2019-06

ASIAN STATE RESPONSES TO CHINA'S SPACE POWER STRATEGY

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NAVAL POSTGRADUATE SCHOOL

MONTEREY, CALIFORNIA

THESIS

ASIAN STATE RESPONSES TO CHINA'S SPACE POWER STRATEGY

by

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June 2019

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REPORT DOCUMENTATION PAGE	*Form Approved OMB No. 0704-0188*

1. AGENCY USE ONLY *(Leave blank)*	**2. REPORT DATE** June 2019	**3. REPORT TYPE AND DATES COVERED** Master's thesis

4. TITLE AND SUBTITLE
ASIAN STATE RESPONSES TO CHINA'S SPACE POWER STRATEGY

5. FUNDING NUMBERS

6. AUTHOR(S) Benjamin T. Smart

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Naval Postgraduate School
Monterey, CA 93943-5000

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)
N/A

10. SPONSORING / MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.

12a. DISTRIBUTION / AVAILABILITY STATEMENT
Approved for public release. Distribution is unlimited.

12b. DISTRIBUTION CODE
A

13. ABSTRACT (maximum 200 words)

China's rise as a space power has coincided with its quest for hegemony in the Indo-Pacific. Advances in China's space capabilities constitute a threat to regional states' national security, economic competitiveness, and national prestige. Accordingly, regional space powers have revised their strategies to better compete with China. This thesis examines Japan's, India's, and Vietnam's renewed approaches to space power and space security amidst China's rise. Shifts in military, commercial, and civil space policy are examined among the selected case studies. This thesis finds that Asian states are departing from historical norms by employing militarized space assets to counter the security threat from China. They are also allowing the private sector to play a larger role in their commercial space industry to improve efficiency, innovative capacity, and diplomatic outreach. Bilateral and multilateral cooperation, as well as investments in techno-nationalist space-science projects, also supplement the renewed soft-power response to Chinese space diplomacy. This thesis presents policy prescriptions for the United States to capitalize on the increasing degree of alignment among regional space powers' strategic interests. Recommendations include enhanced military-to-military relations, relaxation of commercial restrictions, and increased cooperation in civil space to balance against China.

14. SUBJECT TERMS
space, space power, China, Vietnam, India, Japan, civil, commercial, military, diplomacy, soft power, internal balancing, external balancing, balance of power

15. NUMBER OF PAGES
125

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	**18. SECURITY CLASSIFICATION OF THIS PAGE**	**19. SECURITY CLASSIFICATION OF ABSTRACT**	**20. LIMITATION OF ABSTRACT**
Unclassified	Unclassified	Unclassified	UU

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. 239-18

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ASIAN STATE RESPONSES TO CHINA'S SPACE POWER STRATEGY

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Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF ARTS IN SECURITY STUDIES
(FAR EAST, SOUTHEAST ASIA, THE PACIFIC)

from the

NAVAL POSTGRADUATE SCHOOL
June 2019

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ABSTRACT

China's rise as a space power has coincided with its quest for hegemony in the Indo-Pacific. Advances in China's space capabilities constitute a threat to regional states' national security, economic competitiveness, and national prestige. Accordingly, regional space powers have revised their strategies to better compete with China. This thesis examines Japan's, India's, and Vietnam's renewed approaches to space power and space security amidst China's rise. Shifts in military, commercial, and civil space policy are examined among the selected case studies. This thesis finds that Asian states are departing from historical norms by employing militarized space assets to counter the security threat from China. They are also allowing the private sector to play a larger role in their commercial space industry to improve efficiency, innovative capacity, and diplomatic outreach. Bilateral and multilateral cooperation, as well as investments in techno-nationalist space-science projects, also supplement the renewed soft-power response to Chinese space diplomacy. This thesis presents policy prescriptions for the United States to capitalize on the increasing degree of alignment among regional space powers' strategic interests. Recommendations include enhanced military-to-military relations, relaxation of commercial restrictions, and increased cooperation in civil space to balance against China.

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INITIAL DISTRIBUTION LIST **109**

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LIST OF ACRONYMS AND ABBREVIATIONS

AP-MCSTA	Asia Pacific Multilateral Cooperation in Space Technology and Applications
APSCO	Asia Pacific Space Cooperation Organization
ASAT	Anti-Satellite
ASEAN	Association of Southeast Asian Nations
BMD	Ballistic Missile Defense
BRI	Belt and Road Initiative
BSL	Basic Space Law
C4ISR	Command, Control, Communications, Cyber, Intelligence, Surveillance, and Reconnaissance
CNES	National Center for Space Studies
CNSA	China National Space Administration
DRDO	Defense Research Development Organization
ESA	European Space Agency
GEO	Geosynchronous Orbit
GPS	Global Positioning System
GSLV	Geosynchronous Launch Vehicle
GWIC	Great Wall Industry Corporation
ICBM	Intercontinental Ballistic Missile
IGMDP	Integrated Guided Missile Development Program
IGS	Information Gathering Satellite
INCOSPAR	Indian National Committee for Space Research
IOR	Indian Ocean Region
IRNSS	Indian Regional Navigation Satellite System
IRS	Indian Remote Sensing
ISC	Integrated Space Cell
ISR	Intelligence, Surveillance, and Reconnaissance
ISRO	Indian Space Research Organization
ISS	International Space Station
JAXA	Japan Aerospace Exploration Agency

JPY	Japanese Yen
JSDF	Japan Self-Defense Forces
LEO	Low Earth Orbit
MAD	Mutually Assured Destruction
MFA	Ministry of Foreign Affairs
MHI	Mitsubishi Heavy Industries
MoD	Ministry of Defense
MoU	Memorandum of Understanding
MTCR	Missile Technology Control Regime
NASA	National Aeronautics and Space Administration
NASDA	National Space Development Agency of Japan
ODA	Official Development Assistance
OST	Outer Space Treaty
PPR	Peaceful Purposes Resolution
PSLV	Polar Synchronous Launch Vehicle
SAR	Synthetic Aperture Radar
SCWG	Space Cooperative Working Group
SDI	Strategic Defense Initiative
SIC	Spatial Information Corridor
SSA	Space Situational Awareness
STA-1	Strategic Trade Authorization
TERLS	Thumba Equatorial Rocket Launching Station
UN-COPUOS	United Nations Committee on the Peaceful Uses of Outer Space
UNOOSA	United Nations Office for Outer Space Affairs
VAST	Vietnam Academy of Science and Technology
VNPT	Vietnam Post and Telecommunications Group
VNSC	Vietnam National Space Center

ACKNOWLEDGMENTS

I would like to thank the faculty of the National Security Affairs Department for their guidance throughout my tenure at NPS. I am especially grateful to my primary advisor, James Clay Moltz, for his expertise and mentorship, which played an instrumental role in this thesis from the very beginning. I am also fortunate for the support of my friends and family. Final credit is reserved for my parents and my grandfather, my greatest supporters in all that I do.

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I. INTRODUCTION

A. MAJOR RESEARCH QUESTION

Asian states are growing increasingly concerned over China's growing space capabilities and are devoting renewed attention to their respective space security strategies in response. Demonstrations such as China's 2003 manned *Shenzhou V* launch and 2007 anti-satellite (ASAT) test have triggered varying responses from Asian states that perceive these growing space capabilities as threats to national security and regional stability. Though existing research has delved into how Asian states are individually addressing China's space-related capabilities through internal initiatives, and how states are responding to the rise of China in terrestrial-economic and military contexts, a research gap lies in comparative analysis of Asian states' strategic responses to China's growing space power. Accordingly, this thesis aims to address the following question: How have Asian states' space power strategies adapted to China's rise as a space power?

B. SIGNIFICANCE OF THE RESEARCH QUESTION

Space is presently a far more dynamic and anarchic domain than it was throughout the Cold War. No longer dominated by just the superpowers' civil and military programs, international space activity is now complemented by an array of emerging commercial and military actors, as well as a substantial number of developing states. The rapid increase in international space activity following the Cold War has occurred outside of traditional cooperative norms, increasing the risk and stakes of space-related conflict.[1] The brisk introduction of new actors in space, all with unique motivations and interests, challenges previous understanding of space power and space security, as states craft strategies that account for these post–Cold War shifts. Pursuing more than just military interests, China's space power strategy has particularly responded to these changes, as it has reaped utility from civil and commercial space activity while simultaneously achieving national security

[1] James Clay Moltz, *Asia's Space Race: National Motivations, Regional Rivalries, and International Risks* (New York: Columbia University Press, 2012), 190–91.

objectives.[2] As China continues to employ this multifaceted approach, rival Asian states are devising their own counter-strategies to enhance their national security, maintain technological parity, remain commercially competitive, and reaffirm their status as a regional power.

While an understanding of Asian states' space strategies is important for its own sake, its implications extend beyond mere description. A holistic evaluation of these strategies, assessing their effectiveness in countering China's rise as a space power, is crucial to determining the space-related role the United States could serve in the region. A comparison of regional case studies might also provide insight into how similar Asian states might respond to China's growing space capabilities. Additionally, this analysis could outline a foundation for increased regional cooperation to foster space security.

C. LITERATURE REVIEW

Space power theory is a relatively young discipline within national strategy, but as nations compete to incorporate space into their security calculations, debates surrounding applications of space power have increased in both frequency and significance. Space power is widely understood to be a subset of national power and is accordingly subjected to its analytical frameworks. Indian space analyst Ajay Lele supports this assessment, defining power as "the capability of the state to use the various resources available at its command in the pursuit of national objectives."[3] He elaborates that space power is affected by and exerts influence over the gamut of national motivations—economic, sociocultural, diplomatic, and security—and is subjected to hard and soft characterizations.[4] Similarly, as with power in a broadly defined sense, Lele argues that defining space power is complicated by contextual variations. This analytical link between national power and

[2] John J. Klein, *Space Warfare: Strategy, Principles, and Policy* (London: Routledge, 2006), 37; Michael Sheehan, *The International Politics of Space* (London: Routledge, 2007), 160, https://doi.org/10.4324/9780203933909.

