.[22] These are issues that trouble over a billion Indians and Pakistanis.[23]

Faced with the renewed collusive threat from the China–Pakistan duo, the deterrence debate in India is heating up as a growing power, like India, is seeking a new normal and stakeholders, like the IAF, are arguing that it is now fusing in capabilities that would allow it to practice dissuasive compellence. If India is serious about effectively managing multiple adversaries and significantly raising the costs of aggression against it, India will naturally have to sharpen its military tools and develop more proactive, synergized, and networked operational strategies.

Protection of Overseas Interests

In the past, India has sporadically attempted to protect its overseas interest, which primarily comprises the safety of its diaspora and burgeoning economic investments, with stray expressions of kinetic and nonkinetic military capability to retain influence and assist friendly neighbors in distress. Following the signing of the Indo–Sri Lanka Peace Accord (ISLA) in July 1987, the Indian government deployed the Indian Peace-Keeping Force (IPKF) rather hastily in an attempt to restore peace in the troubled island. While the primary reason for the intervention was to oversee the implementation of the ISLA and broker peace between Tamil separatist groups and the Sri Lankan government, it had concurrent strategic objectives of restricting the entry of extraregional powers such as the United States into the region should the latter show an interest in such mediation.[24] Many commentators like to showcase India's military intervention in Maldives in 1988 in response to an urgent request for help from then–President Maumoon Abdul Gayoom, who was facing a coup, as a copybook intervention operation, and due credit must be given to Prime Minister Rajiv Gandhi for his decisiveness. The gradual evolution of India's intervention policies has crystallized over the years, and its successful nonkinetic interventions in Kuwait, Libya, and Yemen, where it evacuated thousands of citizens by swiftly deploying its air and naval assets, reflect

[22] Sushant Sareen, "India-Pakistan ceasefire: The phantasmagoric peace process," *Raisina Debates*, 27 February 2021, https://www.orfonline.org/.

[23] Arjun Subramaniam, "The End of Diffidence India Has Moved from Restrained to Robust Deterrence," *Times of India*, 18 March 2019, https://timesofindia.indiatimes.com/.

[24] For a detailed examination of the ISLA and IPKF operations in Sri Lanka, see chapters 10 and 11 in Arjun Subramaniam, *Full Spectrum: India's Wars 1972–2020* (New Delhi: HarperCollins, 2020), 164–209.

emerging clarity in this domain. The lack of doctrinal clarity, however, obfuscates decision making and leaves much to the personality of the decision makers.

In his many forays overseas, Prime Minister Modi repeatedly emphasizes the protection of Indian interests and diaspora as important as India's role as a preferred security provider in the IOR. New Delhi's continued attempts at engaging IOR littorals, such as Mauritius and Seychelles, and closely watching developments in Sri Lanka and Maldives indicate that India is not going to be a pushover, especially given China's massive dual-purpose infrastructure investments in the IOR through its ambitious Maritime Silk Route portion of the Belt and Road Initiative and increased naval presence in the region. India's military means of protection of overseas interests comprise a combination of initiatives that ensure presence and demonstrate intent. While the former is achieved through continuous deployment of Indian naval ships on "flying the flag" missions, the latter is ensured through increasing operational engagements with strategic partners.[25] Regular conduct of military exercises and a willingness to position military training teams to build capacity are some such initiatives. While regular engagement with strategic partners like the United States, France, the United Kingdom, Japan, and Singapore offers opportunities to the Indian military to enhance interoperability and absorb best practices, propositions of military assistance to smaller partner nations—such as Afghanistan, Seychelles, Mauritius, Oman, Sri Lanka, Vietnam, and African states, such as Uganda—demonstrate modest intent and growing reach. Building credible expeditionary and power-projection capability is the next operational step to support this doctrinal posture.

Improving Operational Conversion

Conversion of Prime Minister Modi's advise to his military commanders into operational deliverables demands the dismantling of the status quo within civilian and military bureaucracy, which are comfortable with it and satisfied with incremental changes in reform and doctrine. The three elements that would facilitate this transformation are structural reform, leapfrogging, and embracing technology. While the institution of the post of chief of defence staff (CDS) and the creation of the Department of Military Affairs (DMA) in December 2019 are welcome steps,[26] structural reform would only be complete with the comprehensive integration of the Ministry of Defence (MoD) with service headquarters

[25] Kishore Kumar Khera, "International Military Exercises: An Indian Perspective," *Journal of Defence Studies* 11, no. 3 (July 2017), https://idsa.in/.

[26] Harsh V. Pant and Kartik Bommakanti, "CDS and the path to Jointmanship," *ORF Commentaries*, 10 January 2020, https://www.orfonline.org/.

with cross-pollination and adapted to Indian conditions. The institution of a progressively empowered CDS with operational accountability to Parliament is considered essential, though it is assessed that the predominance of conventional continental threats and the overwhelming influence of the IA will impede a level playing field in this process unless there is decisive political direction.[27] A road map for integrated theater commands would be next in line despite fierce turf battles between the three services. Rather than have separate integrated commands (space, cyber, and special forces) to placate service requirements, India would do well to create an integrated force like the PLA's Strategic Support Force called Strategic Enabling Command that includes space, cyber, information, and electronic warfare.[28] For starters though, the creation of two brigade plus-sized integrated battle groups (IBG) comprising land, aerial, and naval components with embedded humanitarian and disaster relief (HADR) elements on the east and west coasts to deal with expeditionary and OOAC operations could empower the CDS sufficiently during the teething years of transition. Though still a work in progress, the announcement of the impending creation of an Air Defence Command, and a Maritime Command thereafter, were supposed to kick-start the process in right earnest.[29] However, the untimely death of India's first CDS, General Bipin Rawat, and the inability of the three services to roll out an India-specific integration model, has delayed any further reform. The appointment of Lt Gen Anil Chauhan (R), the Military Advisor (MA) to the National Security Advisor (NSA), as the second CDS of India is likely to ensure that integration remains a Key Result Area (KRA) for the Modi Government.

Traditionally associated with operational maneuvers that facilitate the bypassing of static or sluggish defenses with speed and surprise, the application of leapfrogging at the strategic level from the Indian standpoint involves taking tough decisions in the doctrinal, technological, and intellectual dimension of war fighting. Lagging a rapidly transforming Chinese military, India has no choice but to leapfrog across decades of stagnation in all the areas mentioned above. By raising the level of intellectual capital within the armed forces, infusing a greater level of understanding of the military within the political establishment, and making

[27] The author has been consistently critical of piecemeal changes to the higher defense organization and operational structures, but not of the aspirational final objective of complete integration.

[28] For an excellent overview of the missions and organization of the PLA's Strategic Support Force (SSF), see Kevin L. Pollpeter, Michael S. Chase, and Eric Heginbotham, *The Creation of the PLA Strategic Support Force and Its Implications for Chinese Military Space Operations*, Rand Report RR-2058-AF (Santa Monica: CA: RAND, 2017), https://www.rand.org/.

[29] Shishir Gupta, "Maritime, air defence theatre commands to be set up by June 2021," *Hindustan Times*, 23 March 2021, https://www.hindustantimes.com/.

radical changes in India's defense research innovation and industrial complex, India has an opportunity to bypass lost fourth-generation opportunities and catch up with China. This will only be possible if New Delhi seizes collaborative opportunities, abandons rigid notions of surrendering strategic autonomy ,and engages with partners on sensitive technology-related projects in cutting-edge areas such as space, sensor fusion, aircraft and warship design, radars, and weapons, to name a few.[30] Only if all the above initiatives are woven into the ambitious Atmanirbhar Bharat initiative (Self-Reliant India) will India's defense manufacturing ecosystem rise to the China challenge.[31]

Leapfrogging in the intellectual domain would necessitate major reform in professional military education (PME) to widen horizons and empower the military to deal with the complexities of a multi-domain conflict in a rapidly changing geopolitical environment. This would include embedding multidisciplinary civilian faculty in teaching and research positions at academies and war colleges and opening opportunities for academically inclined medium and senior leadership to avail of sabbaticals at carefully selected universities across the world.

Offering a balanced assessment of India's current position in this domain, Ashley Tellis argues, "Partly because of poor national policies, India today has major shortcomings in regard to the quality of its academic achievements, the resources committed to research, and the competence needed to develop advanced military critical technologies and to integrate complex systems."[32]

Indian Army: Need for Multi-Domain Awareness and Capability

While continental deterrence along stressed land frontiers will continue to occupy much of the focus of the IA, it needs to restructure defensive and offensive fighting formations to cater to the creation of the proposed dual-purpose IBG that could operate as joint task forces and execute both defensive and offensive missions with the individual services acting as capability and force providers. The IA has taken the lead in a serious attempt to "rightsize" its operational structures. Announcing this at the Army Commanders' Conference (ACC) in 2018, the then–

[30] A comprehensive list of priority technology convergence issues that would facilitate this 'leapfrogging' are listed in a Brookings Publication edited by Ashley J. Tellis. See Ravinder Pal Singh, "Building Advanced Defense Technology Capacity," in *Getting India Back on Track: An Action Agenda for Reform*, ed. Ashley J. Tellis et al. (Washington, DC: Brookings, 2014), 288.

[31] For a crisp examination of the Atmanirbhar Bharat initiative in defense manufacturing, see Anuj Prasad and Ananadita Kaushik, "Making India Atmanirbhar in the Defence Sector," *Economic Times*, 23 June 2020, https://economictimes.indiatimes.com/.

[32] Ashley J. Tellis, *Troubles, They Come in Battalions: The Manifold Travails of the Indian Air Force* (Washington, DC: Carnegie Endowment for International Peace, 2016), 60–61.

Chief of Army Staff General Bipin Rawat indicated that it was not the "tail" alone that would be trimmed, but also frontline infantry battalions.[33] Instead of looking to raise additional forces to cover gaps created by shedding forces, the IA would leverage technology to increase surveillance through a multilayered network of satellites, unmanned aerial vehicles (UAV), improved battlefield surveillance radars (BFSR), quick reaction teams (QRT) for varied terrain, and a reduced sensor-to--shooter loop that includes integral helicopter assets complemented by designated offensive and mobility airpower assets from the IAF.

Notwithstanding the absolute necessity of heavy armor in the desert sector, the IA will do well to rethink the density and profile of the elements of maneuver in the obstacle-ridden plains of Punjab and the mountainous terrain that runs along much of the LoC and the LAC. The PLA's deployment of armor on the Tibetan Plateau must be countered not with a force-on-force philosophy, but with a combination of armor, robust antitank guided missiles (ATGM) defenses, and airpower that can interdict effectively. The rebalancing of the IA's offensive formations by moving several elements from the western border northward to focus on China is the right step and conveys an intent that has been latent far too long.[34]

There was a move in the 1980s when General Krishnaswamy Sundarji and his then–Director General of Military Operations (DGMO) Lt General B.C. Joshi attempted to restructure India's Para and Special Forces (SF) capability that clearly differentiated between airborne forces and special forces but failed because of institutional hubris and rigidity. Over time, the lines between Para and SF in the Indian context have blurred, with most Para battalions having also converted to SF that caters to specialized operations in diverse terrain (desert, mountains, and jungle).[35] Airborne assault and air-landed operations are distinctly different from SF operations, and expecting units to switch roles effortlessly is unreasonable given the difference in tasks assigned to the two forces. While the former are much like classical infantry assaults except that forces are inducted into the tactical battle area (TBA) through the medium of air, the latter comprises small-team missions with specialized tasks that can be assigned across the spectrum of conflict. If India's armed forces are convinced that airborne assault and air-landed

[33] For a detailed initial look at the Indian Army's four-pronged internal restructuring plan, see Rahul Singh, "General Bipin Rawat Explains Why the Restructuring of the Indian Army Is His Top Priority," *The Print*, 23 October 2018, https://theprint.in/.

[34] Rajat Pandit, "India to Rebalance Forces, Firepower to LAC and IOR," *Times of India*, 1 November 2020, https://timesofindia.indiatimes.com/.

[35] Interview with Lt Gen R.K. Nanavatty (Retd) in August 2017, who was entrusted with this study in 1986–87 as a colonel. The study did not materialize into any meaningful structural changes. A revisit is essential if India's Special Forces are to emerge as a decisive force.

operations will continue to remain relevant, particularly in OOAC or expeditionary operations, it must manage its mix of airborne forces and SF from internal manpower resources and focus on five domains: jungle, mountain, plains/desert, urban, and OOAC. The airborne forces should train with both IBG, while the SF would be controlled centrally and designated to theater commands based on the tasking and terrain.

Artillery played a pivotal role in the Kargil conflict. If the British imported M777 A-2 ultra-light 155-mm howitzers, with a maximum range of 30 kilometers, and the indigenously developed 155-mm towed medium guns with a range of more than 40 kilometers are not inducted with speed, Indian forces are likely to be interdicted severely in any assault, particularly if an adversary possesses superior fire support. Similarly, any high-altitude incursions of the Kargil kind cannot be countered with a firepower-intensive initial response if the IA does not have ultralight, mobile, and air-portable guns at its disposal and displays operational patience to shape the battlefield with air and artillery before launching infantry assaults.

There is also the need for significant improvements in command, control, communications and intelligence (C3I), particularly when it comes to battlefield situational awareness, sensor fusion, and interoperability, particularly with the IAF. Forward air controlling is still an archaic mission, which lags far behind the joint terminal attack controller (JTAC) concept that has been embraced by all modern armed forces that fight integrated battles across the spectrum of conflict. JTACs have been critical in COIN and urban operations in Afghanistan and Iraq and should be embedded in India's COIN forces, particularly for checking infiltration and conducting raids against terrorist waiting areas or militant training camps along the LoC.

Lack of battlefield access to cope with the peculiarities of high-intensity limited wars, and not any grandiose offensive strategies, led to India's much overhyped Cold Start doctrine in the early part of the past decade.[36] An archaic colonial cantonment culture along with a railway and road network that was not conducive to speedy movement of offensive formations from the hinterland into likely battle areas along the international border (IB) made it imperative for the IA to permanently locate offensive formations less than 100 kilometers away from the IB. The location of offensive formations outside the radii of action of enemy strike aircraft was an obsessive characteristic of sequential war fighting until the 1990s. It was only when the IAF acquired a reasonable degree of air superiority

[36] Muhammad Azam Khan, "India's Cold Start Is Too Hot," *Proceedings* 137, no. 3 (March 2011): 42–47.

and assured the IA of minimum attrition to its strike corps that these offensive formations moved into their waiting areas before launching an offensive. This took anywhere between ten and 14 days, with a window of opportunity of a further two weeks, to conduct offensive operations before a likely ceasefire was usually expected to be negotiated. With such flexibility being a luxury of the past and the distinct possibility of short and intense limited conflicts under a nuclear overhang and stringent red lines emerging from the General Headquarters of the Pakistan Army in Rawalpindi, India had to produce a logistics plan that played out into this cycle and allowed it to achieve some operational objectives, given that India's conventional military superiority would be leveraged during postconflict negotiations.

The Cold Start or Proactive Strategy that many refer to is merely a long overdue attempt to circumvent infrastructure and logistics shortfalls to ensure battlefield access.[37] Even today, the IA needs to streamline its mobilization mission further through synergy with state governments and rail and road networks. While the IAF's heavy airlift capability has been significantly enhanced and validated during the recent crisis in Eastern Ladakh to support the swift mobilization of the IA at speeds not seen before,[38] it cannot substitute an efficient and heavy-duty road and railway network that supports both intra- and intertheater mobility.

Indian Navy: Stabilizer in the IOR and Partner in the Indo-Pacific

During his traditional press conference on the eve of Navy Day (3 December 2018), India's former Chief of Naval Staff (CNS) Admiral Sunil Lanba, announced plans to add 56 surface warships, six submarines, and substantial naval aviation assets to the operational inventory of the IN in the next decade. While this capability accretion may be linked to a direct naval contest between the IN and the PLA Navy (PLAN) in the Indian Ocean, it would fall short of the required numbers to cater to such an expansive strategy, as much of the accretion would replace legacy platforms.[39] More specifically, it is likely that the induction of six *Scorpen*-class submarines, *Arihant*-class nuclear submarines, and a sizable number of high-quality indigenously built surface combatants, such as the indigenous aircraft car-

[37] Most Western strategic analysts pounced on the strategy as a 'muscle flexing' attempt by the Indian Army without critically analyzing the logistics quagmire that the Indian Army was facing. For a detailed analysis of the Indian Army's Proactive strategy, see Subramaniam, *Full Spectrum*, 346–47.

[38] Manmohan Bahadur, "An Expert Explains: The Role of the Indian Air Force in Eastern Ladakh," *Indian Express*, 3 October 2020, https://indianexpress.com/.