[3] Ajey Lele, "Power Dynamics of India's Space Program," *Astropolitics* 14, no. 2–3 (September 2016): 121, https://doi.org/10.1080/14777622.2016.1237212.

[4] Lele, 121.

space power forms the basis of space power theory, but analysis of space power strategy and its applications have continuously adapted to shifts in contemporary context.

While the use of space power has adapted to the context of the time, space power has remained an important element in promoting space security and national influence. Space power is used to promote space security, which Moltz defines as "the ability to place and operate assets outside of the Earth's atmosphere without external interference, damage, or destruction," similar to how national power helps provide national security.[5] He notes that in accordance with both the realist and liberal schools of international relations, the use of both hard and soft space power have been used in attempts to promote space security, particularly in the Cold War. The Cold War experience is illustrative of how space power can take on soft and hardline characterizations to fulfill national objectives. The United States and Soviet Union most notably fulfilled both liberal and realist expectations of space activity during the Cold War by conducting military space operations, engaging in civil space competition, and negotiating diplomatic agreements that restricted their competition to practices less harmful to the space environment.[6]

The dual-use nature of space technology presented a challenge to super power strategists throughout the Cold War. As South Asian strategic analyst Sobia Paracha explains, "Generally, space technologies include an extensive range of dual-use technologies, such as navigation, telemetry, rocketry, satellite set-ups, and also purely military technologies, like missiles, [ASAT technology,] and missile defense."[7] As the superpowers raced to build intercontinental ballistic missiles (ICBMs) to deliver nuclear warheads across vast distances, the technological similarities between nuclear delivery vehicles and civilian launchers proved especially concerning. These developments, coupled with advancements in nuclear technology, fueled the infamous deterrence strategy

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[5] James Clay Moltz, *The Politics of Space Security: Strategic Restraint and the Pursuit of National Interests* (Stanford, CA: Stanford University Press, 2008), 11, 14–15.

[6] Sheehan, *The International Politics of Space*, 7–16; Moltz, *The Politics of Space Security*, 41,64.

[7] Sobia Paracha, "Military Dimensions of the Indian Space Program," *Astropolitics* 11, no. 3 (September 1, 2013): 157, https://doi.org/10.1080/14777622.2013.842453.

of mutually assured destruction (MAD).[8] Although the superpowers aimed to outpace their respective rival's technological progress in space to promote their own security, there was greater utility to be reaped through cooperative means, given the immense costs MAD posed.[9]

Given this context of MAD, the United States and Soviet Union began to engage each other early in the Cold War to prevent misunderstandings that could lead to a high-stakes nuclear conflict. Soviet-American cooperation yielded many formal agreements that limited the military use of space, such as the Partial Test Ban Treaty, the Outer Space Treaty (OST), the Anti-Ballistic Missile Treaty, and the Strategic Arms Limitation Treaty.[10] These agreements helped forge bilateral understanding and respect alongside informal practices of information sharing and consultation which helped prevent conflict, while also extending the superpowers' influence across the rest of the world.[11] This assortment of diplomatic breakthroughs throughout the Cold War represents how the diplomatic use of space power achieved mutually desired strategic objectives, promoted collective space security, and spread national influence.

Sheehan affirms this assessment and goes on to cite the United States' announcement of the Strategic Defense Initiative (SDI) and cancellation of previous cooperative agreements following the détente era as a U.S. return to using hardline space power.[12] While diplomacy prevailed throughout the détente era, the United States' announcement of the SDI sparked a realist renaissance, reviving fears that the aforementioned agreements had aimed to contain.[13] While SDI never came to be, the announcement of a space-based weapons system that was intended to disrupt the Soviet Union's nuclear weapons strategy is a noteworthy example of how military-based space

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[8] Wilson Wong and James Fergusson, *Military Space Power* (Santa Barbara, CA: Praeger, 2010), 5.

[9] Moltz, *Asia's Space Race*, 15–16.

[10] Moltz, *The Politics of Space Security*, 174.

[11] Moltz, *Asia's Space Race*, 2012, 16.

[12] Sheehan, *The International Politics of Space*, 55–66.

[13] Sheehan, 66.

power aimed to promote unilateral space security, albeit at the expense of preexisting diplomatic treaties. Although cooperation in space between the superpowers resumed soon after, and even expanded after the collapse of the Soviet Union,[14] hardline use of space power came became increasingly present in space strategy discourse throughout the era of U.S. unipolarity.

At the end of the Cold War, debate surrounding the effectiveness of military-strategic doctrines to promote space security continued. As the United States went unchallenged as the dominant space actor, some American military analysts and realist scholars envisioned space as the inevitable next frontier for warfare. They accordingly advocated for military dominance of the space domain, aiming to capitalize on the absence of meaningful opposition to U.S. space power. David Lupton, an officer in the U.S. Air Force, asserted that space power is analogous to that of sea power, air power, and land power in military strategy and evolved from these earlier sets of domain-tactical beliefs.[15] Lupton perceived a mutual objective of establishing control of the warfare environment in terrestrial and space doctrines, favoring weaponized approaches over liberal alternatives. Weaponization is considered the stationing or use of weapons in or from space either offensively or defensively, while militarization is generally understood as the use of space-derived information in support of terrestrial operations.[16] Although his work preceded the end of the Cold War, Lupton's doctrine influenced later scholars such as Mantz, who advocates for an even more aggressive, weaponized space power theory based upon space-strike, space-protection, and space-denial missions.[17]

Everett Dolman, an associate professor at the School of Advanced Airpower Studies, argued that weaponized space doctrines such as Lupton's and Mantz's were the

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[14] Sheehan, 179; "NASA - United States-Soviet Space Cooperation during the Cold War," NASA, accessed August 25, 2018, https://www.nasa.gov/50th/50th_magazine/coldWarCoOp.html.

[15] David E. Lupton, "On Space Warfare: A Space Power Doctrine" (Maxwell Air Force Base, Ala.: Air University Press ; 1988), 4.

[16] Raja Qaiser Ahmed and Misbah Arif, "Space Militarization in South Asia: India's Quest for Space Weapons and Implications for Pakistan," *Asian Survey* 57, no. 5 (October 1, 2017): 814, https://doi.org/10.1525/as.2017.57.5.813.

[17] Michael Mantz, *The New Sword: A Theory of Combat Space Power* (Maxwell Air Force Base, AL: Airpower Research Institute, May 1995), 37, 46, 51.

gateway to a secure and prosperous space environment in the absence of a governing space authority. Dolman formulated a strategy called "astropolitik," based upon the concept of realpolitik,[18] and envisioned the "application of the prominent and refined realist vision of state competition into outer space policy."[19] Dolman claims that the United States should monopolize military space power—establishing space control in Lupton's terminology—to replace the present anarchic order of space, allowing the United States to serve as the ultimate governing authority beyond the Earth's atmosphere.

By establishing military dominance of space through weaponized means, Dolman argues the United States could prevent an authoritarian state from doing so and creating an illiberal space order. Dolman also claims that U.S. space dominance would benefit the international community by serving as the benign space authority and enforcing a liberal space order. Such military-strategic applications of space power have become increasingly controversial. Sheehan argues that such thinking only advances the realist "self-fulfilling prophecy"[20] and French space analyst Alain Dupas believes astropolitik-style weaponization deters potential commercial investors, hindering commercial space development instead of promoting it.[21]

Despite their former salience, hardline strategies for applying space power no longer represent the only lens through which to analyze it. Changes in international space activity following the Cold War have stimulated updated doctrines and space strategies for nations to remain competitive in twenty-first-century space. The dominance of commercial space activity, increased military dependency on space assets as force multipliers, reduced threat of nuclear war, and the introduction of many new spacefaring nations all represent post-Cold War shifts in space activity that complicate Cold War–era frameworks in the

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[18] Realpolitik translates to "political realism" from German and is attributed to Ludwig von Rochau; G.R. Berridge and Lorna Lloyd, "Realpolitik," in *The Palgrave Macmillian Dictionary of Diplomacy*, 3rd ed. (London: Macmillian Publishers Ltd., 2012).

[19] Everett Dolman, *Astropolitik: Classical Geopolitics in the Space Age* (Portland, OR: Frank Cass Publishers, 2002), 1.

[20] Sheehan, *The International Politics of Space*, 11.

[21] Alain Dupas, "Commercial-Led Options" in James Clay Moltz, *Future Security in Space : Commercial, Military, and Arms Control Trade-Offs* (Monterey, CA: Monterey Institute of International Studies, 2002).

present context. The rapid growth of the international space economy is especially noteworthy, having almost doubled from $176.7 billion to $330 billion in total valuation from 2005–2014.[22] This figure is remarkable considering the devastation wrought on the global economy during the Great Recession. Additionally, international commercial space activity represented 76 percent of this figure, eclipsing global civil and military spending by a factor of three.[23] The commercial space sector is also playing a large role in innovation formerly led by civil programs in countries such as in the United States; the rise of commercial space innovation could offer more cost-effective and timely developments than state-led initiatives, representing another post-Cold War shift with significant implications for national space power.[24]

Although some military space power doctrines take notice of the increase of non-state interests in space and the interaction between the space and terrestrial environments,[25] options that do not enhance the risk of conflict exist. These alternatives involve an emphasis on the use of soft space power to establish liberal practices of cooperation and self-restraint. Soft space power is based on a "mechanism for attraction," a concept which is based upon influencing other countries through foreign policy to share common interests they otherwise would not have.[26] States most commonly utilize their civil and commercial space programs to exert this influence by leveraging their technological prowess to arrange cooperative agreements or commercial arrangements.

Civil space programs contribute to national space power and international cooperation by promoting scientific research, technological development, and national prominence on the world stage. While civil space programs have been criticized for potentially contributing to military capabilities under a peaceful guise, given the dual-use

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[22] The Space Foundation, "The Space Report 2015: The Authoritative Guide to Global Space Activity" (Colorado Springs, Colorado: Space Foundation, 2015), 14.

[23] The Space Foundation, 2.

[24] James Clay Moltz, "From Nations to Networks: The Changing Dynamics of Twenty-First Century Space Power," *Strategic Studies Quarterly* March 2019, 80.