[39] "Frequently Answered Questions," Indian Ministry of Defence, https://mod.gov.in/; and *Military Balance 2018*, the annual publication from IISS.

riers, frigates, destroyers, corvettes, and fast-attack craft, would only replace the existing aging warships and may not contribute to any significant fleet accretion. Notwithstanding the cogent and expansive doctrine of 2015 that positions the IN as a key tool of military diplomacy and a net security provider in the IOR, it currently clearly lacks the capability to expand this posture to areas of the Indo-Pacific that lie east and south of the Sunda Straits because of two primary reasons.[40] First is a recognition that the IOR segment of the Indo-Pacific is of immediate significance and takes up much of the IN's resources—since 2016, the IN has had near--continuous deployments in six locations in the IOR and is stretched to expand this to distant seas.[41] Flowing from the first limitation, a corollary impediment to fulfilling the emerging requirements of the Indo-Pacific construct is budgetary support for the IN allocated at a mere 14 percent of the 2018–19 Defence Budget.[42] What is even more alarming is that the capital budget of the IN has only increased 1 percent annually for the past ten years as of 2016.[43]

In terms of mission orientation, the suggested creation of two IBGs located in the Andaman and Nicobar Islands and at Karwar in Karnataka, with specific OOAC tasking, is likely to draw significant resources out of the two major fleets, the Western and Eastern Fleets, which have their defensive and offensive tasks cut out in the Arabian Sea and Bay of Bengal respectively. Consequently, there could be an emergent need for a robust third fleet in the southern region, especially since the IN must support its expanded operational missions into the southern oceans over the next decade. This requirement is unlikely to be met soon due to serious fiscal constraints imposed by the COVID-19 pandemic.

It could be argued that with the changing texture of large-fleet engagements on the high seas that would mainly comprise beyond-visual-range (BVR) engagements and the absence of muscular offensive capability represented by multiple carrier task forces (CTF), like the kinds possessed by the US Navy, the traditional Mahanian missions of sea denial, sea control, and protection of extended sea lanes of communications would need some reflection. Maritime defense, maritime diplomacy, and protection of maritime interests and influence with limited but ad-

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[40] Indian Navy Strategic Publication 1.2, *Ensuring Secure Seas: India's Maritime Security Strategy* (New Delhi: Integrated Headquarters, Ministry of Defence [Navy], 2015).

[41] The six deployments have been in the Persian Gulf, Gulf of Aden, Southwestern Indian Ocean, Central and Southern Indian Ocean, Northern Bay of Bengal, Malacca & Sunda Straits. See Commodore Srikant Kesnur, "Indian Navy-Mission Deployed and Combat Ready," *Times of India*, Mumbai edition, 4 December 2018.

[42] Laxman K. Behera, *Defence Budget 2018–19*. See n.10.

[43] Shane Mason, *Military Budgets in India and Pakistan: Trajectories, Priorities, and Risks* (Washington, DC: Stimson Center, 2016), 19.

equately coercive offensive and power-projection capability can be the new normal. When synergized with other elements of India's maritime power such as the Coast Guard, space assets for maritime surveillance and commercial shipping, the country's comprehensive maritime strategy should flow out of the proposed national security doctrine or strategy. This is not a major departure from how the IN sees itself as the lynchpin of India's maritime strategy, and rightfully so.[44]

Heavily outnumbered in the subsurface domain by the PLAN without any possibility of closing the gap over the next two decades,[45] the IN cannot possibly think of robust sea control as its primary war-fighting role unless it has a minimum of a two-carrier fleet complemented by adequate antisubmarine warfare capability. Until then, control in open seas and in any conflict scenario is tantamount to wishful thinking with the much-debated blockade mission in India's northern Arabian Sea—a mission that cannot be accomplished considering that Gwadar in Pakistan will be a dual responsibility of the PLAN and Pakistan Navy. Until India's second aircraft carrier is fully operational by the end of 2023 and offers flexibility of deployments and force application strategies, sea denial could remain the main war-fighting role of the IN, particularly when faced with a rapidly expanding and numerically vastly superior PLAN.

Surface and aerial antisubmarine warfare (ASW) have already emerged as key deterrent missions. The IN is the second-largest operator of the Boeing P-8I Poseidon, after the US Navy, and must continue to be supported with an adequate budgetary allocation. Acting as a significant force multiplier in this mission will be the enhancement of the IN's multi-domain awareness with partner support. This is highly probable, considering the signing of the Logistics Exchange Memorandum of Agreement (LEMOA), Communication and Compatibility Security Agreement (COMCASA), and Basic Exchange and Cooperation Agreement for Geo-Spatial Cooperation (BECA), all of which have been significant steps in the US–India Strategic Partnership.[46] While the former will enhance logistics interoperability, particularly in the maritime domain, the latter two will provide

[44] Clearly enunciated in the official National Maritime Strategy.

[45] The Indian Navy currently has less than 20 submarines as against the PLAN strength of more than 70 submarines. See "India vs China: A comparison of the Indian and Chinese (PLA) Navies," *Naval Technology*, 9 September 2020, https://www.naval-technology.com/.

[46] Mark Rosen et al., "The U.S.-India Relationship: Putting the Foundational Agreements in Perspective," *CNA Report*, February 2017. Produced by the CNA's Strategic Studies Division, the paper offers a convincing perspective of why India stands to gain significantly by signing the CISMOA and BECA given the increasing convergence on operational issues between the United States and India. Also see Dinakar Peri, "LEMOA fully operational now," *The Hindu*, 9 September 2018, https://www.thehindu.com/; and Jeff Smith, "COMCASA: Another Step Forward for the United States and India," *The Diplomat*, 11 September 2018, https://thediplomat.com/.

India with space, aerial, and maritime situational awareness at an exponentially higher degree. Notwithstanding the much-needed boost given to India's dedicated military satellite program with the launch of the naval satellite, GSAT-7, India's space-based maritime awareness assets are inadequate to support its maritime aspirations of being a net security provider in the region, particularly since it is being seriously challenged by the regularity with which PLAN submarines and warships are making repeated and prolonged forays into the IOR.[47]

In terms of mission capability in the short term, naval aviation assets focus on maritime surveillance, ASW, and air defense of the fleet, while very few assets are left to conduct any meaningful offensive antishipping strikes over long distances. Any meaningful offensive aerial capability of a CTF in the medium term will necessarily have to integrate IAF capability, a mission that the IAF executes with significant finesse. Whether the IAF will be able to assign Jaguars, SU-30 MKIs, and Rafales from its current inventory of barely 31 or 32 fighter squadrons for this mission in a dual domain conflict with China (land and maritime) is debatable. The acquisition of a second carrier with a larger complement of offensive platforms will add significant punch to the IN. Commissioning its second carrier will be a test of the IN's resolve to operationalize INS *Vikrant*, its indigenous aircraft carrier. With the completion of the fourth phase of its sea trials, the *Vikrant* is all set to be operationally inducted into the IN in a phased manner.[48] Retaining a two-carrier fleet after the INS *Vikramaditya* is phased out will depend on India's ability to commission its second indigenous carrier, the 65,000-tonne INS *Vishal*, by around 2032. Complementing the two futuristic carriers will be 57 yet-to-be-identified multirole 4th Gen+/5th Gen fighters that would form the offensive complement of the IN's aviation arm. Where the IN will continue to punch above its weight is in the realm of maritime diplomacy and flying-the-flag missions. It will willingly lead coalitions or OOAC operations in a multinational environment, given its extensive experience of operating with all the leading navies of the world in varied maritime environments.[49]

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[47] Express Web Desk, "What Is GSAT-7 Rukmini?," *Indian Express*, 5 July 2017, https://indianexpress.com/.

[48] Yogesh Naik, "Indigenous Aircraft Carrier Handed over to Indian Navy," *Indian Express*, 29 July 2022, https://indianexpress.com/.

[49] The Indian Navy has engaged in more than 75 exercises with friendly countries and strategic partners over the last decade. See "Exercises with Foreign Navies," Indian Navy, https://www.indiannavy.nic.in/.

Indian Air Force: Looking Afresh at the Deep and Joint Battle

Like the IN, the IAF has doctrinal clarity in most areas of aerial war fighting, including how best to impact a joint battle, and has validated elements of its subconventional capability during the Balakot strike in February 2019.[50] It has also validated several concepts in employing its offensive and enabling capabilities during the ongoing face-off with China in Eastern Ladakh that began in May 2020 and continues today.[51]

But regrettably, while this clarity has been accompanied by excellent training and continuous validation of doctrinal precepts, it has seldom been backed with technological self-sufficiency and institutional support, and it is only now that there is political understanding in terms of what airpower can accomplish as a tool of statecraft.[52] Despite being a highly proficient war-fighting force, declining force levels of its offensive aerial platforms have forced the IAF to constantly revise its mission accomplishment capability, particularly in the realm of offensive air operations across the spectrum of conflict.[53] "Fighting the best with what we have" seems to be the current philosophy in the IAF when confronted with the dilemma of being realistic and yet not alarmist when it comes to offsetting the adverse impact of declining force levels with concepts like surge operations and swing-role capability.[54]

If the IAF was expected to limp to its authorized strength of 42 squadrons only by 2032 as per earlier estimates, that date could well be pushed back by another few years, considering the slow tendering process for the purchase of the 114 multirole fighter aircraft (MRFA), the tardy rate of production of the indigenous Tejas fighters, and the fiscal impact of the COVID-19 pandemic.[55] Notwithstanding the brave figures put forward by successive chiefs of air staff, there may well be a strong case for the IAF to see the writing on the wall and recalibrate its strategies and mission focus with a reduced force structure in mind.[56]

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[50] Christina Goulter and Harsh Pant, "Realignment and Indian Airpower Doctrine," Journal of Indo-Pacific Affairs 1, no. 1 (Fall 2018): 21–44, https://www.airuniversity.af.edu/.

[51] Arjun Subramaniam, "IAF Has Enhanced India's Deterrent and Coercive Posture in Eastern Ladakh," *Indian Express*, 23 November 2020, https://indianexpress.com/.

[52] Arjun Subramaniam, "The Indian Air Force, Sub-Conventional Operations and Balakot: A Practitioner's Perspective," *ORF Issue Brief* 294 (May 2019), https://www.orfonline.org/.

[53] Tellis, *Troubles, They Come in Battalions*.

[54] An interpretation of the current IAF operational philosophy by the author, an experienced operational practitioner who recently retired from the IAF.

[55] Rajat Pandit, "Govt Scraps Single Engine Fighter Plan, Asked IAF to Go for Wider Competition," *Times of India*, 23 February 2018, https://timesofindia.indiatimes.com/.

[56] Rahul Bhatia, "India Needs to Fix Its Indigenous Fighter before Building Stealth Aircraft," *Carnegie India Commentary*, 10 August 2022, https://carnegieindia.org/.

Mission reorientation is inevitable with reduced force levels and must be a careful mix of threat and capability-based assessments. Deep strikes with a strategic impact and a widespread attempt to dominate the airspace may have to give way to more selective targeting and localized dominance of airspace that is limited by space and time. Runway interdiction and attacks on critical infrastructure may be missions of the past, with greater emphasis on blinding the enemy's radar, communication, and computer networks, or suppression of enemy air defenses (SEAD) being more profitable in short and high-intensity conflicts. Impacting the joint battle in and around the TBA in varied terrain with high-performance and multimission capable platforms, will be the acid test for a transformed IAF. Interdiction has always been a favorite mission of the IAF, and current capabilities, if supported by near real-time intelligence, have the potential of causing significant attrition to an adversary's reserve forces before they are committed to combat, or depleting the combat potential of large mechanized formations as they rapidly induct across high-altitude terrain toward combat zones (these are merely hypothetical examples to indicate what interdiction can do). Well-controlled and technology-enabled battlefield air strikes (BAS), or close air support (CAS) as it is more commonly known across the world, is a mission that needs significant refinement not only within conventional TBAs in the plains and high-altitude terrain but also in COIN and urban environments. Current training regimens are suboptimal, mainly due to niggling turf and technology issues, and need to be addressed speedily before they start impacting operational outcomes. A fusion of manned and unmanned platforms into offensive missions is another area that may demand significant focus and reorientation.

The IAF can be sanguine that with the completed induction of the C-17 and C-130s, as well as that of the Chinook heavy-lift and Apache attack helicopters, the IAF's transport and helicopter fleets will contribute significantly to its metamorphosis into a credible tool of statecraft. In a recent record-breaking effort, the IAF's Western Air Command (WAC) airlifted 463 tonnes from a single base (Chandigarh) in six hours to multiple airfields and drop zones in the Ladakh sector.[57] While such capability reflects the IAF's commitment to effective logistics and sustenance operations in support of the IA in remote locations, it adds significant heft to the IAF's rapid airlift capability (RAC) for likely expeditionary or OOAC and HADR operations. If there is a vital mission that has seen significant lag, it is the continued lack of focus and capability gap in casualty evacuation (CASEVAC), particularly in COIN and high-altitude operations. This is not to

[57] Press Trust of India, "IAF Airlifts Record 463 Tonnes of Load in 6 Hours to Airfields and Drop Zones in Ladakh," *Times of India*, 18 December 2018, https://timesofindia.indiatimes.com/.

say that the IAF and aviation component of the IA have not shown great resolve and unbelievable courage in CASEVAC operations, particularly in Siachen. However, the platforms and life-saving equipment have never supported the indomitable courage of the aviators. Rescue of downed aircrew, extrication of wounded combatants from behind enemy lines, and CASEVAC support to SFs are some of the enabling missions that would get fresh impetus with the induction of platforms like the Chinook and Apache military helicopters. With the IAF having consolidated its air mobility fleets from a medium- to long-term perspective, the challenge would lie in balancing tactical and strategic tasks in a futuristic integrated structure that could involve theater commands with continental, maritime, and OOAC focus. Centralization of strategic mobility assets may be an inescapable imperative.

As India reviews its war-fighting strategies in terms of the human price it is willing to pay while waging wars of different kinds, airpower offers much in terms of achieving operational objectives with significant reduction of risk to one's own ground troops as well as civilians. For this to fructify, there must be greater engagement of IAF strategists with the IA and the political establishment on two major fronts. First, to "resolve the tension between securing self-sufficiency in the production of advanced weapon systems (and platforms), and the need to maintain technological superiority over the nation's adversaries for deterrence."[58] Second, to proliferate a greater understanding within the strategic community and the political executive of what airpower can and cannot do across the spectrum of conflict and debunk the longstanding perception that airpower is always escalatory.[59]

The Centrality of Jointness

Grappling with Differences

The IA remains the largest and most dominant element in the country's national security structure, and rightly so, considering the enormous sacrifices it makes daily. Navies across the world are sanguine that they operate in a domain that is so unique that whatever the profile of operational structures, their share of the pie is assured as long as oceans remain contested spaces. Air forces across the world—and the IAF is no exception—have grappled with the reality that while they have the capability to deter and coerce at the strategic level and shape land

[58] Tellis, *India as a Leading Power*.

[59] Frans Osinga, "Air Warfare," in *The Oxford Handbook of War*, ed. Julian Lindley-French and Yves Boyer (Oxford: Oxford University Press, 2012), 457.

and maritime spaces in the operational domain, they lack the staying power that boots on ground and warships demonstrate to sustain operational and strategic outcomes.[60]

Based on the string of cross-border punitive operations, consistent political signaling, and resilient national security responses in adverse circumstances since the current government has been in power, many will argue that the present administration has a pulse on the role of force in statecraft. While there is an element of truth in this proposition, more needs to be done in bridging the gap between the political establishment and the military in terms of understanding what the military can and cannot achieve as an effective tool of statecraft in India's pursuit of "leading power" status. The inclusion of the IA and the IAF in operational talks with the Chinese to diffuse the Eastern Ladakh crisis is indicative of a willingness on the part of the current government to stay firm over its deterrent posture along the LAC.[61]

Though the specter of "long wars" has not disappeared with the current Russia–Ukraine conflict extending into its second year, current paradigms of conflict in the conventional domain from an Indian standpoint at short, high-intensity, and geographically localized limited conflicts that demand synergized and simultaneous application of combat power. Airpower offers the element of surprise, thus the possibility of seizing an early initiative in any conflict. Even at the lower end of the spectrum of war fighting, synergized application of combat power is what gives nation-states that extra edge in a prolonged conflict against diffused adversaries, even if outcomes and not decisive victories are the order of the day.

If that is a given in contemporary warfare, why then is the ongoing Indian debate on physical integration of operational structures so fierce and marked by intransigence and continued protection of turf? No easy answers emerge, except that only an enlightened political leadership with a sound understanding of India's armed forces, their DNA, strengths, and weaknesses can break down significantly asymmetric barriers that exist between a dominant army and the other two services.

Expeditionary/OOAC Operations

The biggest challenge for India's armed forces in the years ahead will be to progressively identify the most challenging scenarios that would demand integration

[60] Arjun Subramaniam, "The Debate over Integrating the Services: Understanding the Air Force Perspective," *The Print*, 17 February 2018, https://theprint.in/.