[25] Klein, *Space Warfare: Strategy, Principles, and Policy*, 38.

[26] Ajey Lele, *Asian Space Race: Rhetoric or Reality?* (India: Springer, India, 2013), 219–34.

nature of space technology, there are undeniable positive externalities from civil space projects. Civil space projects such as the U.S. Apollo program spurred leaps in both scientific research and technical capacity while also contributing to American "techno-nationalism."[27] The success of such missions promoted the image of U.S technological leadership over that of the Soviet Union, contributing to the legitimacy of the United States' ideology over the Soviet Union's amidst their Cold War competition.[28] Achievements in civil space activity promote a heightened sense of legitimacy over rival states, as evident in the Cold War experience, and help facilitate cooperation with states impressed or concerned by these technological demonstrations.

Commercial space programs also serve as agents of soft space power, but the security implications of commercial activity must also be acknowledged. In general, the use of economic space power is flexible because it can be leveraged to attain either diplomatic or security-related outcomes. Trade restrictions advance realist expectations of inter-state competition and aim to enhance space security by weakening potential adversaries; however, efforts to remove such barriers and promote amicable relations enhance soft power by creating diplomatic capital, potentially opening doors for cooperation in other areas. The United States lifted restrictions of sensitive technology transfers to India in 2018, granting it Strategic Trade Authorization (STA-1), in a show of soft power as part of a larger effort to establish amicable relations and balance against China.[29] While there are obvious hardline security implications of expanded strategic trade between the United States and India, it is important to note that United States is not coercing India to take any specific course of action by granting it STA-1 status. Instead, the United States hopes to influence India's decision to balance against China by establishing strategic trade relations.

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[27] Joan Johnson-Freese, *Space as a Strategic Asset* (New York: Columbia University Press, 2007), 11.

[28] John Logsdon, "Why Space Exploration Should Be A Global Project," *Space Policy* 24, no. 1 (February 2008): 3.

[29] Ankit Panda, "Strategic Trade Authorization: A Fillip for India's 'Major Defense Partner' Status with the US," *Diplomat*, August 1, 2018, https://thediplomat.com/2018/08/strategic-trade-authorization-a-filip-for-indias-major-defense-partner-status-with-the-us/.

China's multifaceted space power strategy utilizes economic, diplomatic, and security-related elements of space power to enhance national space security. China aims to develop a competitive, holistic space program that can enhance relationships with developing states, limit the influence of other space powers, and use dual-use technology to efficiently advance its military capabilities. China's increasing ability to produce dual-use technology reinforces its military strategy by seeking asymmetric advantages over conventionally superior adversaries like the United States, and could pose a challenge to potential American intervention in the South China Sea or Taiwan Strait.[30] These points illustrate how China is using its military-space sector to undermine its potential adversary, the United States, by developing advanced dual-use technology; however, China's space strategy utilizes its space sector for more than just military utility.

China accrues diplomatic capital from heavily subsidized sales of satellites, ground systems, and launches to foreign countries, enhancing the soft power elements of its space strategy. China markets space technology through the Great Wall Industry Corporation (GWIC) to developing states not only to develop a profitable presence in emerging markets and reinforce its desired image as a peaceful power, but also to extend its influence as a space power in areas that traditionally favored the United States.[31] China's diplomatic space strategy is set to benefit tremendously from the inclusion of the Spatial Information Corridor (SIC) as part of the Belt and Road Initiative (BRI). SIC will offer 65 countries partaking in BRI services from Chinese space assets.[32] According to the China National Space Administration (CNSA), SIC will provide access to "remote sensing, communications and broadcasting, the Beidou satellite navigation system, as well as satellite positioning services for applications including telemedicine, disaster relief,

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[30] Matthew John Dillon, "Implications of the Chinese Anti-Satellite Test for the United States Navy Surface Forces" (master's thesis, Naval Postgraduate School, 2008), 6.

[31] Rob W. Chambers, "China's Space Program a New Tool for PRC 'Soft Power' in International Relations?," (master's thesis, Naval Postgraduate School, 2009), 144; Moltz, "From Nations to Networks," 77.

[32] Jiang Hui, "The Spatial Information Corridor Contributes to UNISPACE+50," United Nations Office for Outer Space Affairs, 2018, http://www.unoosa.org/documents/pdf/copuos/stsc/2018/tech-08E.pdf.

transport, entertainment and counter-terrorism."[33] SIC also aims to promote cooperation in space science, applications, and space exploration.[34] Although the United States has maintained its status as the dominant space power, China's space strategy poses a significant challenge to the United States' strategic ambitions. The diplomatic capital accrued from China's space-related ventures abroad, such as SIC, could allow it to establish cooperative agreements and norms of space activity instead of the United States, enhancing China's space security by becoming a more dominant diplomatic power in space-related issues.

Equally important to China's space strategy is the role of its civil space program. China has established itself as a space power in the eyes of many as a result of its civil space achievements, ranging from the 2003 *Shenzhou V* manned space launch to its *Chang'e 1* lunar probe mission in 2008,[35] as well as ongoing plans to launch an upgraded, large space station in 2022.[36] In both the civil and military space sectors, such demonstrations of advanced indigenous technology aim not only to promote China's national status, but also to reinforce China's tech-driven economic initiatives like Made in China 2025. This program aims to overcome the middle income trap by developing high end domestic manufacturing capabilities and decrease China's reliance on technology from abroad.[37] The plan also emphasizes the production of civil space equipment, eyeing 80% domestic capacity by 2025.[38]

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[33] Jack Kavanagh, "China Offers Satellite Data to Belt and Road Countries to Tackle Disasters," UN-SPIDER Knowledge Portal, May 22, 2018, http://www.un-spider.org/news-and-events/news/china-offers-satellite-data-belt-and-road-countries-tackle-disasters.

[34] Jiang Hui, "The Spatial Information Corridor Contributes to UNISPACE+50."

[35] Moltz, *Asia's Space Race*, 93; "Chang'e 1," NASA, 2007, https://nssdc.gsfc.nasa.gov/nmc/spacecraft/display.action?id=2007-051A.

[36] Phoebe Weston, "China Unveils Plans to Put a New Space Station into Orbit by 2020," *Daily Mail Online*, June 1, 2018, https://www.dailymail.co.uk/sciencetech/article-5795627/China-unveils-plans-new-space-station-orbit-2020.html..

[37] James McBride, "Is 'Made in China 2025' a Threat to Global Trade?," Council on Foreign Relations, accessed November 26, 2018, https://www.cfr.org/backgrounder/made-china-2025-threat-global-trade.

[38] Adam Jourdan, "Factbox: Made in China 2025: Beijing's Big Ambitions from Robots to Chips," Reuters, accessed November 26, 2018, https://www.reuters.com/article/us-usa-trade-china-policy-factbox/factbox-made-in-china-2025-beijings-big-ambitions-from-robots-to-chips-idUSKBN1HR1DK.

China is establishing itself as a holistic space power much more quickly than its regional rivals, forcing them to revamp their space strategies in light of the Chinese threat. India, Japan, and Vietnam have watched China's space strategy unfold much to their peril, as China's comprehensive approach to space power threatens their regional prominence and ambitions. India's space strategy also aims to exploit dual-use technology in pursuit of national security, relying on indigenous civilian launch vehicle technology as it enhances its satellite programs for military applications.[39] India has also improved the range of its nuclear missiles using technology like that in its civilian launch vehicles.[40]

Additionally, India's revised comprehensive space strategy aims to counter growing Chinese influence across the Indo-Pacific, particularly in countries which comprise the String of Pearls that geographically constrains India. Lele argues developing space powers will "fall more on India because of its space infrastructure and economical commercial launching facilities."[41] In this context, the soft power relationship between India's civil program and its diplomatic aims is similar to China's military-driven space strategy, as the rival states both aim to extend their influence as technological leaders across the developing world. India's space exploration missions, such as its 2014 Mars probe mission, enhance its image as a technological leader among developing nations while also stoking techno-nationalist sentiments. Furthermore, India's space program contributes to larger national economic initiatives such as the "Make in India" and "Digital India" efforts meant to improve domestic manufacturing capability and facilitate the transition to an innovation-based economy.[42]

According to space analyst and professor Saadia Pekkanen, Japan has shifted its space strategy's focus from solely market and scientific research purposes to increasingly

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[39] Paracha, "Military Dimensions of the Indian Space Program," 163,170.

[40] Sheehan, *The International Politics of Space*, 151; "Agni V," Jane's by IHS Markit, accessed September 13, 2018, https://janes-ihs-com.libproxy.nps.edu/Janes/Display/jswsa386-jsws.

[41] Ajey Lele, *Asian Space Race*, 67.

[42] Neeta Lal, "India's Soaring Space Ambitions," *Diplomat*, August 9, 2017, https://thediplomat.com/2017/08/indias-soaring-space-ambitions/.

allow for security applications.[43] She explains how, following a series of commercial failures throughout the 1990s, Japan's commercial space industry found safe haven from superior international competition in a mutually beneficial relationship with Japan's security bureaucracy. Following a 2008 piece of legislation that allowed military space activity, the Basic Space Law, Japanese commercial space firms earned contracts from Japan's security sector that allowed them to remain in business while developing dual-use technology to protect against threats from China and North Korea.[44] Pekkanen concludes that this strategic shift has allowed Japan to pursue a multifaceted space strategy in response to China's by allowing existing commercial industries to serve a space-related military-industrial complex, efficiently promoting national security and economic development.

Vietnam has adopted a primarily development-oriented space strategy. Making use of increased economic power following market reforms in the mid-1980s, Vietnam began investing in indigenous space capabilities to achieve "orbital sovereignty," promote international prestige, and become less dependent on other space powers.[45] Despite this aim and Vietnam's investment in indigenous space technology and infrastructure, it still embraces cooperation with external space powers.[46] This trend illustrates Vietnam's desire to leverage its space program for diplomatic and security purposes in addition to socioeconomic development. States such as Vietnam are often the targets of larger space powers' soft power strategies, such as Japan's. Japan has contributed a considerable amount of financial assistance to Vietnam in its quest to establish a highly-capable space program.[47] Despite Vietnam's ambitions to develop indigenous space capabilities, it

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[43] Saadia M Pekkanen and Paul Kallender-Umezu, *In Defense of Japan: From the Market to the Military in Space Policy* (Stanford, CA: Stanford University Press, 2010), 223.

[44] Pekkanen and Kallender-Umezu, 225.

[45] "VINASAT-1 Bodes Well for Vietnam's Telecoms Development," *People's Army Newspaper*, April 4, 2008 quoted in Robert Harding, *Space Policy in Developing Countries* (New York, NY: Routledge, 2013), 181.

[46] Lele, *Asian Space Race*, 117–20.

[47] Hirotaka Watanabe, "Japan's Space Strategy: Diplomatic and Security Challenges," in *Space Strategy in the 21st Century: Theory and Policy* (London: Routledge, 2012), 293.

benefits from foreign technology and capacity-building efforts offered by larger space powers like Japan in pursuit of shared geopolitical objectives.

D. POTENTIAL EXPLANATIONS AND HYPOTHESES

As previously mentioned, Moltz notes that lack of cooperative norms among Asia's major space powers is fueling an increased risk of conflict. The absence of a stabilizing regional framework implies that Asian states are not using diplomatic space power to ensure collective space security in the wake of increased Chinese space activity. However, bilateral and multilateral cooperation in commercial and security fields are possible responses to China's space power and could fall under commonly cited responses to rising powers.

If Asian states are arming themselves with militarized space equipment, cooperating bilaterally, or working multilaterally to promote space security, their actions will largely fall under one of three possible larger trends in accordance with balance of power theory: balancing, bandwagoning, or hedging. Balancing can occur both internally and externally, as internal balancing entails a state unilaterally redirecting its resources towards countering a potential threat, while external balancing requires cooperation with other states. Asian states would be externally balancing against China if they are collectively working together, or with extra-regional powers like the United States, to promote mutual space security. Despite these states sharing a common interest in responding to China's space power, they are also concerned about attaining relative gains in space power over each other, reflecting a headwind against some kinds of regional multilateral cooperation.[48] While external balancing against China is a plausible explanation of Asian state behavior, the incentive for them to balance must outweigh these incentives to compete among each other. This decision will depend largely on a case-by-case basis, as states without bilateral rivalries face different sets of strategic calculations than those with hostile relations when deciding whether to balance against a third power.

[48] Moltz, *Asia's Space Race*, 31–33.

Conversely, Asian states would be bandwagoning with China if they were accepting China's power by collaborating with China in diplomatic, economic, and security related fields; this explains behavior like Pakistan's. Hedging would occur if Asian states are engaging in a balance of cooperation among China and other powerful states like the U.S. or Japan. Hedging is increasingly considered a common behavior for states close with both the United States and China. This trend is often posited as a choice to rely on China for economic purposes and the United States for political and security related assistance, and explains behavior of many Southeast Asian states such as Thailand and Indonesia. Given the generally warm relations shared among Japan, India, and Vietnam, as well as their respective rivalries with China, it can be reasonably hypothesized that these three states are balancing against China.

E. RESEARCH DESIGN

This thesis will utilize a series of comparative case studies to determine how Asian states are responding to China's growing space power, analyzing India's, Japan's, and Vietnam's space strategies. To determine regional behavior in response to China, comparative analysis must be emphasized over a single case study. Research will primarily be qualitative, as open source quantitative figures surrounding ongoing space-related security projects are scarce; however, publicly disclosed figures such as budgets and launch statistics will be incorporated throughout the analysis.

The three case study countries have been chosen because of their history as space-faring states and their rivalries with China. Status as a space-faring state is necessary for selection as a case study, as states without functioning space programs lack the means necessary to directly counter China's space capabilities. Similarly, each case study must have the strategic motivations to compete with China's growing space power, considering it a threat to their national security or regional prominence, to be considered in competition with China.

Research materials will primarily consist of open source, scholarly works, including journal articles and books from academic publishers; however, information surrounding the most recent space related developments will be found in academic

databases, reliable news sources, and organizational public releases. Official government press releases, statistics, and reports will be also incorporated. For the most recent developments specific to the case studies, the use of reputable press and organizational sources will help fill gaps in information not covered elsewhere.

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II. INDIA

In a remarkably transformative process, India has joined the ranks of the world's major space powers since its humble beginnings in the mid-twentieth century. Unlike the superpowers of the Cold War, whose economic development preceded the establishment of costly multifaceted space programs, India sought to promote socioeconomic development through investment in civil-oriented space technology. This peaceful model, though not without its advantages, has since 2007 been cast aside in favor of a system better suited for competition with other space-faring nations in the region, namely China.

The Sino-Indian rivalry has historically covered a spread of issues ranging from border disputes to clashing regional ambitions, mutual suspicion over military modernization, economic competition, and technological disparities. This competition has naturally spilled over to the space domain. Amidst China's rise, India aims to counter China's holistic space strategy by enhancing its space program to embrace commercial competitiveness, promote national security, support national technological initiatives, and foster strong relationships with both regional and extra-regional partners, including the United States. This chapter will analyze examine how India has altered its space strategy to counter China's rise as a space power. India's history in space will be discussed first, followed by its shifts in New Delhi's strategic approach to the military, commercial, and civil space domains in the current geopolitical climate. The conclusion will summarize the chapter's findings.

A. HISTORY OF INDIA'S SPACE PROGRAM

India's space program has traditionally refrained from dwelling on security applications. Electing instead to pursue civilian utility, India sought to utilize a space program to promote development through technological advancement.[49] Following independence, Indian leadership optimistically perceived a fruitful relationship between science and development, hailing technology as the path towards international cooperation

[49] Moltz, *Asia's Space Race*, 113.

and progress.[50] However, such ambitions would not come to fruition in the space domain until the formation of the Indian National Committee for Space Research (INCOSPAR) in 1962.[51] India's first experiments with rocketry occurred this same year at the Thumba Equatorial Rocket Launching Center (TERLS), where the Soviet Union launched rockets following an agreement with the Indian government.[52] TERLS, which became the primary site for India's earliest space experiments, also launched Nike-Apache sounding rockets provided by the National Aeronautics and Space Administration (NASA) with French payloads.[53]

INCOSPAR was a part of the Department of Atomic Energy and was succeeded by the Indian Space Research Organization (ISRO) in 1969. The space mission was then separated from the atomic in 1972 with the founding of the Space Commission and the Department of Space, and the split simultaneously moved ISRO into the newly created administrative organization.[54] These agencies collectively facilitated many of India's earliest space projects, ranging from receiving stations to space launch vehicles, and benefitted highly from partnerships with space programs from both of the competing Cold War blocs. These international partnerships across the ideological spectrum not only established a working rapport between ISRO and the world's developed space powers, but also facilitated ISRO's gradual rise to major space power status as part of India's strategy of non-alignment.

ISRO was able to successfully play off the Soviet and Western space programs to bolster its technical expertise. In the mid-1970s, India worked with the United States to secure remote sensing data from NASA and learn how to apply it for development-related

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[50] Moltz, 113.

[51] Lele, *Asian Space Race*, 60.

[52] Moltz, *Asia's Space Race*, 114.

[53] Sundara Vadlamudi, "Indo-U.S. Space Cooperation: Poised for Take-Off?," *Nonproliferation Review* 12, no. 1 (2005); B. R. Guruprasad, "Understanding India's International Space Cooperation Endeavour: Evolution, Challenges and Accomplishments," *India Quarterly: A Journal of International Affairs* 74, no. 4 (December 2018): 459, https://doi.org/10.1177/0974928418802077.

[54] Moltz, *Asia's Space Race*, 115.

purposes.[55] ISRO and NASA then collaborated on a telecommunications project which broadcast educational television programs to rural villages across India, another early example of India's development minded space projects.[56] Simultaneously, the Soviet Union launched India's first satellite, the research satellite *Aryabhata*, in 1975.[57] Applications-based projects such as these collectively promoted India's development as envisioned by the nation's independence leaders, and were the primary focus of the Indian space program in its earliest years. Nonetheless, India's space program, which relied on launch services from abroad, lagged behind China's, which had independently launched its first satellite five years earlier, in 1970.[58]

India's international cooperation continued even after 1974, when India tested its first nuclear device. India established a joint commission to facilitate cooperative projects with the French National Center for Space Studies (CNES) this same year. According to Indian space analyst B.R. Guruprasad, the most notable project to result from this Joint Commission was the Viking rocket engine, an incomplete system transferred from France to India to be completed together.[59] Between 1974 and 1978, ISRO devoted over 100 man years of labor to complete the Viking engine with CNES, providing India with a liquid-fueled propulsion system and technical experience.[60] Meanwhile, India also worked alongside the United States to develop its first launch vehicle: the SLV-3.[61] Though

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[55] R.R. Navalgund, "Remote Sensing Applications," in *From Fishing Hamlet to Red Planet: India's Space Journey* (New Delhi: Harper Collins Publishers India, 2015), 558, https://www.scribd.com/document/295946419/9789351776901; Guruprasad, "Understanding India's International Space Cooperation Endeavour," 74.

[56] Moltz, *Asia's Space Race*, 116; Guruprasad, "Understanding India's International Space Cooperation Endeavour," 459–60.

[57] Moltz, *Asia's Space Race*, 117; Guruprasad, "Understanding India's International Space Cooperation Endeavour," 462.

[58] Roger Handberg and Zhen Li, *Chinese Space Policy : A Study in Domestic and International Politics* (London: Routledge, 2006), 65, https://doi.org/10.4324/9780203018347.

[59] Guruprasad, "Understanding India's International Space Cooperation Endeavour," 464.

[60] P.V. Manoranjan Rao and P. Radhakrishnan, "The Small Bang" in *A Brief History of Rocketry in ISRO* (Hyderabad: Universities Press, 2012): 22 cited in Guruprasad, "Understanding India's International Space Cooperation Endeavour," 464.