[61] Rajat Pandit, "Sr IAF Officer Was Present at Latest Talks with China," *Times of India*, 10 August 2022, 20.

or *jointness* of a very high order.[62] The mission that immediately comes to mind is the expeditionary or OOAC operation in a hostile environment, both in a solo and coalition configuration that may or may not have UN sanctions but can be driven by national security imperatives. While the current operational thinking is focused on the former (UN-authorized or endorsed), it is essential that India understands that it may have to risk the latter in a rapidly changing and evolving regional security environment that could call for speed and decisiveness. Fusion of intelligence to mitigate risks, shaping the environment, and execution with speed and surprise are aspects that need to be seriously war-gamed in a multinational environment with both amphibious and air-landed, or a combination of both, being played out in various regions. It is reiterated that effective Indian involvement in a coalition operation, particularly in areas of space, intelligence, and electronic warfare (IEW) and communications interoperability would depend on joining existing information-sharing regimes and protocols and shedding fears of compromising security. One of India's weaker links in its ability to support expeditionary/OOAC operations is a largely indigenous but inadequate military space program. Emerging as a byproduct of a fairly successful civilian space program and even matching China's space program in some areas like robustness of launch vehicles, the number of navigation, surveillance, and reconnaissance satellites India has in space are woefully inadequate to cope with the expanding scope of India's strategic aspirations.[63] With China positioning monitoring stations in proxy states, the asymmetry is only likely to widen.[64] It is inevitable that in the years ahead, as India engages in integrated military exercises with strategic partners against the current template of single-service engagements, it will either have to integrate its space resources with those of partner nations or rely on agreements like COMCASA to share space assets for military exploitation.

High-Altitude Jointness

The next joint mission that merits serious attention—despite having fought many campaigns at high altitude—is the joint army–air force campaign in a limited high-altitude conflict. Similar to the Kargil conflict of 1999, such contingencies have continued to emerge at multiple points along the LAC with China (along the Arunachal, Sikkim and Ladakh sectors). A clear example of this trend is the face-off

[62] *Jointness* or *jointmanship* are typical Indian doctrinal terms that largely conform to Western concepts of integration.

[63] Sudha Ramachandran, "Chinese and Indian Competition in Space Heats Up," *China Brief* 17, no. 13 (20 October 2017), https://jamestown.org/.

[64] Karthik Bommakanti, "A Conceptual Analysis of Sino-Indian Space Deterrence and Space Warfighting," *ORF Occasional Paper*, 10 April 2017, https://www.orfonline.org/.

in Eastern Ladakh that commenced in May 2020 and still continues in a recessed form. Unlike the Kargil campaign, where a joint intelligence mosaic was completely absent, India should take into cognizance the recommendations of the *Kargil Review Committee Report* and fuse in its own improved space-based situational and target-awareness capability with input from its strategic partners. Consequently, India's response mechanisms are likely to be far more robust, and fears of being overwhelmed by a sustained PLA assault led by cyber, artillery, and the PLA Rocket Force (PLARF) may well be unfounded. However, these are merely potential capabilities, and much ground needs to be covered in war gaming, communications, and network interoperability to convert them into actual operational capability.

Future Force Structures

Indo-Pacific Focus

Indian rulers in the past, particularly from the Chola dynasty, have used the Andaman and Nicobar Islands to project power in the Indian Ocean and as a key base for expeditions to the east.[65] The IN has long recognized the islands' potential as a strategic oceanic springboard as highlighted in the 1980s with Vice Admiral M.P. Awati (retired) arguing, "As the naval activities of the extra-regional powers are stepped up in the Southwest Pacific and spill over into the IOR, the significance of the Andaman Complex will increase."[66]

After much diffidence over converting the strategic potential of the Andamans into capability, the Andaman and Nicobar Command (ANC) promises much in terms of emerging as a model for IBG (East) that could serve as a template for further integration, particularly in theaters where OOAC operations are likely to be the focus. The ANC would need significant strengthening in terms of naval assets to form a possible carrier battle group: army assets in the form of an amphibious brigade, air assets comprising at least two fighter squadrons and a squadron of medium-lift and utility helicopters, and multitiered ground-based air defense assets that can be seamlessly networked with onboard naval sensors. The expansion of the ANC, or its fusion with the proposed Maritime Command will need substantial infrastructure creation and can take more than a decade to complete. Wherever assets are not available, fighting formations can be attached on

[65] Darshana M. Baruah, "The Andaman Nicobar Islands: India's Eastern Anchor in a Changing Indo-Pacific," *War on the Rocks*, 21 March 2018, https://warontherocks.com/.

[66] M.P. Awati, "Emerging Security Issues: An Indian Perspective," in *Superpower Rivalry in the Indian Ocean: Indian and American Perspectives*, ed. Selig S. Harrisson and K. Subrahmanyam (New York: Oxford University Press: 1989), 104–07.

long-term rotational deployment as part of a dual-tasking philosophy. For example, Thanjavur Air Force Station in southern India can deploy some fighter assets to the ANC on a rotational basis till force levels permit the deployment of a permanent fighter squadron at Port Blair or Car Nicobar, the two airfields in ANC that support operations. The Defence of Andaman Nicobar Islands Exercise (DANX) conducted in October 2019 can serve as a template for progression to assault and offensive operations in the future.[67] The IAF–USAF Cope India 2019 aerial exercise at Air Force Station Kalaikunda in the Indian state of West Bengal—involving USAF F-15s from the Pacific Air Forces and a variety of platforms from the IAF, including SU-30 MKIs, Airborne Warning And Control Systems (AWACS), and tankers—flew several missions over the northern Bay of Bengal working out interoperability issues in large force engagements over maritime spaces, among other exercises.[68]

Karwar, on India's western coast, offers similar potential to locate an IBG (West) within the umbrella of the Maritime Command. With infrastructure associated with Project Seabird that includes an airfield under construction, Karwar is ideally suited to support a carrier battle group with land and aerial components with a primarily OOAC role.[69]

The advantage of these two formations would be that they would serve as the nodal units for any kind of interoperability mechanisms or joint exercises with partner countries. For example, all OOAC training with US Indo-Pacific Command (INDOPACOM), Japan, Vietnam, Singapore, and Australia would be the responsibility of the ANC, while the Karwar battle group would assume responsibility of interoperability with US Central Command (CENTCOM), the Bahrain-based US Fifth Fleet, the United Kingdom, France, Oman, and other partner littorals in the region—such as the Maldives, Seychelles, and so forth.

Some preconditions for the operationalization of these structures would be the rationalization of assets from the Maritime Command or from the existing Eastern, Southern, and Western Naval Commands; allocation of fighter squadrons from existing resources; and creation of an OOAC division with a complement of

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[67] Press Information Bureau, Government of India, Ministry of Defence, "Defence of Andaman and Nicobar Islands Exercise 2019 (Danx-19) 14 October to 19 October," https://pib.gov.in/.

[68] An overview of the exercise from an Indian and US perspective is available at a few websites: Press Information Bureau, Government of India, "Chief of the Air Staff visits Ex Cope India-18," 5 December 2018, https://pib.gov.in/; "US and Indian Air Forces Conclude Exercise Cope India 2019," *Air Force Technology*, 19 December 2018, https://www.airforce-technology.com/; and Rajeswari Pillai Rajagopalan, "Why the 2018 US-India Air Force Exercises Matter," *The Diplomat*, 11 December 2018, https://thediplomat.com/.

[69] B. Lacey, "India's Super Port: Karwar to Revolutionise the Indian Navy," Future Directions International, 18 June 2014.

National Disaster Relief Force (NDRF) elements to create a broad-spectrum force that is capable of more than just war fighting. There could be some resistance from individual services to release resources to the OOAC command and battle group. However, the creation of these two battle groups along with command and control of joint structures involving space, cyber, and special forces could significantly empower the CDS, who also holds the post of chairman of the joint chiefs of staff, to emerge as a single-point advisor to the political establishment on matters related to the Indian military. Also of significance is that India's recent joining of the Basic Exchange Cooperation (BECA) regime allows it to become a fully integrated partner with Western armed forces such as the United States, the United Kingdom, and France.[70]

Challenges to Transformation

Transformation initiatives in large organizations, including the military, are fraught with numerous obstacles and challenges, and this concluding section addresses some of those that will impact the Indo-Pacific. Many of the accompanying suggestions are prognostic and not prescriptive and must be considered so.

Despite some skepticism over changes in procedural, administrative, and mundane disciplinary aspects of functioning in ANC, there is considerable momentum in the generation of fresh ideas to exploit its operational potential.[71] Joint structures will also need to be recalibrated or renamed to reflect synergy. Existing structures such as the Advanced Headquarters or Maritime Air Operations Centre (MAO) will need to be fused and renamed as Joint Force Headquarters and play an increasing role in the operational planning process as against the current top-down planning process that flows down from Service HQs.

The IN will have to expand its operational doctrine to factor in an amalgamation of carrier operations into the operational tasking of the proposed ANC Battle Group and the Karwar Battle Group. It is highly possible that the INS *Vikramaditya* will have its initial home at Karwar, with the possibility of the IN's second carrier being based on the eastern seaboard until the ANC is ready to base it. However, until that happens, the *Vikramaditya* will be a busy warship as it

[70] Basic Exchange and Cooperation Agreement (BECA) is a protocol agreement between the United States and its partners/allies that ensures unconditional sharing of intelligence, satellite data and all other operational inputs that offer enhanced multi-domain awareness. Also see, Shubhajit Roy, "Explained: BECA, and the importance of 3 foundational pacts of India-US defence cooperation," *Indian Express*, 3 November 2020, https://indianexpress.com/.

[71] For some fresh ideas on the strategic importance of the Andaman and Nicobar Islands, see Balaji Chandramohan, "The Growing Strategic Importance of the Andaman and Nicobar Islands," Australian Naval Institute, 9 July 2017, https://navalinstitute.com.au/.

shuttles between India's western and eastern seaboards. Identifying a division for OOAC will not pose much of a problem as the *Secunderabad*-based 54th Division can easily assume the operational responsibility and divest a brigade to the ANC and Karwar battle groups respectively, with one brigade as a reserve if the requirement for any follow-on forces emerges. However, ground mobility assets for these forces in terms of armored personnel carriers will need attention, as will the need for towed artillery.

With two large air bases already operational in the southern peninsula at Arkonam (IN) and Thanjavur (IAF), and satellite bases at Car Nicobar and Port Blair in the Andaman and Nicobar Islands, the IAF and IN will find it quite easy to operate in the theater as long as resources are made available. While a few squadrons of the Su-30 MKI and Jaguar are already maritime-capable, with the former having conducted operations until the Sunda Straits during Exercise Gaganshakti, the bigger challenge will be to dedicate up to four squadrons for maritime strike/air defense roles with the two battle groups until the force levels of the IAF rise from the current 30 squadrons to 34–35 fighter squadrons. The IAF's fifth-generation fighter acquisition must keep the Indo-Pacific security construct as a significant factor that will support interoperability with all countries that are a part of this growing partnership. In the interim period, squadrons will have to train with the two battle groups and multitask with operational commitments along the western and eastern sectors. The bigger challenge for the IAF will be to raise interoperability levels with the IN that will exploit the maximum ranges of these platforms and hone operational procedures with the P-8 I, all of which are on the right trajectory based on an analysis of air operations during Exercise Gaganshakti in 2018.[72] Concurrently, there is a need for the IN's MiG-29s to increase interoperability with IAF AWACS and refuellers. There is also a strong case for the IAF to reconcile to a maximum peak availability of 37 to 38 fighter squadrons over the next decade, considering the lead times that would mark all future acquisitions and the modest pace at which the light combat aircraft (LCA) is being inducted. There has been some convergence in the road map to integration with the services and MoD agreeing that the first step to integration will be the consolidation of the Strategic Forces Command, the ANC, and the creation of Cyber, Space and SF Commands.[73] Instead, a leaner structure on the lines of the PLA's Strategic Support Force can include cyber, information warfare, and space as one large integrated command with three verticals, while the SF will be

[72] Based on a discussion with an unnamed senior IAF officer on some major takeaways from the exercise.

[73] Rajat Pandit, "India May Get Three Unified Commands for Special Operations, Battles in Space and on Web," *Times of India*, 17 October 2015, https://timesofindia.indiatimes.com/.

distinct from airborne forces and comprise two elements with operational and strategic tasking. The strategic element can be formed with elements from all the three services, combined with the National Security Guard (NSG), which can easily be hived off from the Ministry of Home Affairs and amalgamated with the Strategic Forces command to create a leaner structure with two verticals comprising Nuclear Forces and Special Forces. The operational element of the Special Forces will be terrain-specific and separated from the airborne forces and allocated to various army-specific or integrated commands. However, it is felt that the IN's Marine Commandos and IAF Guards can take on specific SF tasks for OOAC operations that will involve operations like sanitation and reconnaissance of amphibious landing areas, airfield protection, and aircraft controlling.

The Indian military has an inflated number of training establishments, and there is an urgent need to both rationalize and restructure them. Increased emphasis on joint and integrated training will provide the right focus and play a significant role in dismantling existing prejudices, foster interoperability, and even reduce wasteful expenditure. Much has already been written about how India's vast continental-focused air force and army commands can be integrated into theater commands, and it is suggested that an incremental approach to integration is the best way forward for India's military. However, if India is to be seriously considered as a leading power, it must step up its training with partner countries to include a joint exploitation of assets through interoperability and interchangeability. It has been more than two decades since India started conducting exercises with the United States, the United Kingdom, France, Singapore, and Japan. Yet the scope of all exercises largely remains centered on single-service operations with only superficial inclusion of joint service maneuvers. Introspection will reveal that this is because of suboptimal integration of capabilities within India's own joint war-fighting capability that causes some amount of diffidence when it comes to looking outward. For example, any COIN or urban counterterrorism operation in the West includes airpower, both kinetic and nonkinetic. India, however, has different templates when it comes to using offensive airpower in COIN and has very little experience of any integrated operations in urban terrain. These gaps need to be addressed while looking at likely OOAC, and it is quite possible that all tools will be employed in some contingencies. There is much ground to be covered if the force structures suggested above emerge as lynchpins of a new and energized Indian military that is truly capable of full-spectrum operations.

Impact

With India overtaking China as the world's most-populous nation in a little more than a decade, while concurrently having the largest working-age population,

employment generation holds the key to societal harmony. If current trends are anything to go by, the Modi government's initiatives to expand manufacturing, rejuvenate the agricultural sector, or translate its Skill India initiatives into jobs is still a work in progress. It makes immense sense, therefore, not to embark on any major downsizing initiatives until either jobs emerge in other sectors or there is a palpable commencement of aging in India's population. Until then, large standing armed forces will not only ensure security but also maintain a sense of discipline within society. The associated revenue costs of pay and pensions are inescapable and must not weigh down capital acquisition. This implies that defense spending may have to move toward 2.5–3 percent of GDP to ensure adequate development of capability to match India's growing geostrategic aspirations. A rightsized and not a downsized professional military can have a huge impact on the continued survival of Indian democracy in an unstable regional security environment.

It is expected that the process of devolution of operational responsibilities by the service chiefs will be slow and marked by fierce protection of turf, making India's force structure look like a hybrid one. The appointment of a CDS has created a momentum in restructuring, which must be continued, as in the long run, the position must be responsible to Parliament for the operational orchestration of the armed forces as an instrument of the state. That would be a defining moment, as would be the sharing of power, responsibility, and accountability in the MoD and service headquarters between the military and bureaucracy.

Though a few scholars and think tanks have debated the inadequacy of India's current force structure to prosecute a two-front operation and the myth of a two-front threat perception, the creation of flexible structures like the proposed battle groups offers some operational comfort.[74] It will allow a leading power like India to be prepared for the worst-case scenario in an unstable geopolitical environment, even if it means an overkill of capability. Strategic competition with China, terrorism, narcotics, nuclear proliferation, population, and climate change directly impact the Indo-Pacific construct and call for enhanced collaborative strategies within the larger framework of the robust and expanding India–US Strategic Partnership. A transformed Indian military with wide-spectrum capabilities will offer Indian statecraft the space to operate autonomously for extended periods of time, with contributions from partners being a force multiplier and not a prerequisite. This would allow India to assert itself as more than just a regional power

[74] Abhijnan Rej, "The Sobering Arithmetic of a Two-Front War," *China Chronicles*, 14 March 2018, http://www.orfonline.org/; and Nitin Pai, "India Is More Secure than We Fear, and Our Political Leaders Are Smarter than We Concede," *The Print*, 19 March 2018, https://theprint.in/.

and emerge as a leading power that contributes to global stability by demonstrating resolve, intent, and capability across the spectrum of conflict.

Concluding Reflections

Any concluding discussion on the transformation of a nation's primary instrument of force, its military, must inevitably reflect on the conflict milieu within which this transformation is envisaged. The renewed possibility of large-scale conventional wars without any abatement in the occurrence of limited wars and subconventional conflict in varied terrain, including vast maritime spaces under a nuclear shadow, seems to be the main template within which wars in the twenty-first century will be fought from an Indian perspective.[75] These scenarios remain distinct possibilities if India continues to experience adversarial relationships across the spectrum of conflict with two powerful neighbors, China and Pakistan, accompanied by a host of continued internal fissures and cracks.

It is, however, the need for credible deterrence against external adversaries and the requirement to constantly plug internal cracks and fissures that drives India's need to maintain its continental posture and a large standing army of 1.2 million personnel. This posture may need decisive political intervention to change after widespread debate on whether there is indeed a case for reconfiguring the IA to face future security challenges. Similarly, the need to maintain a large navy and air force is more about deterrence, latent coercive capability, and support for expansion of interests and influence. Seeing what is currently unfolding in Europe where NATO and non-NATO countries, after years of cutting defense expenditure following the collapse of the Soviet Union, are now scrambling to rebuild conventional capability and raise defense budgets in the face of a resurgent Russia,[76] India would do well to tinker with its force structure in all domains with caution—rightsizing and not downsizing is the need of the hour. Restructuring and progressive integration of the army, navy, and air force to meet contemporary challenges and pool capabilities with partners is an inescapable imperative that will force India to shed some of its dogmas regarding strategic autonomy and single-service architecture, particularly in domains like the Indo-Pacific, where its

[75] The author's comfort with the term *limited war* emerged after a thought-provoking talk at the Changing Character of War program at Oxford by Prof. Dan Stoker, US Naval Postgraduate School, 23 January 2018. The talk was very provocatively titled "How to Think about Limited War (Without Limiting Your Thinking)."

[76] Jaan Maatlary, "Defence Cooperation in Europe: Driving Forces and New Formats," CCW Lunchtime Seminar Series, Oxford University, 6 March 2018.

principal adversary, China, is steaming ahead.[77] Failure to do so will leave India open to sustained pressure on multiple fronts.

Writing in his prognostic book on war in the twenty-first century, *Deadly Scenarios*, Andrew Krepinevich, an accomplished American military scholar and futurist, asks some basic probing questions on transformation in the US military that fit well in this examination of dilemmas facing the Indian military: "What are the most pressing challenges that the military will face in the coming years? What kind of military will the US need to confront them? Is it similar to the one that exists today, or very different?"[78]

Despite the almost 10 percent increase in the defense budget for 2022–23 and a continued push to promote indigenization, improve the ratio of combat forces to support personnel, and a continued search to reduce the revenue budget through short-term engagements such as the Agnipath scheme, which is a new recruitment program for the Indian armed forces, and increasing the retirement ages across the board for officers and other ranks, there is much that needs to be done to transform the Indian military[79] Deepening partnerships and better leveraging the spin-offs of agreements such as COMCASA, LEMOA, and BECA for mutual benefit may be one way out for India to mitigate the growing power asymmetry vis-a vis China in the face of the latter's relentless military modernization.

There is a wide gap between rhetoric and conversion of policy into viable military strategy and capability development even in the current strategic environment. India, however, appears to be emerging from decades of diffidence with countries like the United States, recognizing that "it is a nation invested in the free and open order in the Indo-Pacific region and it is in the interests of the region that India plays an increasingly weighty role in the region."[80] It is exactly these uncertainties that India's military must confront if it wants to emerge as the sword arm of Indian statecraft in its quest for leading power status. ✪

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[77] It must be emphasized here that the author has written in the past against "integration without understanding" and argued that integration must start from the top and only then will it trickle down. This is in consonance with suggestions from many committees, including the Kargil Review Committee, Group of Ministers Report, and Naresh Chandra Committee Report.

[78] Andrew F. Krepinevich, *Deadly Scenarios: A Military Futurist Explores War in the 21st Century* (New York: Bantam Books, 2009), 10.

[79] Laxman Kumar Behera, "Bigger, Not Necessarily Better: India's Defence Budget 2022-23," *ORF Issue Brief*, 23 February 2022, https://www.orfonline.org/.

[80] Alex N. Wong, "Briefing on The Indo-Pacific Strategy" (special briefing, US Department of State, 2 April 2018), https://2017-2021.state.gov/.

Air Vice Marshal (Dr.) Arjun Subramaniam, Indian Air Force, Retired

Air Vice Marshal (Dr.) Arjun Subramaniam, Indian Air Force, (retired) is a fighter pilot, military historian, airpower analyst, and strategic commentator who was until recently the President's Chair of Excellence at National Defence College, India. He previously served as a visiting professor at Ashoka and Jindal Universities and the Fletcher School of Law and Diplomacy and a visiting fellow at The Harvard Asia Center and Changing Character of War program, Oxford University. He is the author of *India's Wars: A Military History 1947–1971* and *A Military History of India since 1972* (both published in the United States) and writes extensively in the public domain.

Developing the Direction of Military Space Capabilities in South Korea

Lt Col Chongsoo Byun, Republic of Korea Air Force
Maj Taeju Ahn, Republic of Korea Air Force
Maj Soonwoo Choi, Republic of Korea Air Force
Dr. Roger Handberg

Abstract

The repeated missile launches by North Korea pose a growing threat to Japan and the US mainland beyond the Korean peninsula. In response, South Korea is developing a missile defense system and a kill chain, but the increasingly diversified missile types and launch methods make it difficult to keep up. To address these challenges, South Korea is placing greater emphasis on acquiring space information, but its military space capabilities are inadequate. To effectively develop these capabilities, Korean decision makers should establish space partnerships with various countries and strengthen interoperability and technical cooperation among civilian and military stakeholders. Additionally, reorganizing South Korea's space-related agencies will be necessary for more efficient development. Cooperation with the United States and Japan remains important, but complementary partnerships with other nations will be critical for addressing the evolving missile threat. These efforts will help to better protect South Korea and its allies against potential missile attacks.

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North Korea's missile launches have increased steadily since 2011, with an average of over 15 launches per year.[1] However, the number of launches reached an unprecedented frequency of 21 in 2016 and 24 in 2017. In 2018, North Korea did not launch any missiles due to a series of peaceful events, including the PyeongChang Winter Olympics, three inter-Korean summits, the US–North Korea summit, and the 19 September inter-Korean military agreement. However, the peace was short-lived, as North Korea resumed its missile launches with more than 20 in 2019.[2] In 2022, North Korea conducted a total of 33 missile launches, including three cruise missile launches. Notably, from

[1] Kim Dong-yeon, "The U.S. think tank needs at least two THAAD batteries in Korea to have the entire defense capability of South Korea," *Monthly Chosun News Service*, 2017, https://monthly.chosun.com/.

[2] Kim Jong-sook, "North Korean Missile Threats and Backgrounds in the New Cold War: Focusing on the Case of North Korean Missile Provocation in 2019 from a Geopolitical Perspective," *Peace and Religion* 8 (2019), 169–206.

25 September to 14 October, North Korea launched missiles ten times within a three-week period, raising military tensions in the region.

North Korean missiles pose a significant threat to neighboring countries, including South Korea, Japan, and the United States, as they can carry nuclear and biochemical weapons.[3] With each new missile model, such as Scud, Rodong, Musudan, and Taepodong, North Korea has been able to increase the range of its strategic targets. Recently, North Korea has further diversified its missile types by developing new missiles such as the North Korean version of Iskander (KN-23), the Army TACtical Missile System (ATACMS), and the super-large multiple rocket launcher (KN-25). These advancements in missile performance, including increased range, heighten the threat to regional stability and require urgent attention from the international community.

Table 1. Classification of North Korea's missiles

	Scud-C	Rodong	Musudan	Taepodong
Classification	SRBM	MRBM	IRBM	ICBM
Missile Range(km)	500	1,300	4,000	> 10,000
Strategic Strike Target	South Korea	Japan	Bases in Guam	US mainland

North Korea's diversification of missile launch methods is a growing concern. Traditionally, North Korea used a vehicle with infinite-track wheels, similar to a tank, to transport missiles to their desired location for firing. However, North Korea has expanded its capabilities with successful missile launches from a train in September 2021.[4] Furthermore, North Korea has been reducing the preparation time for missile launches by switching to solid fuel, which requires less preparation time than liquid fuel. The launches have also expanded from land to sea, with North Korea testing submarine-launched ballistic missiles (SLBM) and constructing submarines capable of carrying them. These developments in North Korea's missile capabilities further complicate regional security and demand attention from the international community.[5]

[3] Cho Hong-je and Park Gyun-yeol, "NORTH KOREA MISSILE: Past, Present and Future," *International Journal of Terrorism & National Security* 3, no. 1 (2018): 1–5, https://www.kci.go.kr/.

[4] Kim Deok-ki, "Focusing on North Korea's nuclear missile provocations and the Korean military's response strategy, Korean triaxial response system," *Military Development Research* 11, no. 2 (2017), 160–80.

[5] Jang Chul-woon, "Changes in North Korea's Missile Development Strategy and Inter-Korean Missile Development Competition," *KINU Online Series* 21-11 (31 March 2021), https://repo.kinu.or.kr/.

The South Korean Response

In response to North Korea's increasing threat of missile launches, South Korea has been developing a missile defense system and a kill chain.[6] The missile defense system tracks ballistic missiles fired by North Korea and intercepts and destroys them in flight before they can reach their targets. Meanwhile, the kill chain aims to preemptively neutralize threats by striking missiles before North Korea launches them. These systems serve as a crucial defense against North Korea's growing missile capabilities, but continued development and enhancement will be necessary to ensure their effectiveness.[7]

North Korea's increasing diversification of missile types and launch methods poses a significant challenge to regional security. By using vehicles and trains to move missiles just before launch, North Korea makes it difficult to detect and preemptively attack its missile forces. Furthermore, the use of solid fuel limits the time available for target information acquisition, adding to the difficulty of detecting incoming threats. The development of submarines equipped with SLBMs also poses a significant threat, as they can remain at sea for extended periods, making detection and interception very challenging. These advancements in North Korea's missile capabilities require an innovative and adaptive response to ensure the security of the region.[8]

North Korea's diverse and evolving missile capabilities pose a significant challenge for South Korea's military response.[9] To effectively operate the kill chain and missile defense system, accurate and real-time information on North Korea's missiles is crucial.[10] However, despite significant advancements in its striking capabilities, South Korea's information assets and acquisition capabilities are still inadequate. The country has heavily relied on the United States for information acquisition, and while efforts to increase its own assets such as Global Hawk and unmanned reconnaissance aircraft are underway, it remains difficult to cover all areas due to North Korea's mountainous terrain and the curvature of the earth's

[6] Kim Se-il, Na Tae-jong, "Research on North Korea's Short- and Long-Range Missile Threat Response System," *South Korea and the International Community* 4, no. 1 (2020): 195–220.

[7] Park Hwi-rak, "South Korea's Military Response Strategy to North Korea's Asymmetric Threat," *Strategic Research Authority* 57 (2013): 273–307.

[8] Park Jae-wan, "South Korea's response strategy through analysis of North Korea's nuclear strategy and submarine-launched ballistic missile (SLBM) threat," *Korea Military Institute* 1 (2017): 39–74.

[9] Bruce W. Bennett et al., *Countering the Risks of North Korean Nuclear Weapons* (Santa Monica, CA: RAND, 2021), https://www.rand.org/.

[10] Felix Kim, "South Korea Strengthens Kill Chain Preemptive Strike System to Deter North Korea," *Indo-Pacific Defense Forum*, 25 July 2022, https://ipdefenseforum.com/.

surface. As a result, there are limitations in acquiring real-time information, and this presents a significant challenge for South Korea's military response.[11]

Lesson Learned from History Regarding Military Space

The Gulf War is often referred to as the beginning of modern warfare, and it also marked the start of space warfare. Air and space assets played crucial roles in collecting, analyzing, and disseminating battlefield information, as well as in operating and controlling precision-guided munitions.[12] Satellites, in particular, played a significant role in overcoming weather limitations and ensuring operational continuity.

The 2022 Russian invasion of Ukraine exemplifies hybrid warfare tactics, which employ both military and nonmilitary means to achieve their objectives. In this context, Russia attempted to use space warfare by launching electronic attacks on commercial satellites providing Internet and intelligence to Ukraine before the full-scale invasion began. Furthermore, during the initial days of the conflict, various forms of electronic attacks, including GPS jamming, satellite communication interference, and internet shutdown, were conducted. In response, Ukraine requested real-time high-resolution satellite imagery from US and European companies to monitor the movement of Russian troops and gain situational awareness. Additionally, Starlink's satellite Internet service provided Ukraine with further support.

The trend in modern warfare is to shorten the combat cycle system, which relies heavily on space assets for gathering and sharing information. The Gulf War was the first to utilize space assets for this purpose. In the 2022 Russian invasion of Ukraine, private companies with satellite technology have provided high-resolution images to monitor the war situation, complementing the information obtained from military satellites. This has allowed for near-real-time use of civilian satellite data in the conflict. As a result, the detection, identification, analysis, and dissemination of battlefield information using space assets has become essential to modern warfare, as it can overcome territorial constraints and provide real-time information to support combat operations.

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[11] Sarah Jeong, "South Korea's Defense Capabilities and Acquisitions Programs," *Asia Dispatches* (blog), 31 August 2021, https://www.wilsoncenter.org/; and Kim Tong-hyung, "N. Korea Insults Biden, Slams Defense Agreement with Seoul," *ABC News*, 28 April 2023, https://abcnews.go.com/.

[12] Marcia S. Smith, *Military and Civilian Satellites in Support of Allied Forces in the Persian Gulf War* (Washington, DC: Congressional Research Service, 27 February 1991), https://www.everycrsreport.com/.

Development of the Republic of Korea's Military Space Capabilities

South Korea's Space Development Plan and Analysis

South Korea is planning to launch its first reconnaissance satellite in 2023 and operate an early warning satellite by the 2030s. To ensure the ability to detect North Korea's missile activities in all weather conditions, South Korea plans to launch four radar and one optical reconnaissance satellites sequentially by 2025. Once operational, these five reconnaissance satellites will provide information on North Korea's missile activities every two hours. However, this may not be sufficient to monitor the situation, so an additional 40 micro-sized satellites will be deployed in clusters in low orbit to spy on North Korea every 10 to 20 minutes.

Once the reconnaissance satellite is operational, South Korea's information-acquisition capabilities are expected to improve to some extent. However, due to limitations on the coverage area, resolution, and revisit time of reconnaissance satellites, it will still be challenging to monitor all parts of North Korea in real-time, and it will take time to achieve full operational capability.

Additionally, the promotion of South Korea's satellite project has been hampered by conflicting opinions among the multiple government ministries that share responsibility for the program. For instance, the Ministry of Science and ICT and the Ministry of National Defense had a disagreement over the promotion of satellites used for civilian-military purposes, resulting in significant time and effort wasted in resolving the impasse.

International Cooperation

Space activities are critical to safeguarding national interests, and ensuring their safety and stability is a matter of national security. Space partnerships have become increasingly vital to national security strategies, providing significant advantages. By leveraging their unique capabilities and systems, allies and partner countries can save costs and offer deterrence benefits. Another significant advantage of space partnerships is their geographical location. Given the space race with China, Japan and South Korea are important partners in US space security.

The continuous missile tests conducted by North Korea have revealed that it has the capability to attack targets beyond the Korean peninsula, including Japan and US bases in the Indo-Pacific theater. Furthermore, North Korea's defiance of UN Security Council resolutions, coupled with China's increasing threats to re-

gional stability, emphasizes the need for enhanced international cooperation among South Korea, the United States, and Japan.[13]

The need for missile defense and reconnaissance capabilities has driven the development of such technologies in Japan. As of 2022, Japan has the third-largest space budget and the fourth-largest number of orbital satellite assets. With seven reconnaissance satellites, Japan is also developing its own defense satellite communications system and pursuing a space situational awareness radar.[14]

In addition, Japan and the United States have a strong space partnership. The two countries signed a space situational awareness agreement in 2013 and are participating in a space situational awareness training event called Global Sentinel and the Schriever Space Wargame. Moreover, in 2021, Japan deployed a liaison officer to headquarters US Space Command to strengthen information exchanges between the two countries and is strengthening space cooperation throughout the Indo-Pacific region.[15]

Similarly, South Korea has been strengthening its space partnerships, although it has not yet progressed to developing capabilities collaboratively like the US and Japan. However, there has been an increase in international participation in South Korea's space affairs in recent years. In 2022, the defense ministries of South Korea and the US agreed to conduct joint studies on space policy. Furthermore, South Korea is enhancing its cooperation with Australia, the United Kingdom, France, and India.

Seoul should continue to strengthen its cooperation with the United States and Japan and consider sending a liaison officer to the US Space Command to establish a cooperative system. The command already operates with liaison officers from Canada, Australia, New Zealand, the United Kingdom, France, Germany, and Japan, and plans to integrate command, control, and space situational awareness data and software tools. Therefore, it would be beneficial for South Korea to establish a cooperative system through human exchanges as soon as possible.

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[13] Jessica Renee Taylor, "Obstacles to US-South Korea Alliance Regional Contingency Planning and Considerations for US Policy," *Journal of Indo-Pacific Affairs* 5, no. 6 (October 2022): 151–66, https://media.defense.gov/.

[14] Kim Jin-woo, "우주 안보 강화하겠다는 일본...'민간위성의 정찰위성 활용 검토'," 경향신문, 23 September 2019, https://m.khan.co.kr/.