[61] Jerome Conley, *Indo-Russian Military and Nuclear Cooperation: Lessons and Options for U.S. Policy in South Asia* (Lanham, MD: Lexington Books, 2001), 33.

intended for civilian use, the United States grew wary of India's advancements in launch vehicle technology, fearing it could eventually develop a delivery system for its nuclear weapons.

U.S. concerns over potential nuclear delivery vehicles in the late 1970s marked the decline of NASA's cooperation with India and India's increased cooperation with the USSR and the European Space Agency (ESA).[62] During the Ariane launch vehicle's third flight in 1981, ISRO was able to launch its *APPLE* experimental communications satellite at no cost, representing the ongoing solidarity between India and its allies at ESA despite cooling relations with the United States.[63] Although the United States launched the first two satellites of India's INSAT communications series, *INSAT 1-A* and *INSAT 1-B*, in 1982 and 1983 following these developments,[64] India's cooperation with the Soviet Union and ESA yielded more productive outcomes given the stability of their relationship amidst India's growing interest in a missile program.

In 1983, India established the Integrated Guided Missile Development Program (IGMDP) in response to a tighter missile-technology control regime led by Western powers.[65] The IGMDP oversaw India's five primary missile projects, including the Prithvi and Agni programs,[66] and repurposed technology from its civilian launch program.[67] The development of India's first nuclear-tipped missile, the mobile Prithvi I, began in 1983.[68] The Prithvi I was unable to reach the Chinese coastline given the constraints posed by its short range,[69] implying that the missile was developed more as a response to the threat from neighboring Pakistan than that from China. India later tested the Agni ballistic missile

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62 Moltz, *Asia's Space Race*, 118.

63 Guruprasad, "Understanding India's International Space Cooperation Endeavour," 465.

64 "List of Communication Satellites," ISRO, accessed February 7, 2019, https://www.isro.gov.in/spacecraft/list-of-communication-satellites.

65 Conley, *Indo-Russian Military and Nuclear Cooperation*, 33.

66 "Integrated Guided Missile Development Programme (IGMDP)," BrahMos Aerospace, accessed February 7, 2019, http://www.brahmos.com/content.php?id=10&sid=25.

67 Moltz, *Asia's Space Race*, 119.

68 "Prithvi-I/II/III," CSIS, accessed February 7, 2019, https://missilethreat.csis.org/missile/prithvi/.

69 CSIS, "Prithvi-I/II/III."

using technology from the SLV-3,[70] demonstrating the nation's determination to promote its strategic deterrence capabilities despite Western concerns.

ISRO and the USSR grew even closer throughout the remaining years of the Cold War. The USSR launched India's first astronaut, Rakesh Sharma, in April 1984 aboard the *Soyuz T11* spacecraft.[71] Furthermore, in 1988, the Soviet Union launched India's first remote-sensing satellite, *IRS-1A*, a milestone for India's goal of indigenous development.[72] However, the end of the Cold War presented new challenges for the Indian space program which complicated its launch vehicle and nuclear missile related ambitions. Although India had made significant strides toward independent capabilities by the late 1980s, the U.S. led Missile Technology Control Regime (MTCR) limited India's ability to acquire missile-related technology from Russia. In 1991, India and the Russian commercial space company Glavkosmos reached an agreement that would have provided India with the cryogenic technology needed for its own heavy launchers.[73] However, the United States felt this agreement violated the MTCR, resulting in U.S. sanctions against Glavkosmos.[74] Despite Russia's assurances to India that it would not cave in to American protests, Yeltsin eventually complied with MTCR guidelines, and Glavkosmos agreed to sell only fully manufactured boosters to India instead of the manufacturing hardware to produce its own.[75]

India's socialist-planned economy also faced significant challenges by the end of the 20th century, prompting interest in commercial space to reignite India's economic

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[70] Moltz, *Asia's Space Race*, 119.

[71] Rajeswari Pillai Rajagopalan, "India's Space Program: A Chronology," *India Review* 10, no. 4 (October 2011): 348, https://doi.org/10.1080/14736489.2011.624012; Pankaja Srinivasan, "The down to Earth Rakesh Sharma," *Hindu*, April 4, 2010, https://www.thehindu.com/features/metroplus/The-down-to-earth-Rakesh-Sharma/article16363952.ece.

[72] Moltz, *Asia's Space Race*, 119.

[73] Conley, *Indo-Russian Military and Nuclear Cooperation*, 60.

[74] Alexander Pikayev et al., "Russia, the US, and the Missile Technology Control Regime," *The Adelphi Papers* 38, no. 317 (March 1, 1998): 36–37, https://doi.org/10.1080/05679329808449492.

[75] Conley, *Indo-Russian Military and Nuclear Cooperation*, 60.

engine.[76] In 1992, the Antrix Corporation was stood up as a corporate division of ISRO to oversee the "commercial exploitation of space products, technical consultancy services and transfer of technologies developed by ISRO."[77] In addition to marketing ISRO services, Antrix was also responsible for promoting space-related industries across India to help reinvigorate the economy.[78] Throughout the early 1990s, the Augmented Space Launch Vehicle (ASLV), a launcher derived from the previously mentioned SLV-3, completed its last successful tests, paving the way for the Polar Satellite Launch Vehicle (PSLV).[79] The PSLV would go on to become the hallmark of India's launch service program, launching an array of ISRO projects into the new millennium.[80] In 1993, India began to launch satellites for its expanding Indian Remote Sensing (IRS) constellation on the PSLV, including the first ocean observation satellite *Oceansat* in 1999.[81] The first PSLV commercial launch occurred the same year, launching the South Korean *Kitsat-3* and German *Tubsat*.[82] Although the ALSV and PSLV demonstrated improvements in indigenous Indian space technology, as they were generally unaffected by the cryogenic episode, India continued to rely on international partners for technical capacity at the highest stages. The first successful launch of the Geostationary Launch Vehicle (GSLV) in 2001 marked India's step toward independent capacity in the heavy launch sector.[83] However, the GSLV used a Russian-built upper stage engine since ISRO had yet to develop its own cryogenic capability.[84] Nonetheless, until India could successfully master its own cryogenic potential, its heaviest launch programs would continue to struggle.

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[76] Moltz, *Asia's Space Race*, 120.

[77] "Antrix Corporation Limited," ISRO, accessed January 19, 2019, https://www.isro.gov.in/about-isro/antrix-corporation-limited.

[78] ISRO, "Antrix Corporation Limited"; Moltz, *Asia's Space Race*, 121.

[79] Moltz, *Asia's Space Race*, 119.

[80] Lele, *Asian Space Race*, 61.

[81] "Oceansat (IRS-P4)," ISRO, accessed February 7, 2019, https://www.isro.gov.in/Spacecraft/oceansatirs-p4.

[82] B.N. Suresh, "History of Indian Launchers," *Acta Astronautica*, no. 63 (2008), 432. cited in Moltz, *Asia's Space Race*, 121.

[83] Rajagopalan, "India's Space Program: A Chronology," 346.

[84] Suresh, "History of Indian Launchers," 433 cited in Moltz, *Asia's Space Race*, 122.

Simultaneously, as China's advancements in space technology grew more worrisome, India began utilizing more of its space-related expertise to improve the quality of its strategic deterrent by commencing work on the Prithvi III, and Agni series missiles. Improvements from the Prithvi I and Prithvi II missiles include a second-stage booster and solid-fuel propulsion system, representing an increase in the application of formerly civilian technology to counter China's rising threat.[85] The Agni project, originally an experimental demonstrator under the IGMPD, then became an operational program, producing the Agni I and Agni II missiles.[86] Furthermore, in the aftermath of the Kargil War, India began planning a ballistic missile defense (BMD) system to counter the missile threat from Pakistan.[87]

India's history as a space faring nation can be best characterized by its ability to play off the rival blocs of the Cold War to enhance its own capabilities, a common tactic of non-aligned countries throughout the ideological struggle. By working with NASA, ESA, and the Soviet Union, ISRO was able to rapidly attain advanced technologies and expertise while promoting its own development and strategic posture. India's doctrine of strategic autonomy governs its activity in other fields as well, and despite a current drift towards alignment with the United States, the doctrine continues to guide India's national-level strategy and its space power strategy.[88] Throughout the early decades of the new millennium, India has continued to exploit its self-proclaimed strategy of non-alignment to optimize its strategic opportunities, reaping the benefits of collaboration, while demonstrating its own space-related capabilities to promote techno-nationalism. Analysis of India's space militarization, the commercial space industry, and advancements in civil space support this assessment and provide valuable insight into how India is responding to China's achievements in space.

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85 CSIS, "Prithvi-I/II/III."

86 "Missiles of India," CSIS, accessed February 7, 2019, https://missilethreat.csis.org/country/india/.

87 Franz-Stefan Gady, "India Successfully Tests Prithvi Defense Vehicle, A New Missile Killer System," *Diplomat*, February 15, 2017, https://thediplomat.com/2017/02/india-successfully-tests-prithvi-defense-vehicle-a-new-missile-killer-system/.

88 "India Struggles With Its Strategy for Becoming a Great Power," Stratfor, March 23, 2018, https://worldview.stratfor.com/article/india-struggles-its-strategy-becoming-great-power.

B. CONTEMPORARY SHIFTS IN SPACE STRATEGY

1. Military

Though India is not at the center of Chinese strategists' concerns, India considers China a primary threat, and relations between the two states therefore remain complex and often strained. While China's advancements in space and military technology worried India prior to 2007, China's ASAT launch particularly threatened India, as it symbolized the growing gap between Chinese and Indian technological progress and India's need to reevaluate its space security strategy.[89] Given the largely civilian nature of India's space program since its origin, India needed to rework its space policy to emphasize security applications. While the development of India's nuclear missile arsenal has benefitted from civilian space technology for decades, India's experiments with conventional military space platforms are a relatively recent development. The repurposing of India's civilian space capabilities has enhanced the lethality of its fighting forces primarily by fulfilling force enhancement and support roles. India's recent achievements in military space culminated with the launch of its first ASAT weapon, representing a national shift toward the weaponization of space.