[15] "25 Nations Participate in Global Sentinel 22," U.S. Space Command, 3 August 2022, https://www.spacecom.mil/; "Schriever Wargame 2023 Concludes," Space Training and Readiness Command Public Affairs, 3 April 2023, https://www.starcom.spaceforce.mil/; and "U.S. Space Command Commander travels to Japan to strengthen space cooperation," U.S. Space Command, 22 March 2022, https://www.spacecom.mil/.

South Korea's positioning, navigation, and timing (PNT) satellite businesses can create momentum for additional collaboration.[16] In 2021, South Korea and the United States signed a joint statement on cooperation in global navigation satellite systems to jointly support the development of South Korea's own navigation satellite system, Korea Positioning System (KPS), and strengthen interoperability. South Korea's independent PNT capabilities could serve as a useful supplement to GPS, and this collaboration could open up more opportunities for joint development.

South Korea should further expand information-sharing channels with Japan to ensure direct and rapid information sharing, given Japan's various space information assets. As North Korea's threats grow, efforts to share information between the two countries become crucial. The information assets or networks of each country can upgrade situational awareness, thus enhancing regional security cooperation. Therefore, building a new South Korea–Japan relationship in the space domain will be an important factor in successful integration.

In addition, South Korea can contribute to regional security by expanding its international cooperation in the space domain. Currently, South Korea is focused on integrating into the Indo-Pacific Partnership for Maritime Domain Awareness, which moves beyond the traditional South Korea–US alliance and pursues a more active role on the international stage.[17] Seoul could also consider joining the Quadrilateral Security Dialogue (Quad) of key Indo-Pacific allies—including India, Japan, the United States, and Australia—to work directly on security issues. To achieve greater goals in the Indo-Pacific region, Seoul should strengthen relations with Australia and India beyond its current partnerships with the United States and Japan, as they are also important regional players.[18]

By joining the Quad, South Korea would establish strong space relations with individual countries in complementary areas of interest, such as technology transfer, interoperability, and securing supply chains to strengthen resilience. In particular, South Korea's space situational awareness system, micro-sized reconnaissance satellites, early warning satellites, and KPS satellites would contribute to space deterrence and allies' cooperation in sharing space information. This pro-

[16] "South Korea to Build Its Own Satellite Navigation System by 2034," *Spacewatch Asia Pacific*, 1 February 2018, https://spacewatch.global/.

[17] Hyun Ji Rim, "South Korea's Stepping Up as an Indo-Pacific Actor Challenges for the New Yoon Administration," *Journal of Indo-Pacific Affairs* 5, no. 6 (October 2022): 1–4, https://media.defense.gov/.

[18] Jagannath Panda, "Seoul's Geopolitical Code on Quad," *Journal of Indo-Pacific Affairs* 5, no. 6 (October 2022): 54–73, https://media.defense.gov/.

vides a strategic option for the United States to focus its capabilities on the space race with China in the Indo-Pacific region.

Civilian–Military Cooperation

As we enter the new space era, the role of private-sector actors has significantly increased. However, these private ventures often have some ties to the military-industrial complex. In the United States, private companies provide communication, surveillance, and reconnaissance services to the military intelligence, and various civilian technologies developed with government investments are also being used for military purposes.

Several private companies, including Planet Labs, SpaceX, and Capella Space, played a crucial role in providing internet services and satellite imagery to US, NATO, and Ukrainian officials during the Russian invasion of Ukraine. For instance, Planet Labs provided imagery that refuted Moscow's claim of troop withdrawal from the Russian border. SpaceX-supported Starlink terminals and antenna equipment in Ukraine for information acquisition and confidential transmission. Capella Space provided satellite radar images to Ukraine, and Hawkeye 60 detected Russian GPS jamming signals and alerted Ukraine. The development of private-sector actors is vital to bridging the gap in space development among partner nations. Private commercial companies offer space services, such as radar images and global data communication, as well as high-resolution imagery. Although these services may not be as high-quality as national satellite services, they can be shared without security restrictions, allowing for fast information dissemination. National space development projects can be costly and time-consuming, and cooperation with private commercial companies can help prevent gaps in necessary capabilities. However, interoperability between civilian and military space assets must be improved to achieve this goal. Civilian and military space assets differ in purpose and performance. For example, military reconnaissance satellites prioritize performance, such as accuracy and speed, over cost, while civilian satellites prioritize cost-effectiveness. Furthermore, the development trend of synthetic-aperture radar (SAR) satellites suggests a difference in operational method or performance between past and current image information acquisition systems.[19] Therefore, technical cooperation from the initial stages

[19] Ko Ungdai et al., "Current Trends of the Synthetic Aperture Radar (SAR) Satellite Development and Future Strategy for the High Resolution Wide Swath (HRWS) SAR Satellite Development," *Journal of Space Technology and Applications* 1, no. 3 (2021): https://doi.org/.

should be pursued to enable mutual supplementation between image information acquisition systems.

Table 2. Trends of SAR satellite development

SAR Satellite Development Trends	Past	Current
Size	Large	Small
Mission	Multiple	Single
Development Cost / Period	High / Long-term	Low / Short-term
Performance / Weight	Low / High	High / Low

During the Trump administration, the United States promoted the commercialization of space by easing regulations and encouraging private companies to participate in space development. As a result, the role of commercial actors in national security has increased, especially in satellite communications, which were previously limited to military agencies. Additionally, Washington is implementing a technology export mitigation policy and fostering international cooperation to promote technology development. South Korea can actively seek space cooperation with US private-sector actors in accordance with these US policy changes.

Meanwhile, South Korea's satellite development technology lags behind that of other advanced countries. While structural technology, including satellite bodies and payload parts, has reached a significant level, there is a need to develop sensors, drivers, and mounting software for mission performance in orbital and posture-control fields. Additionally, data-fusion technology for SAR and electro-optical/infrared (EO/IR) image information is weak. Therefore, it is crucial to establish an international technical cooperation system to secure scarce technologies and develop core technologies.

Organizational Development

Advanced spacefaring countries, such as the United States, Australia, and Japan, typically have independent space agencies such as NASA and the Australian Space Agency, as well as military or intelligence agencies responsible for developing and operating reconnaissance satellites. These countries have systematic organizations for controlling and operating satellites for national security purposes. In contrast, South Korea lacks an independent organization dedicated to national security in the space domain, which hinders effective coordination and cooperation. Therefore, there is a need to restructure South Korea's current fragmented space efforts to promote efficient coordination and effectiveness.

Table 3. Space agencies and bureaucracies of selected nations

Nation	Government Departments/Ministries	Space Agency
United States	Department of Transportation (DOT), Department of Defense (DOD), Department of Commerce (DOC), National Oceanic and Atmospheric Administration (NOAA), Department of Energy (DOE)	National Aeronautics and Space Administration (NASA)
France	Direction générale de l'armement (DGA), Office National d'Etudes et de Recherches Aérospatiales (ONERA), Centre national de la recherche scientifique (CNRS)	Centre national d'études spatiales (CNES)
Germany	Bundesministerium für Wirtschaft und Energie (BMWi)	Deutsches Zentrum für Luft- und Raumfahrt (DLR)
Israel	Technion - Israel Institute of Technology (IIT), Israel Aerospace Industries (IAI)	Israel Space Agency (ISA)

In this respect, a pan-government control organization is required to collaborate with government ministries, carry out legal and institutional development, and oversee space policy development and cooperation. Such an organization can serve as a unified interface for civilian-military cooperation while ensuring efficient operation and integration of civilian-military common space assets.

Next, South Korea's ability to efficiently improve its space operational capabilities is hindered by the lack of laws and institutions that specify the forces responsible for conducting space operations and managing space assets. As demand for military satellites, such as reconnaissance satellites, grows, sufficient budget and manpower must be allocated by establishing forces responsible for coordinating and controlling them through amendments to the Act on the Organization of National Armed Forces. Additionally, a Space Command should be created to independently conduct military space operations and enable integrated efforts and cooperation for space security.

In 2019, the United States established an independent US Space Force (USSF), which separated the new service from the US Air Force. Other developed countries with advanced space programs are also strengthening their space operational capabilities by establishing similar organizations, often centered on the nation's air force. This is because air forces are efficient in developing space assets due to inherent similarities between the space and air domains. In light of this trend, Seoul may consider developing its space operational capabilities centered on the Republic of Korea Air Force (ROKAF).

In 2022, the United States established the Space Forces Indo-Pacific as a component of the US Indo-Pacific Command.[20] Also, in December 2022, the United States activated US Space Forces Korea. These developments are believed to be aimed at deterring China, which is considered the United States' biggest strategic threat, and North Korea, which poses a threat with its nuclear missile program. These USSF commands are aligned with the trend of other developed countries strengthening their space operational capabilities. Therefore, it is necessary for South Korea to establish its own Space Command dedicated to responding to missile attacks and military threats in the space domain. This would enable South Korea to participate in joint combined exercises and training and to conduct stable and integrated space operations.

Conclusion

First, South Korea should prioritize the promotion of international cooperation with advanced space nations to advance its military space capabilities. To achieve this, South Korea should broaden its space partnerships with the United States and Japan by engaging in personnel exchanges and information-sharing programs. Moreover, South Korea can potentially enhance space cooperation through participation in the Quad, contributing to regional security and collaborating on complementary areas of interest.

Second, South Korean policy makers should promote increased civilian-military cooperation in the space domain. Enhancing interoperability between civilian and military space actors is necessary to prevent gaps in capabilities. Furthermore, establishing an international technical cooperation system would be beneficial for the development of core space technologies.

Finally, it is crucial to reorganize South Korea's decentralized space efforts to accelerate its space development. This can be achieved by establishing a pan-governmental control organization that collaborates with government ministries to promote space cooperation and oversee legal and institutional development. Additionally, South Korea should assign the Republic of Korea Air Force (ROKAF) as the lead for coordination and control and create a Space Command dedicated to conducting stable and integrated space operations. By implementing these changes, South Korea can enhance its space capabilities and play a more significant role in promoting regional and global security. ✪

[20] Bae Jae-sung, "When North Korea shoots ICBM…the U.S. Indo-Pacific Space Command is in operation," *The JoongAng*, 22 November 2022, https://n.news.naver.com/.

Lt Col Chongsoo Byun, Republic of Korea Air Force

Lieutenant Colonel Byun is a visiting scholar at the University of Central Florida, specializing in space policy. Previously, he earned his bachelor's degree in aerospace engineering from the ROK Air Force Academy and his master's degree in material engineering from Seoul National University. In addition to this professional military education at the ROK Air College, Byun completed space officer training at Yonsei University.

Maj Taeju Ahn, Republic of Korea Air Force

Major Ahn is a visiting scholar at the University of Central Florida, specializing in space policy. Previously, he earned his bachelor's degree in astronautical engineering and military arts from the ROK Air Force Academy and has received master space officer training from Yonsei University.

Maj Soonwoo Choi, Republic of Korea Air Force

Major Choi is a PhD student in public administration at Florida State University. Previously, he earned his Bachelor of Arts in military science and foreign language from the ROK Air Force Academy and Master of Arts in strategic studies from the US Naval Postgraduate School.

Dr. Roger Handberg

Dr. Handberg is a professor of political science at the University of Central Florida, specializing in space policy, national security policy, and judicial politics. He has published numerous books, articles, and book chapters. His most-recent book is *Chinese Space Policy: A Study in Domestic and International Politics* (Routledge) , which explains the beginnings and expansion of China's space program. Handberg earned his PhD in political science from the University of North Carolina.

VIEW

China and Brazil's Cooperation in the Satellite Sector

Implications for the United States?

Dr. Ana Soliz de Stange

Abstract

This article analyzes the long-standing cooperation between Brazil and China in the satellite sector, which has received little attention in the literature despite its strategic importance. The competition for the use of outer space, in which China and the United States are key players, underscores the significance of this cooperation. The article argues that this cooperation has implications for US interests, which can be viewed through the lens of triangular relations in two dimensions: contestation and competition. To identify these implications, the study conducts a content analysis of bilateral agreements in the satellite sector signed between Brazil and China from 1984 to 2022. The findings provide insights into the triangulation of bilateral cooperation between Brazil and China and US interests in the satellite sector. This study contributes to the broader debate on the strategic competition in the Indo-Pacific region and highlights the need for further research on the implications of Brazil-China cooperation for US interests.

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The United States has historically been the dominant power in the space sector. However, Beijing's significant investment in and development of its own technology in this field have positioned China as a rising challenger to US hegemony. Experts have extensively studied the impact of China's ascent on US national security, but there is a lack of literature on the role of third parties, particularly in Latin America. Brazil was the first Latin American country to partner with China in the satellite sector, paving the way for the first strategic partnership between the two nations in 1993. Brazil also boasts the largest aerospace program in the region, with China as its primary partner. Despite concerns from the Washington about China's growing economic presence in Latin America, little attention has been given to the strategic implications of China's satellite cooperation with Brazil. Given the critical importance of the satellite sector and the limited research in this area, it is crucial to explore whether China's satellite cooperation with countries like Brazil could impact US interests.

The issues of contestation and competition in outer space are crucial to consider, as highlighted in the US *National Security Space Strategy* of 2011.[1] This document recognized the challenges posed by China's growing role in satellite technology and outer space utilization. To further explore the relationship between Brazil and China in the satellite sector, a triangular relations perspective is proposed, assuming that the three states are in a synchronized relationship where the interaction between any two affects the third. To analyze this relationship, a content analysis of the bilateral agreements signed between Brazil and China in the satellite sector from 1984 to 2022 is applied.

The article is structured into three sections. First, it provides an overview of the historical development of the relationship between China and Brazil in the satellite sector. Next, it examines and discusses the potential implications of Brazil–China cooperation in the satellite sector for US interests. The article concludes with some final considerations, suggesting avenues for future research on the subject.

Brazil–China Satellite Cooperation

The cooperation between Brazil and China in the satellite sector played a fundamental role in establishing their bilateral relationship. This partnership was formalized in 1984, when both countries agreed for the first time to incorporate satellite cooperation into their bilateral relationship.[2] The agreement included the development of communication satellites, remote-sensing observation and image-processing satellites, launching rockets, and sounding rockets. In March 1988, the Brazilian National Institute for Space Research (INPE) and the Chinese Academy of Space Technology (CAST) signed a joint agreement to research and produce the China–Brazil Earth Resource Satellite (CBERS). In 1993, the partnership was expanded, leading to the establishment of the first strategic partnership between Brazil and China. This instrument strengthened the bilateral relationship in other sectors, including the commercial sector, with the CBERS program remaining an important pillar of the partnership.

The CBERS program was established to develop satellites for meteorological and telecommunication purposes in geostationary orbit. The first satellite, CBERS-1, was launched in 1999, followed by CBERS-2 in 2003, which also provided satellite

[1] Department of Defense and Office the Director of National Intelligence, *US National Security Space Strategy* (Unclassified Summary, January 2011); and Department of Defense, *Defense Space Strategy* (Summary, June 2020)

[2] "Complementary Adjustment to the Scientific and Technological Cooperation Agreement," signed on 29 May 1984 in Beijing.

images to some African countries as part of South–South cooperation between Brazil and China. CBERS-2B was launched in 2007, and Brazil and China agreed to develop a second generation of CBERS satellites (CBERS-3 and -4). According to Robert Newberry, the technological advancements and increased Brazilian investment and development in the second generation of CBERS satellites raised concerns in some US spheres.[3] Newberry argued that the United States should pay closer attention to satellite programs in Latin America and their potential impact on US national security interests. While he classified Brazil as a US colleague in the satellite sector, he also identified it as a competitor.

The CBERS-3 and CBERS-4 satellites were launched in 2013 and 2014, respectively. In 2015, Brazil and China signed an agreement to develop and launch a sixth satellite, CBERS-4A, which was finally launched in December 2019. The CBERS program has been crucial for Brazil in various areas, including deforestation control and environmental monitoring in the Amazon region, water resources monitoring, urban growth, and soil occupation, as well as for educational purposes.[4]

During the sixth meeting of the Sino-Brazilian High-Level Commission (COSBAN) held virtually in May 2022, the vice presidents of Brazil and China, Hamilton Martins Mourão and Wang Qishan, respectively, expressed their intention to continue with new projects in the bilateral cooperation in the satellite sector. Among these projects are the construction of two more satellites, CBERS-5 and CBERS-6, as well as the preparation of the next Bilateral Cooperation Plan 2023–2032. This intention has been formalized in a recent bilateral agreement, which, according to press reports, was signed during Brazilian President Lula da Silva's visit to Beijing on 14 April 2023.[5] This demonstrates that Brazil's cooperation with China in the satellite sector remains a strategic pillar of the bilateral relationship, regardless of which party is in power in Brasília or its ideological orientation.

The following analysis examines the bilateral agreements that have been signed between Brazil and China in the satellite sector. Bilateral agreements serve as official documents that help identify shared interests, objectives, and the evolution of the agreements' content over time. Most importantly, they provide insight into specific clauses that may indicate the depth of cooperation between the two countries.

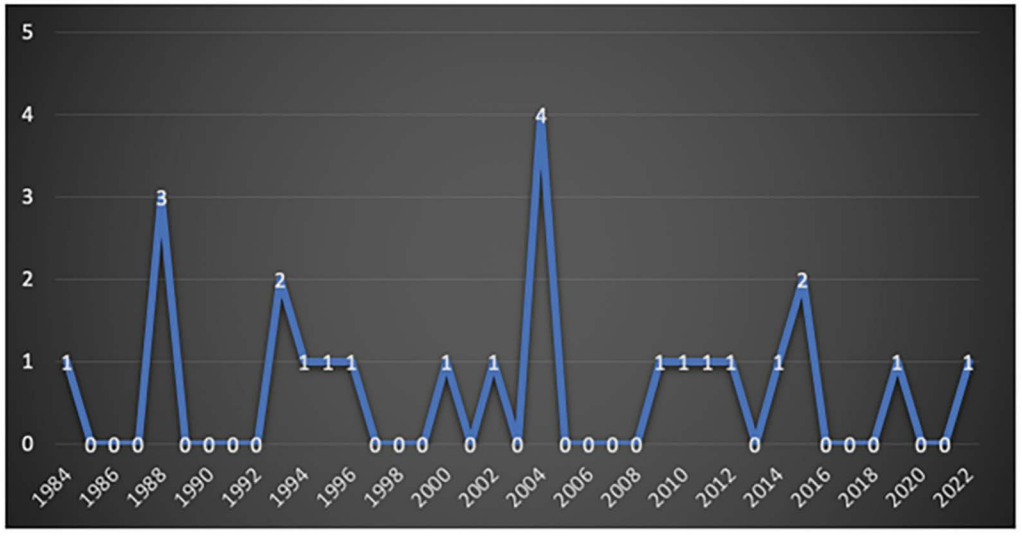
[3] Robert D. Newberry, "Latin American Countries with Space Programs: Colleagues or Competitors?," *Air & Space Power Journal* 17, no. 3 (Fall 2003): 39–45, https://www.airuniversity.af.edu/.

[4] National Institute for Space Research (INPE), "Sobre o CBERS," 5 February 2018, http://www.cbers.inpe.br/.

[5] Cedê Silva, "Lula and Xi sign 15 agreements on trade, agriculture, new satellite," *Brazilian Report*, 14 April 2023, https://brazilian.report/.

Bilateral Agreements

From 1984 to 2022, Brazil and China have signed 24 bilateral diplomatic documents formalizing cooperation in the satellite sector. This article analyzes these bilateral instruments as the main source of data to explore the areas of cooperation, intentions, and common interests between Brazil and China. The types of agreements considered include one complementary adjustment of an agreement, three bilateral acts, two agreements, three protocols, six complementary protocols, five joint declarations, one memorandum of understanding, and three bilateral plans of action. The analyzed agreements have been signed in Portuguese, Mandarin, and English, but this analysis will focus on those signed in Portuguese, which are available on the website of the Brazilian Ministry of Foreign Affairs.[6]



Source: Author`s own compilation, based on data from Brazilian Foreign Affairs Ministry.

Figure 1. Bilateral agreements between Brazil and China in the satellite sector

The following is a summary of the content of the 24 bilateral agreements signed between Brazil and China in the satellite sector, considering the institutions involved, the nexus between civilian and military institutions, and the hierarchy of the officials signing the agreements.

Over time, the institutions involved in carrying out the bilateral cooperation between Brazil and China have been multiple and have changed, mainly on the Chinese side due to restructuring. The main Brazilian institutions involved have

[6] Ministério das Relações Exteriores, Government of Brazil, "Pesquisa Avançada," 2023, https://concordia.itamaraty.gov.br/.

been the National Institute for Space Research (INPE) and the Brazilian Space Agency (AEB). Additionally, the COSBAN established the China-Brazil Space Cooperation Subcommittee, which includes the working group of China–Brazil Ten-year Space Cooperation Plan and the China–Brazil Earth Resources Satellite Cooperation Joint Project Committee.[7]

One notable difference between Brazilian and Chinese institutions participating in this cooperation is that the Chinese institutions are directly linked to the defense sector. While presented as civilian institutions, their primary function is to provide equipment, services, and so forth to the military forces. For instance, this is the case of the State Administration of Science, Technology, and Industry for National Defense (SASTIND)[8]

Table 1. Institutions in charge of the execution of the agreements

Country	Institution
Brazil	National Institute for Space Research
	Brazilian Space Agency
	Ministry of Science and Technology
	Ministry of Defense
China	China Academy of Space Technology
	Ministry of Aerospace Industry
	China National Space Administration
	Commission for Science, Technology and Industry for National Defense
	State Administration of Science, Technology and Industry for National Defense

Source: Author's elaboration, based on information within the bilateral agreements.

Regarding the officials responsible for signing the bilateral agreements, the Brazilian side has mainly been represented by ministers of state, most of whom were the minister of foreign affairs. On the other hand, China has signed agreements through its ambassador to Brazil, director of the State Administration of Science, Technology and Industry for National Defense (SASTIND), and minis-

[7] The highest coordinating body of the Brazil–China Comprehensive Strategic Partnership.

[8] "State Administration of Science, Technology and Industry for National Defense (SASTIND) is under direct supervision of the Ministry of Industry and Information Technology (MIIT). Its predecessor is the Commission of Science, Technology and Industry for National Defense. . . . The major responsibilities of SASTIND involve the nuclear weapon, aerospace technology, aviation, armament, watercraft and electronic industries. It is established to strengthen military forces with additional personnel and more advanced equipment. Ensuring material supplies for the army is its top priority." State Council, People's Republic of China, "State Administration for Science, Technology and Industry for National Defense," 6 October 2014, http://english.www.gov.cn/.

ter of foreign affairs. It is important to highlight that cooperation between Brazil and China under the bilateral strategic partnership is at the highest level, as their respective vice presidents are responsible for COSBAN.

Possible Implications for US Interests

The rapid development of China's space-related technology has raised concerns among US officials regarding the so-called "Three Cs": the contested, congested, and competitive use of space.[9] These three aspects pose challenges in three dimensions: military and strategic, operational, and commercial. For instance, in 2007, China tested an antisatellite system (ASAT) that destroyed an existing satellite, which surprised the United States due to the technology that China has developed and the significant amount of debris produced as a result of the collision. Washington is also concerned about China's increasing engagement with emerging spacefaring nations in pursuit of commercial space ambitions, which US observers and policy makers view as "a part of the more competitive nature of space."[10]

Some Latin American countries have made different decisions regarding satellite technology. For instance, some leftist governments in the region, such as Bolivia, Nicaragua, and Venezuela, have formed partnerships with China. Meanwhile, Argentina and Brazil have taken a more pragmatic approach when it comes to establishing commercial or cooperation agreements in the satellite sector. However, according to officials from Brazil's satellite agency, bilateral cooperation with China and the development of the CBERS program have allowed Brazil to become more self-sufficient in the field of satellite imagery and less reliant on the United States and Europe.[11] This has also enabled opened up the possibility of exporting imaging services to developing countries in Latin America and Africa.

There is still disagreement among analysts on how to interpret the spillover of strategic cooperation between China and Latin American countries in the satellite sector on international relations and great-power competition. While some predict that these joint space programs pose a threat to US national security,[12] others argue that Chinese–Latin American space cooperation is mainly driven by

[9] For an accurate definition, see also, Theresa Hitchens, Joan Johnson-Freese, and James E. Cartwright. *Toward a New National Security Space Strategy: Time for a Strategic Rebalancing* (Washington, DC: Atlantic Council, 2016), 15–23, http://www.jstor.org/.

[10] United States-China Economic and Security Review Commission, *2011 Report to Congress* (Washington, DC: GPO, 2011), 219, https://www.uscc.gov/.

[11] INPE official, interview by the author, December 2012.

[12] R. Evan Ellis, "Advances in China-Latin America Space Cooperation," *China Brief* 10, no. 14 (9 July 2010), https://revanellis.com/.

national development interests and does not follow any global ambitions.[13] However, this article argues that while Brazil follows its national development interests, its cooperation with China in the satellite sector has direct and/or indirect implications for US interests.

In this article, the relationship between Brazil and China in the satellite sector is examined from the perspective of triangular relations, which suggests that foreign policy or actions in a bilateral relationship can directly or indirectly affect a third country. Brazil has pursued a pragmatic foreign policy that prioritizes its own national interests rather than a balancing strategy to support China's rise to global power. [14] However, cooperation with China in the satellite sector has implications for Brazil's relationship with the United States, as Brazil is part of a triangular relationship with both countries. Additionally, bilateral agreements between Brazil and China include clauses that may be interpreted as elements of contestation and competition, suggesting a certain alignment with China in this sector.

This article will now explore how bilateral cooperation between Brazil and China could potentially impact US interests, with a focus on the contestation and competition dimensions. It is worth noting that while the bilateral agreements between Brazil and China do not mention the United States specifically, there are certain elements that could be seen as contesting or competing with US interests.

Contestation

The term *contestation* is used in this article to refer to a country's efforts to limit or disrupt the adversary country's aerospace capabilities. This dimension includes not only military elements but also a strategic dimension. In the case of China, it is challenging US supremacy in the use of space through the development of ASAT weapons and the Beidou navigation satellite system, among others. This dimension also includes the formation of alliances or strategic partnerships. In the following, the article will analyze this last aspect by studying the partnership between China and Brazil in the satellite sector.

Brazil and China have established a comprehensive strategic partnership that covers all possible aspects of a bilateral relationship, including political, diplomatic, commercial, technological, cultural, military, and people-to-people exchanges. In their bilateral agreements, both countries highlight their shared global interests, such as promoting an alternative multilateralism and creating a multipo-

[13] Laura M. Delgado-López, "Sino-Latin American Space Cooperation: A Smart Move," *Space Policy* 28, no. 1 (1 February 2012): 7–14. https://doi.org/.

[14] On the reasons why a country chooses to develop a national space program, see, Deganit Paikowsky, *The Power of the Space Club* (New York: Cambridge University Press, 2017).

lar world with a more equitable distribution of power. These global interests are mentioned in 9 out of the 24 documents related to satellite cooperation, which serves as an explicit element of contestation. This is part of China's strategic contestation and its active diplomacy seeking support from strategic partners.

The bilateral agreements signed between Brazil and China emphasize the peaceful applications of satellite science and technology and recognize the importance of using space for social, economic, and cultural development. While it is not surprising that there are no major explicit elements of contestation against the United States in the agreements, there are some elements that could be seen as pointing in that direction. The clauses related to information sharing, innovations, and the bilateral agreement on satellite cooperation in defense matters signed by both countries all contain elements of contestation.

These bilateral agreements require the prompt sharing of innovations or information with the other party and prohibit the sharing of information with third countries without express consent from both Brazil and China. This implies an implicit limitation to cooperation with third countries, which may have implications for countries outside of the bilateral relationship. While such clauses may be common in this type of bilateral agreements, it is important to consider their potential impact on third countries.

The satellite cooperation agreement on defense issues between Brazil and China is noteworthy, particularly considering Brazil's decision in 2013 to pursue dual-use satellites, including the construction of the Geostationary Strategic Defense and Communications Satellite-1 (SGDC). The project involved a contract with Thales Alenia Space, a partnership between Thales of France and Leonardo of Italy, along with Brazilian companies Telebras and Visiona, as well as Embraer Defense. Through this partnership, Thales Alenia Space is transferring technology to Embraer, which allows Brazil to strengthen its ties with China while also facilitating technology transfer with European partners.[15]

In July 2014, the Ministry of Defense of Brazil signed the Complementary Protocol to the Agreement on Cooperation in Defense Matters between the Brazil and China, in the areas of remote sensing, telecommunications and information technology, with the State Administration of Science, Technology and Industry for Defense. The agreement is also similar in structure and even in content to the bilateral defense cooperation agreement previously signed between Brazil and China on 12 April 2011. Although the agreement signed in 2014 is purely within the satellite sector and aimed at environmental protection and sovereignty

[15] Peter B. de Selding, "Brazil Orders Civil-Military Telecommunications Satellite," *SpaceNews*, 29 November 2013, https://spacenews.com/.

of the Amazon, the analysis of satellite cooperation should be included as part of the cooperation established by both countries in the defense sector.

Competition

Commercial competition for the use of space has intensified due to the increasing number of countries and players venturing into satellite technology, with the majority of satellites in orbit being for commercial use.[16] One example of this is the expansion of commercial satellite imagery into the investment sector, which raises questions about whether this trend will change the rules of international trade.[17] Currently, approximately 80 countries have registered at least one satellite in orbit. China has emerged as a significant player in the satellite industry, becoming a major competitor to the United States in the commercial satellite sector.[18] China's diplomacy has played a crucial role in the commercial satellite arena, as it has signed commercial agreements for the sale of satellites and established cooperation agreements, particularly with countries in the Global South.

The bilateral agreements signed by Brazil and China contain certain clauses that may have implications for commercial interests in the satellite sector, including those of the United States. These implications are related to the commercialization of satellite imagery, inclusion of priority clauses for the provision of parts and services, handling and confidentiality of data, exclusivity of launch services, and development of the satellite industry.

One aspect of the agreements is the inclusion of priority clauses granted to the counterpart for the provision of contracts for the sale of parts, services, and so forth. For instance, for the production of the satellites CBERS-3 and CBERS-4, Brazil and China agreed that each is responsible for a percentage of the construction of the satellites, but the other party has the priority in the sale of parts or services if one of them does not have the capacity to develop it. This is, in practice, a significant limitation on the purchase of inputs from third parties. For example, in the Supplementary Protocol on the Joint Development of Earth Resource Sat-

[16] See, Irina Liu, et al., "Evaluation of China´s Commercial Space Sector," *Institute for Defense Analyses*, 1 September 2019; Eric Tegler, "The Commercial Satellite Industry Is Increasing Awareness In Space But It´s Not Changing Behavior Yet," *Forbes,* 17 December 2021, https://www.forbes.com/; and OECD, *OECD Handbook on Measuring the Space Economy*, 2nd ed. (Paris: OECD Publishing, 2022), https://doi.org/.

[17] Kolemann Lutz, "How Satellite Imagery is Revolutionizing the Way we Invest," *Medium* (blog), 31 December 2018, https://kolemannlutz.medium.com/; and Frank Partnoy, "Stock Picks From Space," *The Atlantic*, May 2019, https://www.theatlantic.com/.

[18] Kari A. Bingen, "Launching Into the State of the Marketplace," *Statement before the House Energy and Commerce Subcommittee on Communications and Technology*, 2 February 2023, https://csis-website-prod.s3.amazonaws.com/.

ellites of 27 November 2002, Article 10 states, "Should either Party need to procure services, parts, components or equipment under its responsibility to complete its obligations under the Cooperation Project, priority for provision of such items will be given to companies or institutions of the other Party, appropriately certified by the procuring Party. Specific contracts will be signed for this purpose."[19] This type of clause is present in several of the bilateral agreements.

The sharing of information and innovations is an aspect that falls under both the contest and competition dimensions. Additionally, there is a clause prohibiting the sharing of information with third parties. Another aspect of the agreements between Brazil and China is the distribution of CBERS products to other countries, along with the development of CBERS data-application software and products for end users. Technical training on CBERS data applications is also conducted for users in both countries as well as other countries. However, the prices of imagery to be sold in other countries must be jointly agreed upon by Brazil and China. Only for the distribution of imagery domestically can each country specify the price. If this is a common practice in China's satellite partnerships, it could have implications for US companies.

In terms of launch services, Brazil and China have agreed to give reciprocal priority to each other, although Brazil currently lacks the capability to launch satellites. Interestingly, for the launch of the CBERS-4 satellite, Brazil was designated as responsible for the launch, but China was granted priority to take on this responsibility in case Brazil was unable to do so.

Finally, the development of the satellite industry is a key reference in the bilateral agreements, with 16 out of 24 documents mentioning it. This encompasses not only the development of satellites but also all aspects related to satellite construction, data utilization, innovation, and more.

Final Considerations

The implications of bilateral satellite cooperation between Brazil and China for the United States are more apparent in the dimension of competition than in that of contestation. The implicit aspects of contestation within the bilateral agreements include the global approach and the explicit prohibition of cooperation with third countries. On the other hand, the bilateral agreements have several

[19] "Supplementary Protocol to the Framework Agreement between the Government of the Federative Republic of Brazil and the Government of the People´s Republic of China on Cooperation in the Peaceful Applications of Outer Space Science and Technology for the continued Joint Development of Earth Resource Satellites," signed 27 November 2002 in Brasilia.

elements in the competition dimension, which imply various consequences for US commercial interests.

While using bilateral agreements as the only source of data is not sufficient to fully quantify the implications, it does provide a solid initial basis for analyzing the triangulation between Brazil, China, and the United States. The case study should be expanded to other strategic partners of China to determine if the contents of the bilateral agreements signed by China in the satellite sector have similar or new elements of contestation and competition. ✪

Dr. Ana Soliz de Stange

Dr. Soliz de Stange is postdoctoral researcher and lecturer at the Helmut-Schmidt Universität - Universität der Bundeswehr Hamburg, Germany. She obtained her PhD from the University of Hamburg. Her research focuses on the field of international relations and includes the topics of triangular relationships, especially Latin American–China–US relations, regional integration in Latin America, and populism. She is particularly interested in the study of synchronization, a concept borrowed from physics, which she proposes as an interdisciplinary approach to the examination of triangular relations in the context of international relations. ana.soliz@hsu-hh.de.