As previously mentioned, China's ASAT test in 2007 was one of the first major catalysts for the militarization of the Indian space program. In the aftermath of this demonstration, India began reorganizing its bureaucracy to prepare for military space operations. One such shift came under the Defense Space Vision 2020 which aimed to enhance satellite capabilities across the armed forces under the Integrated Space Cell (ISC).[90] According to Indian security analyst Rajeswari Rajogopalan at the Observer Research Foundation, this cell was placed under the Integrated Defense Staff in 2008 "so that [ISRO, the Department of Space, the Ministry of Defense (MoD) and the military] talk

89 Moltz, *Asia's Space Race*, 127.

90 The Space Foundation, "The Space Report: 2010," 122, Cited in Moltz, *Asia's Space Race*, 2012, 128.

to each other about requirements, capabilities, and relevant policy."[91] Intra-organizational coordination under the ISC has facilitated India's militarization of space, providing the Indian military with an array of new capabilities.

Given India's history of border disputes with its rivals China and Pakistan, India sought to utilize military-dedicated satellites to monitor contested areas and enhance force readiness. Thus, India's first experiments with militarized space assets specifically emphasized intelligence, surveillance, and reconnaissance (ISR) capabilities. However, the degree to which India's space program was militarizing was unclear during this time. Although India launched a couple of observation satellites in the early 2000s which could have served both the military and civilian sector, *Cartosat-2A*, launched in 2008, was the first satellite widely speculated to be dedicated to the Indian military due to its precise resolution.[92] Nonetheless, ISRO maintained that the satellite was dedicated to civilian missions.[93] India's arrangement with Israel to acquire *RISAT-1* and *RISAT-2* also raised questions about the stated-civilian intentions of India's space program, as these radar imaging satellites were based on Israel's *TecSAR* reconnaissance satellites.[94]

Once again, however, the ambiguity of dual-use technology hindered accurate assessments surrounding India's military space capabilities.[95] As China's regional ambitions continued to grow, India's military space strategy did as well. By the early 2010s, China's regional power projection strategy looked more towards the Persian Gulf through the Indian Ocean, Pakistan in South Asia, and the Straits of Malacca in Southeast Asia. China's strategy expanded to geographically surround the Indian subcontinent with sympathetic—or debt loaded—governments and military assets, forming the String of Pearls and spurring India's fears of containment.

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[91] Rajeswari Pillai Rajagopalan, "India's Space Program: Challenges, Opportunities, and Strategic Concerns," *National Bureau of Asian Research*, February 10, 2016, https://www.nbr.org/publication/indias-space-program-challenges-opportunities-and-strategic-concerns/.

[92] Ajey Lele, "GSAT-7A and India's Growing Military Space Needs," December 31, 2018, http://www.thespacereview.com/article/3629/1.

[93] Paracha, "Military Dimensions of the Indian Space Program," 164.

[94] Paracha, 165.

[95] Lele, "GSAT-7A and India's Growing Military Space Needs."

Accordingly, India began to invest in solely military-dedicated force enhancing satellites, offering improved communication, ISR, and navigation capabilities to conventional Indian forces. India launched *GSAT-7* in 2013, the first Indian satellite officially recognized for military use.[96] The designation of *GSAT-7*, India's first military-dedicated satellite, as a naval asset strongly suggests that India fully intends to utilize its military space assets to support conventional conflicts where it deems them most critical, given the increased attention to the maritime domain. According to an official press release, the Indian Navy proclaims the satellite will **"**cover an area spread from Persian Gulf to Malacca Strait and will thus cover an area equivalent to almost 70% of the IOR [Indian Ocean Region]."[97] Similarly, the air force support satellite launched in 2018, *GSAT 7-A*, represents yet another element of India's transition from a ground combat-oriented military to counter China's regional power projection.[98] India's only joint command operates on the Andaman and Nicobar Islands, territories positioned to the west of the Strait of Malacca,[99] and will especially benefit from the increased communications ability offered by India's military space satellites. The *Cartosat* constellation grew rapidly during this time, totaling 6 spacecraft at the end of 2018.[100]

As of early April 2019, the only other purely military-dedicated satellites within the Indian Armed Forces are the communications satellite *GSAT-6*, and the electronic intelligence satellite *EMISAT*.[101] India plans to rapidly increase the scale of its military space program and launch more satellites with military potential. In addition to *Cartosat-*

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96 Rahul Bedi and James Hardy, "India's First Dedicated Military Satellite Launched," Jane's by IHS Markit, August 30, 2013, https://janes-ihs-com.libproxy.nps.edu/Janes/Display/jdw53124-jni-2013.

97 "Navy Gets a Boost with Launch of First Dedicated Defence Satellite," Indian Navy, accessed August 22, 2018, https://www.indiannavy.nic.in/content/navy-gets-boost-launch-first-dedicated-defence-satellite.

98 Lele, "GSAT-7A and India's Growing Military Space Needs."

99 "ARMED FORCES," Jane's by IHS Markit, accessed August 29, 2018, https://janes-ihs-com.libproxy.nps.edu/Janes/Display/indis100-sas.

100 Lele, "GSAT-7A and India's Growing Military Space Needs."

101 "India Launches Latest Military Comms Satellite," Jane's by IHS Markit, accessed August 20, 2018, https://janes-ihs-com.libproxy.nps.edu/Janes/Display/jdw59600-jdw-2015; Madhumathi D.S., "India Gets Surveillance Satellite," *Hindu*, April 1, 2019, https://www.thehindu.com/sci-tech/technology/pslv-isro-emisat-launch-from-sriharikota-on-april-1/article26699077.ece.

3 and four radar imaging *RISAT* class satellites, ISRO also plans to introduce two new *GISAT* class imaging satellites by the end of 2019.[102] Given that the previous *RISAT* and *Cartosat* class satellites were utilized for civilian service as well, it can be reasonably deduced from ISRO's projected launch schedule that India will continue to utilize dual-purpose space assets alongside purely military spacecraft in support of national security.

India also desires to break away from dependence on the American Global Positioning System (GPS), having formed the Indian Regional Navigation Satellite System (IRNSS), a follow-up to the GPS-assisted GAGAN system devoted to civil aviation.[103] While not providing full global coverage, and also shared by the military and commercial sectors, the IRNSS will provide independent navigational support for India's armed forces, especially in the context of its expanding its maritime presence across the IOR. Having recently signed an agreement with the Seychelles to maintain a military base in the archipelagic nation, the IRNSS will allow the Indian Navy to effectively operate in new sectors of the IOR and meaningfully counter China's growing maritime presence.[104] India's growing attention to the military utility of force-enhancing satellites complements its growing regional presence well and is conducive with its overall balancing effort against China.

India has also made significant organizational developments in space which have guided the employment of space assets within a joint framework. India has made steps towards a formal doctrine which incorporates space into joint operations, publishing the Joint Doctrine Indian Armed Forces – 2017.[105] By adopting joint doctrine and emphasizing space as a warfare domain, India will more effectively counter Chinese

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[102] Singh, "Isro to Launch 5 Military Satellites This Year to Boost 'Strategic Assets in Space,'" https://timesofindia.indiatimes.com/india/isro-to-launch-5-military-satellites-this-year-to-boost-strategic-assets-in-space/articleshow/68713168.cms.

[103] "Satellite Navigation," ISRO, accessed February 7, 2019, https://www.isro.gov.in/spacecraft/satellite-navigation.;"Strategic Weapon Systems," Jane's by IHS Markit, accessed August 29, 2018, https://janes-ihs-com.libproxy.nps.edu/Janes/Display/sasa049-sas.

[104] Steve George and Manveena Suri, "As China Concerns Grow, India Looks to Build Military Presence in Seychelles," CNN, accessed January 21, 2019, https://www.cnn.com/2018/02/18/asia/india-military-base-seychelles-intl/index.html.

[105] Jane's by IHS Markit, "ARMED FORCES," https://janes-ihs-com.libproxy.nps.edu/Janes/Display/indis100-sas.

expansion in the IOR by reducing bureaucratic friction, developing and fielding new military technologies, and matching Chinese power projection with meaningful resistance.

Furthermore, while India's BMD program aims to counter the growing missile threat from China, it has also facilitated the development of India's ASAT weapon in response to China's advancements in the military-space domain. While India's efforts to improve its warhead delivery capabilities date back to the 1980s, its embrace of a BMD system is a more recent example of the growing overlap between India's civilian and non-nuclear military space capabilities. India's BMD program is currently comprised of the endo-atmospheric Advanced Air Defense and exo-atmospheric Prithvi Defense Vehicle systems, providing India with the ability to target incoming missiles at a projected altitude of 40 km and 150 km, respectively.[106]

Advancements in India's BMD program have played a critical role in the context of India's space power strategy, as they provided New Delhi with the ability to produce a kinetic ASAT weapon of its own. In the years following China's ASAT launch, the Indian government proclaimed that it would develop its own ASAT weapon, an unprecedented idea in the history of the formerly civilian-oriented space program.[107] By 2013, the chief of the Defense Research Development Organization (DRDO), Avinash Chander, declared that India could develop an ASAT weapon on short notice given India's advancements in BMD, requiring only accurate targeting technology and a kinetic kill vehicle.[108] However, Chander also admitted that an ASAT demonstration was unlikely given the risks posed by the resulting orbital debris and the de facto demonstration of ASAT capabilities through BMD exercises.[109]

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106 Franz-Stefan Gady, "India's Advanced Air Defense Interceptor Destroys Incoming Ballistic Missile in Test," *Diplomat*, accessed September 12, 2018, https://thediplomat.com/2017/12/indias-advanced-air-defense-interceptor-destroys-incoming-ballistic-missile-in-test/.

107 Moltz, *Asia's Space Race*, 129–31.

108 "Dr. Avinash Chander DS & Chief Controller R&D (Missile & Strategic Systems) DRDO," Video, 11:27, April 23, 2013, https://www.youtube.com/watch?v=h5l4vogTVVc.

109 "Dr. Avinash Chander DS & Chief Controller R&D (Missile & Strategic Systems) DRDO."