Cosmic Collision Course

Power Dynamics and Geopolitical Implications of Space Debris Management in the Quadrilateral Security Dialogue Countries

Shalini Singh

Abstract

This article delves into the relationships among the Quadrilateral Security Dialogue (Quad) countries and their approaches to space debris management. As the Quad nations enhance their collaboration in space exploration and security, this study addresses three key research questions. Firstly, it examines how the management of space debris illuminates power dynamics within the Quad countries—and the resulting implications for their joint endeavors in space exploration and security. Secondly, it investigates the extent to which the space debris policies of the Quad align with their broader geopolitical interests in the Indo-Pacific region, shaping their interactions with other spacefaring nations. Lastly, it explores the need to establish accountability for space debris retrieval and analyzes the existing legal frameworks surrounding this issue. The article contends that effective space debris management has become a critical element of the Quad's cooperative efforts in space, with existing policies reflecting the countries' geopolitical interests. Furthermore, it underscores the significance of fostering accountability and international cooperation in the realm of space debris management.

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The Quadrilateral Security Dialogue (Quad) is a strategic forum established in 2007, comprising four democratic nations: the United States, Australia, Japan, and India. The initiative aims to promote a free, open, and inclusive Indo-Pacific region by addressing shared regional challenges and fostering cooperation in various areas, such as maritime security, infrastructure development, and disaster relief. The Quad countries have held several meetings at different levels of government, with an emphasis on strengthening their partnership in response to the evolving geopolitical landscape.

In recent years, the Quad has expanded its scope to encompass emerging areas of cooperation, such as cybersecurity, climate change, and space exploration. Recognizing the strategic importance of space, the Quad established a Space Working Group (SWG) in 2021 to enhance coordination and collaboration in space activities, particularly in areas like satellite communication, Earth observation, and space situational awareness.

Space debris management has become a crucial aspect of the Quad's collaborative endeavors in space, with particular emphasis within the SWG dedicated to the long-term sustainability of outer space activities.[1] The increasing volume of space debris poses a significant threat to satellite functionality and human spaceflight safety. As the Quad countries expand their presence in space, addressing the space debris challenge becomes vital to ensure the sustainability and security of their space activities.

The SWG plays a pivotal role in facilitating dialogue and cooperation among the Quad countries regarding space debris management. Through this platform, member nations have committed to sharing best practices, coordinating efforts to track and monitor space debris, and exploring joint initiatives to develop technologies for space debris mitigation and removal. Additionally, the group aims to align their respective national policies on space debris, enhancing the coherence and effectiveness of their collective efforts. By actively engaging in these endeavors, the Quad countries have emerged as influential actors in promoting the long-term sustainability of the space environment, contributing to the broader objective of fostering a free, open, and inclusive Indo-Pacific region.[2]

Geopolitical Interests and Space Debris Policies

The geopolitical interests of the Quad countries and their space debris policies are intricately intertwined, given the strategic importance of space for national security, economic growth, scientific advancement, and international influence. Space is a crucial domain for national security, with satellites providing essential capabilities like communication, navigation, and Earth observation, which are vital for military operations. Managing space debris becomes imperative to safeguard these assets from collision risks, ensuring the uninterrupted functioning of these systems. Therefore, Quad nations share a common interest in collaborating on space debris policies to protect their collective security interests.

The space research industries contribute significantly to the economies of the Quad nations. The United States possesses a robust private space industry, while India, Japan, and Australia are experiencing substantial growth in space sectors. Space debris poses a threat to commercial satellites and future space operations, potentially impacting these economic interests. Collaborating on space debris

[1] "Quad Joint Leaders' Statement" (press release, Press Information Bureau, Government of India, 24 May 2022), https://pib.gov.in/.

[2] Ankit Panda and Benjamin Silverstein, "It's Time for the Quad to Chart a Bold Course on Space Governance," *The Diplomat*, 21 October 2021, https://thediplomat.com/.

management can help safeguard these economic assets and ensure the continued growth of the space sector.

Space exploration and scientific research are also vulnerable to space debris. By cooperating on space debris management, the Quad nations can ensure that space remains accessible for scientific missions and that the benefits of space research can be shared widely.

Furthermore, leadership in space debris management can enhance the international influence of Quad nations. By adopting a proactive stance on this issue, the Quad can demonstrate its commitment to responsible behavior in space, contribute to the development of international norms and rules, and shape the global agenda on space sustainability. While individual Quad nations have taken significant steps to mitigate space debris (fig. 1), there is a pressing need for the bloc to come together and formulate comprehensive guidelines for space debris management.[3]

For effective cooperation on space debris management, the Quad countries can engage with a variety of international and regional organizations and forums, including but not limited to the following:

- **United Nations Office for Outer Space Affairs (UNOOSA)**: UNOOSA plays a crucial role in promoting international cooperation in the peaceful use and exploration of space, as well as the utilization of space science and technology for sustainable economic and social development. Collaborating with UNOOSA can provide the Quad nations with a platform to share best practices, develop international guidelines, and advocate for responsible behavior in space. By engaging with UNOOSA, the Quad countries can contribute to the global efforts in ensuring the long-term sustainability and peaceful utilization of outer space.
- **International Telecommunication Union (ITU)**: The ITU acts as a critical partner in allocating global radio spectrum and satellite orbits. Given that space debris can pose interference risks to these orbits and radio frequencies, the ITU serves as a valuable platform for the Quad nations to propose new rules and guidelines related to space debris. By engaging with the ITU, the Quad countries can contribute to the development of measures to mitigate space debris and ensure the continued functionality and integrity of satellite systems, safeguarding the global radio spectrum and satellite orbits for present and future space activities.

[3] Benjamin Silverstein, "The Quad Needs More Than Bilateral Agreements to Achieve Its Space Goals," Carnegie Endowment for International Peace, 20 May 2022, https://carnegieendowment.org/.

- **European Space Agency (ESA)**: The ESA has been at the forefront of studying and promoting measures for space debris mitigation. Collaborating with the ESA provides an opportunity for Quad nations to share knowledge and technology, fostering valuable exchanges in the field of space debris management. Additionally, coordination with the ESA can facilitate joint efforts in space debris tracking or removal, promoting a collective approach to address the challenges posed by space debris. By leveraging the expertise and resources of the ESA, the Quad countries can enhance their capabilities in mitigating space debris and contribute to the overall sustainability of space activities..
- **Association of Southeast Asian Nations (ASEAN)**: Several ASEAN nations are actively developing their space capabilities and showing a growing interest in space sustainability. Collaborating with ASEAN offers an opportunity for the Quad nations to work together in promoting responsible space practices within the region. The Quad countries can engage with ASEAN to foster dialogue, share expertise, and explore potential collaborations on technical and policy initiatives related to space debris management. By working hand in hand with ASEAN, the Quad nations can contribute to the advancement of space sustainability efforts in Southeast Asia, fostering a cooperative and inclusive approach to address the challenges of space debris.

Bringing together nations from diverse regions with varying aspirations, capabilities, and aims not only serves as an invitation for other countries to join the initiatives but also adds a crucial layer of accountability to the initiative. This collaboration enables countries to share cutting-edge technologies and Earth observation satellite data, akin to the objectives of the SWG within the Quad. By holding countries accountable for their unsustainable actions in outer space, this collective effort promotes responsible behavior and fosters a sense of responsibility among all participating nations.[4]

Accountability for Space Debris Retrieval/Removal

International organizations have consistently introduced new initiatives to monitor, regulate, and delineate the scope of outer space activities. These initiatives encompass the following organizations and their respective efforts:

[4] Ken Moriyasu, "Quad expands cooperation to space at first in-person summit," *Nikkei Asia*, 25 September 2021, https://asia.nikkei.com/.

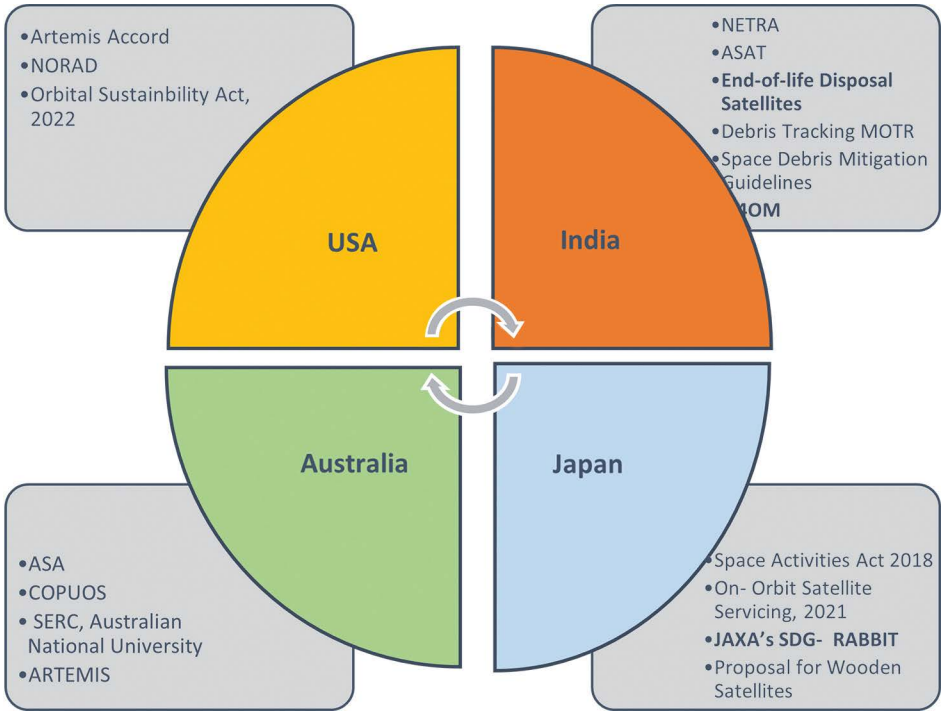

Figure1. Individual initiatives by Quad nations for space debris management (author's compilation)

- **Outer Space Treaty (OST) (1967)**: The OST serves as the cornerstone of international space law, establishing that outer space, including the moon and celestial bodies, is beyond the appropriation of any nation and should be utilized for the common benefit of all countries. The treaty also holds parties are liable for damage caused by space objects they launch.
- **The Rescue Agreement (1968):** This agreement primarily addresses the rescue and return of astronauts and the return of launched objects that return to Earth. While not directly dealing with space debris removal, it is part of the broader legal framework governing space activities.
- **Liability Convention (1972):** This convention outlines the liability of launching states for damages caused by their space objects on Earth's surface or to other spacecraft. However, it does not specifically address space debris removal.
- **Registration Convention (1975)**: This convention requires states to register their space objects with the United Nations, aiding in the identification and tracking of space debris. Although it does not explicitly focus on debris removal, it plays a crucial role in enhancing space situational awareness.

- **UN Committee on the Peaceful Uses of Outer Space (COPUOS) and Inter-Agency Space Debris Coordination Committee (IADC) Guidelines (1993):** COPUOS and IADC have jointly developed guidelines for the long-term sustainability of outer space activities, including recommendations for debris mitigation and prevention. These guidelines, although nonbinding, represent international consensus on best practices for managing space debris.

Together, these international agreements and guidelines form a comprehensive legal framework for regulating outer space activities, addressing issues of ownership, liability, registration, rescue, and the mitigation of space debris.

However, have primarily focused on identifying and raising awareness about the issue of space debris, without providing concrete mechanisms for debris removal or resolving the accountability aspect of debris management. The existing regulations have certain drawbacks, including the following:

1. **Lack of specific regulations**: The current legal framework lacks specific regulations dedicated to space debris removal, resulting in regulatory gaps and unclear responsibilities for debris management.
2. **Nonbinding guidelines**: The guidelines issued by COPUOS and IADC , while offering valuable recommendations, are not legally binding. This voluntary nature may lead to inconsistent implementation and adherence to best practices among space actors.
3. **Ambiguity in liability and responsibility**: The existing legal framework does not provide clear definitions regarding the responsibility for space debris removal and the associated costs. This ambiguity can lead to inaction or disputes among states regarding their obligations.
4. **Technical challenges:** Space debris removal poses significant technical challenges, and the current legal framework falls short in providing guidance on how to address these challenges or support the development of debris removal technology.
5. **Jurisdiction and ownership:** The legal framework does not sufficiently address jurisdictional and ownership matters related to space debris. This lack of clarity complicates the process of removal and disposal, especially when debris ownership is unclear or when multiple parties are involved.
6. **Nonstate actors and commercial activities:** The current legal framework primarily focuses on state responsibility, which may not adequately address the increasing presence of nonstate actors and commercial space activities. Additional considerations and regulations are necessary to address space debris generated by these entities.

7. **Limited international cooperation mechanisms**: The existing legal framework lacks comprehensive mechanisms to foster international cooperation in space debris removal. Given the global nature of the problem, enhanced collaboration among nations is essential to effectively address the issue.
8. **Uncertainty regarding classification and ownership:** The Outer Space Treaty does not provide clear guidance on the classification and ownership of space debris, making it challenging to determine ownership rights and responsibilities. This ambiguity can hinder debris removal efforts.[5]

The Space Treaty prohibits states from interfering with or disrupting space objects under the jurisdiction of others. This raises questions about the extent of jurisdiction over space objects and the removal of debris generated by other entities. Additionally, there is no explicit clarification on unclaimed debris and how it should be addressed within the legal framework.[6]

Addressing these limitations and ambiguities within the legal framework is crucial for effective space debris management. Future efforts should focus on developing specific regulations for debris removal, clarifying liability and responsibility, fostering international cooperation, and providing guidance on technical challenges and ownership issues to ensure a sustainable and secure space environment.

International Cooperation and Potential Solutions

Despite the existence of various international initiatives, the lack of strict and binding rules remains a significant challenge in preventing and removing space debris and addressing the associated risks to space activities. There is a pressing need to establish clear accountability for space debris within international law and agreements. This entails defining the responsibilities of relevant stakeholders in preventing the creation of new debris, mitigating risks posed by existing debris, and addressing damages caused by space objects. Several incidents in the past two decades have underscored the criticality of space debris management and the imperative for accountability:

- **China's antisatellite test (2007)**: In 2007, China conducted a highly controversial antisatellite missile test, deliberately destroying one of its own weather

[5] Alexander Karl, "Active removal of space debris—Discussing technical and economic issues," *Aerospace Research Central*, 29 November 2012, https://arc.aiaa.org/; and Carl Q. Christol, "Scientific and legal aspects of space debris," *Acta Aeronautica*, October 1994, https://doi.org/.

[6] Matteo Frigoli, "Between Active Debris Removal and Space-Based Weapons: A Comprehensive Legal Approach," in *Space Security and Legal Aspects of Active Debris Removal*, ed. Annette Froehlich (Cham: Springer, 2019), 49–70, https://link.springer.com/.

satellites, the Fengyun-1C. This test resulted in the creation of more than 3,000 trackable debris fragments, along with numerous smaller pieces, substantially augmenting the population of debris in low Earth orbit. The repercussions of this incident serve as a stark reminder of the urgency to establish accountability and deter reckless actions that contribute to the proliferation of space debris.

- **Iridium 33 and Cosmos 2251 collision (2009)**: In 2009, a significant collision occurred between two satellites: the operational commercial satellite Iridium 33 owned by the United States and the nonoperational government-owned satellite Cosmos 2251 from Russia. The collision resulted in the fragmentation of both satellites, generating a multitude of debris fragments. This incident serves as a poignant reminder of the imperative to establish accountability for effectively mitigating the risks associated with existing debris, including nonoperational satellites.
- **Reentry of spacecraft**: Notable instances of spacecraft reentry, such as Russia's Mir space station in 2001, China's Tiangong-1 space laboratory in 2018, components of the Chinese Long March 5B rocket, and the International Space Station's (ISS) evasive maneuver to avoid the approaching Russian satellite Cosmos 1408, have raised concerns regarding the risks involved. Although no severe injuries or significant property damage were reported, these incidents underscore the potential dangers associated with uncontrolled reentries and emphasize the necessity for accountability in managing space debris.[7]

Incorporating accountability into international laws will contribute to the following:

- **Prevention and mitigation**: By establishing clear accountability, countries and other actors will be motivated to proactively prevent and mitigate space debris, recognizing the potential consequences and liabilities associated with irresponsible actions. This will encourage the adoption of best practices, technological advancements, and collaborative efforts to reduce debris generation and enhance space debris mitigation measures.
- **Compensation for damages**: With clear accountability, determining liability and allocating responsibility for damages caused by space debris becomes more straightforward. This clarity facilitates the process of seeking compensation

[7] Yannick Radi, "Clearing Up the Space Junk: On the Flaws and Potential of International Space Law to Tackle the Space Debris Problem," *ESIL Reflections* 12, no. 2 (9 March 2023), https://esil-sedi.eu/.

from the responsible party, ensuring that those impacted by debris-related incidents can be appropriately compensated for any harm or losses incurred.

- **Debris removal**: Accountability incentivizes entities to actively participate in debris removal efforts. When accountable for objects they launch into space, even after those objects become debris, there is a direct interest in supporting or undertaking debris removal initiatives. This can drive the development of debris removal technologies, collaborative missions, and international cooperation to address the accumulation of space debris.
- **Foster international cooperation:** Accountability plays a vital role in fostering international cooperation on space debris management. Clear accountability measures encourage countries to align their interests and cooperate in sharing technology, data, and expertise to effectively manage space debris. This collaboration can include joint research and development initiatives, information sharing platforms, and the establishment of common standards and guidelines for responsible space activities.

By integrating accountability into international laws and agreements, these actions will help prevent and mitigate space debris, ensure fair compensation for damages, drive debris removal efforts, and foster international cooperation in addressing the challenges posed by space debris.

Conclusion

Space debris management presents a significant opportunity for cooperation among Quad members. The Quad countries possess the capability to establish a collaborative framework among themselves to effectively address the space debris issue. Such efforts will not only contribute to the sustainability of outer space activities but also serve as an invitation to other regional actors to join in this important cause. The Quad's commitment to space debris management reflects its recognition of the sustainability imperative, geopolitical interests, and its capacity to mobilize international cooperation. By proactively addressing space debris, the Quad demonstrates its commitment to a safer and more sustainable space environment for the benefit of all.

Space security and sustainability are common areas of interest among Quad members, as all countries actively engage in space activities that are integral to their national security, economic development, and scientific pursuits. However, space debris poses a significant risk to these assets and activities, necessitating collaborative efforts by the Quad members to effectively manage and mitigate this challenge and ensure the long-term sustainability of space operations.

One crucial aspect of space debris management is demonstrating responsible behavior in space. By working together in this endeavor, the Quad members can underscore their commitment to responsible conduct, countering perceptions of space as solely a domain of military competition. This cooperative approach allows the Quad to assume leadership in setting international norms and standards for space activities, aligning with established guidelines such as the IADC guidelines.

Enhancing technological cooperation is another essential aspect of effective space debris management. This collaborative effort among the Quad countries facilitates the development and sharing of advanced technologies required for tracking, monitoring, and potentially removing space debris. By pooling their expertise and resources, the Quad members can not only address the immediate challenge of space debris but also strengthen their overall technological cooperation.

Considering the geopolitical context, the Quad's interest in space debris management extends beyond the direct threat posed by debris. It also serves to counterbalance China's influence in space and challenge China's record on space debris management. By taking the lead in promoting space sustainability, establishing norms, rules, and capabilities for debris management, the Quad sets a benchmark for responsible behavior that stands in contrast to China's actions.

Moreover, space debris management offers an opportunity for Quad cooperation to deepen and foster trust among its members. Addressing this complex technical challenge requires sustained collaboration, data sharing, and potentially joint operations. By working together on space debris management, the Quad enhances cooperation and builds confidence, strengthening their collective resilience in addressing future challenges.

To achieve effective space debris management, the Quad can collaborate with other regional organizations and countries through various means. Sharing data on space debris can improve tracking and prediction globally, contributing to enhanced space safety. The Quad's advanced space capabilities position it to assist other countries and organizations in capacity building for debris management, including sharing best practices, offering technical assistance, and collaborating on research and development. Additionally, the Quad can actively participate in the development of international norms, rules, and standards for space debris management through engagement in international forums and voluntary initiatives. Collaboration with other regional organizations, such as ASEAN, the European Union, or countries with emerging space capabilities, can further enrich knowledge exchange and joint efforts in space debris tracking and removal.

While countering China's influence is a part of the Quad's approach, it is equally important to demonstrate a constructive and cooperative model for space activities. Space debris management, with its emphasis on shared challenges and the pursuit

of global public goods, plays a pivotal role in showcasing the Quad's positive engagement in the realm of space affairs. ✪

Shalini Singh

Shalini is a PhD scholar in international relations from the Amity Institute of International Studies, Amity University, Noida, India. Her research interests revolve around security studies and primarily great-power politics and African studies.

COMMENTARY

The Art of Thriving in Space

A Resilience Strategy for India's Future in Space

Sqn Ldr Mohit Choudhary, Indian Air Force

Abstract

This article discusses the need for India's Department of Space (DOS) to develop a strategy of space resilience to increase the ease of military and commercial access to space and prepare for great-power competition. The strategic environment affecting space includes external threats, emerging trends within the space domain, and the characteristics of the domestic space ecosystem. The article defines *space resilience*, examines its constituent concepts, and connects space resilience to commercial growth, deterrence, and great-power competition. Furthermore, it anticipates implicit risks in the strategy of space resilience. The article recommends that the DOS adopts a strategy of space resilience to create a flexible, responsive, and affordable space ecosystem with a robust industrial base to preserve access to space and deter an adversary from attempting to negate the use of space. The application of space-resilience concepts offers significant commercial and military advantages, such as widening the industrial base, creating a modular commercial off-the-shelf market, and simplifying launch technology.

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Space strategist John J. Klein argues that the purpose of space strategy is to ensure access to and use of space. He also emphasizes that the interconnected concepts of *mission assurance* and *resilience* are essential to achieving this goal.[1] With the democratization and commercialization of space, the need to retain access is increasingly crucial. Aspiring countries like India must leverage new avenues of growth offered by the commercialization of space to develop a functional space architecture that increases the ease of military and commercial access to space. This strategy of space resilience will enable India's Department of Space (DOS)—as a super-governing body for all space activities— to prepare India for great-power competition.

To begin, this article briefly analyzes the strategic environment. Following Harold R. Winton's concept of military theory, it defines space resilience and examines its constituent concepts. Next, it connects space resilience to commercial

[1] John J. Klein, *Understanding Space Strategy: The Art of War in Space* (London: Routledge, 2019), 21–22, https://doi.org/.

growth, deterrence, and great power competition. Finally, it anticipates implicit risks in the strategy. [2]

The strategic space environment encompasses external threats, emerging trends within the space domain, and the characteristics of the domestic space ecosystem. Examining the external threat environment, President Xi Jinping has stated that space activities are crucial to the "China Dream."[3] Additionally, Chinese thinking suggests that adversaries' reliance on space makes space assets and infrastructure a critical target.[4] As a result, the People's Republic of China (PRC) has developed a plethora of hard- and soft-kill space weapons.[5] Moreover, the PRC identifies cyberspace attacks as the most potent form of combat, with the cyberattack force as the lead agency.[6] Pakistan's possession of ballistic missiles and the import of sensitive tracking technology from the PRC means it can threaten India's space assets.[7] Furthermore, nonstate actors pose a significant threat in space due to the easy availability of cyberweapons and difficulty attributing attacks within the domain.

The contemporary space strategy must consider the emerging trends in the space environment. In addition to natural environmental concerns, the most significant challenge is the issue of space debris. Kessler's syndrome predicts that self-perpetuating space debris can render space inaccessible.[8] Furthermore, despite the vastness of space, chokepoints and high-value positions have emerged, such as orbital slots, frequency spectrums, and Lagrange points, which hold enormous commercial and military value.[9] Additionally, the pursuit of space-based resources and energy abundance has sparked a new space race, leading state actors to develop cooperative regimes to harness space for their societies' advancement.[10] The unprecedented proliferation of commercial actors in space has revolutionized industry competition, making it difficult for India to compete.

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[2] Harold R. Winton, "An Imperfect Jewel: Military Theory and the Military Profession," *Journal of Strategic Studies* 34, no. 6 (December 1, 2011): 854–57, https://doi.org/.

[3] Namrata Goswami and Peter A. Garretson, *Scramble for the Skies: The Great Power Competition to Control the Resources of Outer Space* (Lanham: Lexington Books, 2020), 189.

[4] "China's Ground Segment: Building the Pillars of a Great Space Power" (China Aerospace Studies Institute, n.d.), 12.

[5] Goswami and Garretson, *Scramble for the Skies*, 194–96.

[6] "In Their Own Words: Science of Military Strategy 2020," In Their Own Words (China Aerospace Studies Institute, January 2022), 405–7.

[7] Scott Neuman, "China Acknowledges Sale Of Advanced Missile Technology To Pakistan," *NPR*, March 22, 2018, sec. The Two-Way, https://www.npr.org/; "China Gifts Anti-Satellite Radars to Pakistan, Aims to Destroy India's Space Program," *Firstpost*, 14 November 2022, https://www.firstpost.com/.

[8] Alessandro Cacioni, "Space Explained: How Much Space Junk Is There?," *Insights*, 19 December 2022, https://www.inmarsat.com/.

[9] Klein, *Understanding Space Strategy*, 39–40.

[10] Goswami and Garretson, *Scramble for the Skies*, 1–7.

The Indian space ecosystem faces several challenges. Currently, India's space sector is entirely dependent on the Indian Space Research Organization (ISRO), which has long operational timelines and uses outdated technology. India has significant shortages in military satellite capabilities in fields such as communications, earth observation, and ELINT.[11] Moreover, existing capabilities are concentrated in a handful of LEO satellites, making them high-reward targets for adversaries. This concentration of space assets can lead to strategic blindness if these assets are attacked. Also, the existing revisit time of systems is higher, which can hamper time-critical ISR activities.[12] Commercially, ISRO shares technology with industry partners; however, a single-customer situation leads to negligible growth and a lack of institutional investments.[13] Furthermore, there is no legislative framework to support the expansion of the industry and enable the commercial exploitation of space resources.[14] The overarching limitation for India's future space trajectory is budget constraints unless the industry becomes self-sustaining.

According to a study by the RAND Corporation, *space resilience* refers to enhancing mission assurance in a contested space environment.[15] It also involves minimizing downtimes despite hostile actions and adverse conditions.[16] Considering the strategic environment, the DOS must adopt a space resilience strategy to establish a flexible, responsive, and affordable space ecosystem with a robust industrial base. This strategy will help ensure access to space and deter adversaries from attempting to disrupt its use. By doing so, India can better prepare for great-power competition, commercially and militarily.

Space resilience is based on the concept of disaggregation, which involves separating space capabilities across multiple systems, platforms, and orbital planes to enhance mission success despite hostile action and adverse events.[17] A meticulously planned disaggregated architecture can distribute the space assets and services into multiple orbital planes and frequency spectrums, potentially decrowding chokepoints. Disaggregation can also reduce the complexity, improve the maintainability

[11] T. H. Anand Rao, *India's Space Security Dilemma* (New Delhi: KW Publishers Pvt Ltd in association with Centre for Air Power Studies, 2021), 124–26.

[12] Rao, *India's Space Security Dilemma* 124–26.

[13] Rajeswari Pillai Rajagopalan and Narayan Prasad, eds., *Space India 2.0 Commerce, Policy, Security and Governance Perspectives* (New Delhi, India: Observer Research Foundation, 2017), 12.

[14] Rajagopalan and Prasad, *Space India 2.0 Commerce*.

[15] Gary McLeod et al., *Enhancing Space Resilience Through Non-Materiel Means* (RAND Corporation, 2016), 3, https://doi.org/.

[16] "Space Domain Mission Assurance: A Resilience Taxonomy" (Washington, DC: Office of the Assistant Secretary of Defense for Homeland Defense & Global Security, 2015), 3, https://purl.fdlp.gov/.

[17] "Space Domain Mission Assurance," 6; and "Resiliency and Disaggregated Space Architecture," White Paper (Air Force Space Command, 21 August 2013), https://www.afspc.af.mil/.

and affordability of space systems, and enhance resilience through distribution and diversification.[18] According to Klein, utilizing multiple nodes or ground segments—well-displaced—to achieve the same mission will eliminate a single high-value target.[19] Similarly, diversifying capabilities into numerous adaptable and interoperable systems can ensure availability despite hostile action. A prime example is a PNT system, with multiple space satellites and ground stations providing an expanded target set to an adversary. Additional resiliency measures include cyber and jamming protection, hosting military payloads in civilian systems, and creating indistinguishable platforms.

The application of space resiliency concepts offers significant advantages to both the commercial and military sectors. Instead of relying on large, complex architectures of a few satellites, the DOS can explore smaller, more flexible designs that incorporate better technology refresh rates and shorter system fielding timelines.[20] Simpler constellations can widen the industrial base beyond the existing narrow pool, allowing India's military space requirements to be met quickly through commercial vendors other than the ISRO and creating a modular COTS market. Affordable systems will benefit India's commercial launch industry by providing a stable demand signal from the government and commercial customers. Smaller payloads simplify launch technology, lowering entry barriers and making the indigenous space industry more competitive. Increased capital inflows into the commercial sector will improve independent research in space technologies, such as reusable launch vehicles, space resource extraction, in-space servicing, manufacturing, and so forth. If the space ecosystem can take over the routine industry loads and become self-sustaining, it will allow the ISRO to focus on exploratory missions and equitably distribute the commercial benefits of space throughout society.

Expanding into space requires a significant capital investment, which is challenging for India's armed forces due to budgetary constraints. However, adopting less complex systems can reduce risks with technology development, shorten procurement timelines, and reduce cost overruns. Currently, the Indian Navy and Indian Air Force operate just one dedicated communication satellite each.[21] By diversifying the capabilities across multiple smaller systems and hosting the military payloads onto civilian satellites, India can reduce launch and operating costs, complicate the enemy's targeting calculus, and mitigate the effects of an attack.[22]

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[18] "Resiliency and Disaggregated Space Architecture."
[19] Klein, *Understanding Space Strategy*, 35.
[20] "Resiliency and Disaggregated Space Architecture."
[21] Rao, *India's Space Security Dilemma*, 123.
[22] "Resiliency and Disaggregated Space Architecture."

Ground segments also require resiliency—such as hardened and distributed control stations, cyber-protected networks, and multiple space launch centers—to strengthen the overall military space capabilities. Additionally, space resiliency can amplify space deterrence by denying the benefit of a space attack. Multiple smaller systems distributed across platforms and orbits can complicate the targeting calculus, and simpler space systems enable rapid reconstitution capabilities, reducing service downtime and the efficacy of an attack.[23] Collaborating with capable partners against a common adversary can further enhance deterrence through entanglement and raises the barrier of an attack.[24]

The strategy of space resilience is well-suited for India's participation in great-power competition. First, by increasing India's presence in space, space resilience can help accelerate its emergence as a major space power, allowing New Delhi to gain influence in the international space community and influence policies in its favor. In the context of coercion being used as a tool of state policy in great-power competition, India's increased presence in space will enable it to resist coercion effectively and even force aggressors to pay heed to its requirements.[25] Second, as Klein suggests, diplomacy and alliances can be effective tools for emerging space powers.[26] Entanglement is a key component of space resiliency, and it can make India an attractive partner for different poles of the great-power competition, providing New Delhi with vital leverage. Lastly, in the context of Space 2.0, with states intensively competing for the space industry, space resiliency can expand India's industrial base, enabling it to compete in the commercial space markets and attract countries looking to avoid aligning with either pole of the great-power competition.

To conclude, the implementation of a space resilience strategy will present both risks and challenges. It will take time to see results and will require perseverance from government, military, and commercial actors. Unplanned insertions may lead to costly changes in the network, potentially slowing down the process. Multiplying space assets through this strategy will require investment in space situational awareness (SSA) capabilities, which are currently limited. Initially, the required capital may give the impression that it is expensive, and returns are not immediate. Diluting the preponderance of the ISRO will require tough political

[23] "Resiliency and Disaggregated Space Architecture."

[24] Christopher Stone, "Reversing the Tao: A Framework for Credible Space Deterrence" (thesis, Missouri State University, 1 December 2015), 4, https://bearworks.missouristate.edu/.

[25] John J. Klein, *Space Warfare: Strategy, Principles, and Policy*, Space Power and Politics 1 (New York: Routledge, 2006), 61–63.

[26] Klein, *Understanding Space Strategy*, 129–31.

decisions in a country that values state-owned enterprises. As the industry expands, there will be a greater need for progressive and transparent legislation and governance, which will test the administration's ability to deliver. Furthermore, while space resilience can enhance space deterrence, it cannot deter weapons development and testing and may lead to an increase in the number of enemy weapons and capabilities, thereby increasing the target set. In conclusion, while the space resilience strategy is not a panacea, it is a critical contributor to India's space security by retaining access to space, widening the industrial base, and making the entire space enterprise self-sustaining. This will enable India to succeed in the great-power competition. ✪

Sqn Ldr Mohit Choudhary, Indian Air Force

Squadron Leader Choudhary is a student at the Schriever's Space Scholar concentration of the Air Command and Staff College, Montgomery, Alabama. He was commissioned in 2011 and holds a bachelor's degree in science from the Jawaharlal Nehru University, New Delhi and a postgraduate diploma in applied aeronautics from the Jamia Milia Islamia University, New Delhi.

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