India departed from this policy in March of 2019, conducting its first successful ASAT test after one unsuccessful trial in February.[110] During the test, India shot down its own satellite, the DRDO-owned *Microsat-R* launched in January 2019.[111] In the wake of the test, Prime Minister Narendra Modi proclaimed that "India stands tall as a space power," being one of four nations to successfully "acquire such a specialized & modern capability."[112] While the test has been perceived by some as a pre-election tactic by the Prime Minister, it has also been seen as a response to China's increasingly threatening space power strategy and the constructive partnership between China and Pakistan in space.[113] Despite the perceived electoral incentive, given India's longstanding interest in pursuing an ASAT weapon, India's weaponization of space is best understood as a form of internal balancing in response to the security threat from China. India has also made strides in its development of terrestrial directed energy weapons,[114] representing a potential avenue towards laser-based ASAT capability in the future should it choose to pursue such an option. However, according to the Indian Ministry of External Affairs, India does not yet possess satellite jamming capabilities and chose to test a kinetic kill vehicle for its first ASAT exercise because it "is a technology where we have developed capability… we have used the technology that is appropriate to achieve the objectives set out in this mission."[115]

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110 Ankit Panda, "Exclusive: India Conducted a Failed Anti-Satellite Test in February 2019," *Diplomat*, March 30, 2019, https://thediplomat.com/2019/04/exclusive-india-conducted-a-failed-anti-satellite-test-in-february-2019/.

111 Panda.

112 Chowkidar Narendra Modi (@narendramodi) "#MissionShakti is special for 2 reasons," Twitter, March 27, 2019, 12:11am., https://twitter.com/narendramodi/status/1110801488559759360

113 Jeffrey Gettleman and Hari Kumar, "India Shot Down a Satellite, Modi Says, Shifting Balance of Power in Asia," *New York Times*, March 28, 2019, https://www.nytimes.com/2019/03/27/world/asia/india-weather-satellite-missle.html.

114 Shaurya Karanbir Gurung, "India Gets a Step Closer to Laser Weaponry as DRDO Successfully Tests Laser System," *Economic Times*, July 14, 2018, https://economictimes.indiatimes.com/news/defence/india-gets-a-step-closer-to-laser-weaponry-as-drdo-successfully-tests-laser-system/articleshow/61954646.cms.

115 "Frequently Asked Questions on Mission Shakti, India's Anti-Satellite Missile Test Conducted on 27 March, 2019," Ministry of External Affairs, March 27, 2019, https://mea.gov.in/press-releases.htm?dtl/31179/Frequently+Asked+Questions+on+Mission+Shakti+Indias+AntiSatellite+Missile+test+conducted+on+27+March+2019.

India's nuclear missiles also benefit from advancements in the civil space field and pose an unprecedented strategic threat to China. Although India's nuclear strategy and space strategy differ significantly, the technological overlap in India's new missiles and civilian launchers is worth noting given India's history of repurposing civilian launch vehicle technology. India's first ICBM, the solid-fueled Agni V, is reportedly an enhanced version of the Agni III which can operate on an extended range by using the solid-fuel motors from the PSVL or GSLV.[116] Following a 2018 test of the Agni V, Nitin A. Gokhale, an Indian security analyst, declared that the Agni V is the first Indian missile capable of reaching "high value targets" on the Chinese coast like Shanghai given its increased range and status as an ICBM.[117] Zhang Zhaozhang, a professor at the People's Liberation Army National Defense University, recognized this improvement and declared that China must improve its BMD program in light of the successful test.[118]

2. Commercial

The commercial element of India's revamped space strategy pits Antrix against China's Great Wall Industry Corporation (GWIC) in a battle for market share in the global space economy and outreach among developing nations. On a larger scale, the rise of India's commercial space industry reinforces national initiatives like Digital India, India's response to Made in China 2025, by promoting innovation at the highest levels of the value chain to compete with China's similar programs.[119] Antrix has staked out a comparative advantage over its rival in the lightweight launch services industry, but GWIC remains ahead in the heavier segment. India and China are also competing to foster space start-ups as they become increasingly important to national space power. In this respect, India's

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116 "Agni III," Jane's by IHS Markit, accessed September 7, 2018, https://janes-ihs-com.libproxy.nps.edu/Janes/Display/jswsa384-jsws; Jane's by IHS Markit, "Agni V."

117 Kai Schultz and Hari Kumar, "India Tests Ballistic Missile, Posing New Threat to China," *New York Times*, August 7, 2018, https://www.nytimes.com/2018/01/18/world/asia/india-ballistic-missile-icbm.html.

118 Saibal Dasgupta, "Agni-V: China Says India Underplaying Agni, It Can Hit Europe," *Times of India*, accessed January 21, 2019, https://timesofindia.indiatimes.com/india/Agni-V-China-says-India-underplaying-Agni-it-can-hit-Europe/articleshow/12752380.cms.

119 Lal, "India's Soaring Space Ambitions."

commercial space industry is well positioned to compete with China's given ISRO's attention to increased privatization and public-private partnerships.

India traditionally competed against China in the launch services industry by relying on the PSLV. By marketing a low-cost launcher to developing, budget-constrained space powers, India can effectively compete with GWIC to accumulate diplomatic capital. Given the PSLV's relatively low launch price, averaging around $21 million per launch,[120] and ability to place multiple satellites in different orbits,[121] India has staked out a unique advantage over China in the lightweight launch services industry. The PSLV set a world record for carrying the most satellites into space on a single launcher, having put 104 satellites into orbit in a single 2017 mission.[122] India leverages this cost-cutting ability to promote outreach among developing space powers in a way GWIC cannot. This is evident in the PSLV launch in June of 2017, in which 20 satellites from both established Western space powers and emerging spacefaring nations like Slovakia, Lithuania, Latvia, Chile, and the Czech Republic were put into orbit through Antrix.[123]

Given the more favorable price per kilogram ratio for low-earth orbit (LEO) launches the PSLV holds over China's comparable Long March 4B booster (see Table 1), as well as its previously mentioned capabilities, Antrix has successfully outperformed GWIC in the lightweight launch services sector. Although the Long March 3B/E is more efficient in delivering satellites to LEO, the launcher is primarily utilized for heavy geosynchronous orbit (GEO) launches,[124] leaving other launchers to compete with the

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120 *The Annual Compendium of Commercial Space Transportation: 2018*, Federal Aviation Administration, (Alexandria, VA: Federal Aviation Administration, January 2018), 218, https://www.faa.gov/about/office_org/headquarters_offices/ast/media/2018_AST_Compendium.pdf.

121 "ISRO's Experiment To Re-Start PSLV Stage-IV A Success: Official," NDTV.com, December 17, 2015, https://www.ndtv.com/india-news/isros-experiment-to-re-start-pslv-stage-iv-a-success-official-1256226.

122 "ISRO Launch PSLV: ISRO Sends Record 104 Satellites in One Go, Becomes the First to Do So," *Economic Times*, February 15, 2017, 104, https://economictimes.indiatimes.com/news/science/isro-sends-104-satellites-in-one-go-breaks-russias-record/articleshow/57159365.cms.

123 "International Customer Satellites Launched," Antrix, accessed February 7, 2019, http://www.antrix.co.in/business/international-customer-satellites-launched.

124 Federal Aviation Administration, *The Annual Compendium of Commercial Space Transportation: 2018*, 172–173.

PSLV. Despite this efficiency and the program's success over GWIC, the PSLV is designed to launch small satellites, a much less profitable endeavor than heavier alternatives.[125] However, the low cost per launch has greater potential for international outreach among developing space powers, as the PSLV offers a low-cost method for financially constrained states compared to costlier, heavier alternatives. Until Antrix can field a more competitive heavy launcher, India's commercial space launch industry will remain limited to catering to a less profitable segment of the market.[126] However, India will be buoyed by the diplomatic capital its lightweight launches provide.

Table 1. Indian and Selected Chinese Launch Vehicle Specifications[127]

LAUNCH VEHICLE	PRICE PER LAUNCH	LEO CARGO	GEO CARGO	PRICE PER KG (LEO)	PRICD PER KG (GEO)
PSLV	$21 million	3,250 kg	1,425 kg	$6,500	$14,700
GSLV	$47 million	5,000 kg	2,500 kg	$9,400	$18,800
GSLV MkIII	$60 million	8,000 kg	4,000 kg	$7,500	$15,000
Long March 4B	$30 million	4,200 kg	1,500 kg	$7,100	$20,000
Long March 3B/E	$70 million	12,000 kg	5,500 kg	$5,800	$12,700

The prospects for Antrix outcompeting GWIC in the heavy launch sector are presently poor. It was not until recently that India produced its own cryogenic engine for the GSLV, integrating it into Antrix's portfolio of available hardware. The GSLV attained fully indigenous capacity in 2014 after over a decade of development, when the rocket

[125] Bhargav Dhakappa, "India's New Space Industry Gets Commercial," IndianFolk, February 18, 2018, https://www.indianfolk.com/indias-new-space-industry-review/.

[126] Bhargav Dhakappa, "India's New Space Industry Gets Commercial."

[127] Adapted from Federal Aviation Administration, *Annual Compendium of Commercial Space Transportation: 2018*, and Andre Tartar and Yue Qiu, "The New Rockets Racing to Make Space Affordable," Bloomberg, July 26, 2018, https://www.bloomberg.com/graphics/2018-rocket-cost/. Price per kg (GEO) calculated by the author. Ratios are rounded to the nearest hundred. Lowest price estimates are included when no set number is available.

successfully employed the Indian built cryogenic booster.[128] China, on the other hand, has utilized the Long March 3B/E, its heavy GEO launch vehicle, since the mid-1990s, offering a more efficient price per kilogram ratio than the GSLV.[129] Antrix hopes that the in-development GSLV Mk III, also called the LVM3,[130] will be a more viable competitor to China's heavy launchers. The GSLV MkIII promises to deliver payloads 3,000 kg heavier into LEO and 1500kg more into GEO than the standard GSLV.[131] Nonetheless, although the GSLV MkIII is more efficient than China's light GEO launcher, the Long March 3A, it still can't outcompete the Long March 3B/E.[132] Furthermore, the upcoming Long March V could very well be cheaper than the GSLV MkIII once it becomes operational, posing a longer term threat to India's heavy launch prospects.[133]

While Antrix remains the primary element of India's commercial space strategy, a coordinated effort by India's government aims to foster the development of the private sector to compete against similar initiatives in China. As previously mentioned, Antrix was founded with the intention of facilitating private space industries. However, it was not until recently that the Indian government offered meaningful support to private actors in commercial space. The passage of the Space Activities Bill of 2017, which provides oversight on matters of licensing, supervision, and liability, aims to support the private productization of the PSLV and other initiatives conducive to promoting an efficient supply chain and economy of scale.[134] By authorizing wider production of the PSLV, ISRO can

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128 Arun Ram, "Isro Successfully Launches Indigenous Cryogenic Engine-Powered GSLV-D5," *Times of India*, January 5, 2014, https://timesofindia.indiatimes.com/india/Isro-successfully-launches-indigenous-cryogenic-engine-powered-GSLV-D5/articleshow/28437867.cms.

129 Tartar and Qiu, "The New Rockets Racing to Make Space Affordable."; Federal Aviation Administration, *The Annual Compendium of Commercial Space Transportation: 2018*, 176–77.

130 Federal Aviation Administration, *The Annual Compendium of Commercial Space Transportation: 2018, 188.*

131 "GSLV Mk III," ISRO, accessed February 7, 2019, https://www.isro.gov.in/launchers/gslv-mk-iii.

132 Tartar and Qiu, "The New Rockets Racing to Make Space Affordable."

133 Federal Aviation Administration, *The Annual Compendium of Commercial Space Transportation: 2018, 180.*

134 "PSLV Productionisation," ISRO, accessed January 19, 2019, https://www.isro.gov.in/update/11-jan-2019/pslv-productionisation; Narayan Prasad, "The Future of India's Commercial Spaceflight Is Closely Tied to the PSLV's," The Wire, December 28, 2017, https://thewire.in/politics/future-indias-commercial-spaceflight-closely-tied-pslvs.

devote its scarce resources to other projects such as the manned space flight program and the GSLV Mk III.[135] Furthermore, ISRO is interested in collaborating directly with the private sector in satellite development, having facilitated the development of 30–35 satellites through a public-private partnership.[136]

To a lesser extent, India and China are competing to produce high-caliber space start-ups to spur innovation and efficiency. Drawing inspiration from models in the West, ISRO is looking to "incubate" start-ups by cultivating their competitiveness domestically before they enter the global market.[137] According to the chief of ISRO, K. Sivan, "ISRO will provide the seed money to these start-ups. It will also bear the cost of infrastructure and provide initial funds to start-ups for space equipment" through these incubators.[138] ISRO plans to build six incubation centers and six corresponding research hubs by late 2019.[139] These efforts by ISRO to foster private sector development and public-private collaboration represent the increased attention to efficiency within India's space economy. However, despite its achievements, India's commercial space sector is still in its early stages, and it will take time for its incubators and other growth favoring policies to take full effect. Nonetheless, the long-term outlook for India's commercial space industry benefits from government support, the PSLV's efficiency, and ISRO's pragmatic interest to privatize existing services so as to focus on larger, high-visibility civil missions.

3. Civil

India recognizes China's outreach across Asia and the IOR and is taking steps to compete with its growing regional influence through the use of space diplomacy. Surrounded by the String of Pearls, India continues to rely on its bilateral relations and

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135 ISRO, "PSLV Productionisation."

136 Dhakappa, "India's New Space Industry Gets Commercial."

137 Raghu Krishnan, "Isro Incubators to Spot the Stars in Startup Space," *Economic Times*, August 13, 2018, https://economictimes.indiatimes.com/small-biz/startups/newsbuzz/isro-incubators-to-spot-the-stars-in-startup-space/articleshow/65381099.cms.

138 Surendra Singh, "Isro to Set up 12 Incubation, Research Centres to Promote Space R&D," The Times of India, October 14, 2018, https://timesofindia.indiatimes.com/india/isro-to-set-up-12-incubation-research-centres-to-promote-space-rd/articleshow/66206451.cms.

139 Singh.

involvement in multilateral forums to promote strong relationships, further its space-related interests, and counter China's soft power strategy. As for national prestige, India's space exploration missions aim to close the gap with China's technological and astronomical achievements. While China still leads India in this respect, ISRO's pipeline of astronomical exploration projects aims to close this gap and bolster India's status across both Asia and the international community.

Given the role of non-aligned international cooperation throughout ISRO's history, it is unsurprising that ISRO has continued to collaborate with its foreign partners of conflicting strategic ambitions. By continuing to collaborate with both sides of the geopolitical spectrum, India benefits from increased opportunities for partnership and mutual benefit as it aims to compete with China on earth and in space. ISRO continues to cooperate with NASA, as the two space agencies are conducting a joint mission using a highly advanced synthetic aperture radar (SAR): *Nisar*.[140] The *Nisar* satellite is intended to "observe and take measurements of some of the planet's most complex processes, including ecosystem disturbances, ice-sheet collapse, and natural hazards such as earthquakes, tsunamis, volcanoes and landslides."[141] India is also hosting a ground station for the Russian satellite navigation system GLONASS in exchange for the reciprocal expansion of the IRNSS, fulfilling the promise of a memorandum of understanding (MoU) between ISRO and Roscosmos.[142] The security-related implications of both of these projects are significant, as India's ability to cooperate with established military powers in the development of sensitive space technologies provides a strong foundation for security-related cooperation amidst China's rise.

While ISRO still collaborates with its closest historical partners, the organization's growth is beginning to come full circle, as it is expanding its assistance to rising space

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140 "Home Page - NASA-ISRO SAR Mission (NISAR)," NASA, accessed February 7, 2019, https://nisar.jpl.nasa.gov/.

141 "Mission - NASA-ISRO SAR Mission (NISAR)," NASA, accessed February 7, 2019, https://nisar.jpl.nasa.gov/nisarmission/.

142 "Russia, India Sign MoU on Mutual Deployment of State Navigation Stations," Sputnik News, April 7, 2017, https://sputniknews.com/science/201704071052397527-roscosmos-india-navigation-stations/.

powers around the world in response to China's increasing diplomatic clout. ISRO has signed MoUs and Framework Agreements with states such as Armenia, Bulgaria, Indonesia, Mauritius, Mexico, South Africa, Tajikistan, Thailand, and Vietnam.[143] These arrangements often facilitate cooperation in joint research projects for space science and space applications.[144] India has even brokered an MoU for the peaceful use of outer space with China. This rare example of bilateral space-related cooperation between the two rival civilizations listed a number of specific projects for ISRO and CNSA to work on, including remote sensing data sharing and exchange and the cross-calibration of each country's respective remote sensing and astronomical observation satellites.[145] Although the brokerage of this MoU is noteworthy given the Sino-Indian rivalry, the MoU excludes security applications and its concrete proposals are limited, with few exceptions, primarily to space science missions. Areas such as deep space exploration, space components, and satellite navigation warrant mere discussion under the MoU's guidelines and could potentially yield no results by the agreement's expiration in 2020.

India's efforts to promote its image as a top-tier space power and compete with China for influence are evident in its activity in the Asia Pacific Regional Space Agency Forum (APRSAF). India does not participate in the China-led APSCO but instead has sent delegations to Japan's annual regional space forum APRSAF consistently since 2005 to promote its image as a responsible space power. It has co-hosted the forum twice, in 2007 and 2017, promoting the themes of "Space for Human Empowerment" and "Space Technology for Enhanced Governance and Development," respectively.[146] These subjects cater to emerging space powers at the forum and supplement India's bilateral approach to

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143 "International Cooperation," ISRO, accessed February 7, 2019, https://www.isro.gov.in/international-cooperation.

144 "SANSA and ISRO Sign MoU during BRICS Summit," SANSA, accessed February 7, 2019, https://www.sansa.org.za/2018/08/02/sansa-and-isro-sign-mou-during-brics-summit/; "India and Mexico Cooperate on Remote Sensing," UN SPIDER, October 23, 2014, http://www.un-spider.org/news-and-events/news/india-and-mexico-cooperate-remote-sensing.

145 "2015-2020 Space Cooperation Outline between ISRO and CNSA," ISRO and CNSA, May 15, 2015, http://www.mea.gov.in/Portal/LegalTreatiesDoc/CH15B2096.pdf.

146 "Annual Meetings | APRSAF-14," APRSAF, accessed February 7, 2019, https://www.aprsaf.org/annual_meetings/aprsaf14/meeting_details.php; "Annual Meetings | APRSAF-24," APRSAF, accessed February 7, 2019, https://www.aprsaf.org/annual_meetings/aprsaf24/meeting_details.php.

diplomacy with developing space powers. Despite its absence at the annual conference in its early years, India has become one of APRSAF's most active contributors, represented by a diversified body of dignitaries from across the vast Indian bureaucracy.[147] India even holds one of four seats at the APRSAF Executive Committee as a result of its previous co-hosting, providing agenda setting power up to the 2021 Forum.[148] India's recently earned status on the APRSAF executive committee is an especially notable achievement. Despite the rotating basis of the position, for the time being, India wields valuable agenda setting power at a time when APRSAF is seeing some of its highest levels of participation.

India's leadership in regional space cooperation is especially significant in the context of China's SIC and BRI. Despite its contributions to BRI, and by extension, its access to services offered in SIC,[149] India is unlikely to utilize Chinese space-based resources as it already possesses its own assets which offer similar services. Given the massive scale and scope of this Chinese project, India's ability to counteract China's soft power space influence is critical to maintaining its prestige and diplomatic leverage in the region. While India cannot compete with the scale of investment comprising BRI at large, India can counteract China's soft power influence in the space domain through its leadership in APRSAF and bilateral partnerships.

While India has historically been a leader at the U.N. and other international forums, the changing geopolitical environment in the Indo-Pacific presents an opportunity to leverage India's activity in international organizations for increased diplomatic outreach over China. India is very active in the UN Committee on the Peaceful Uses of Outer Space (UN-COPUOS) and its subcommittees, advocating for responsible state behavior in space.[150] India is also currently a leading contributor to the UN Space Based Information for Disaster Management and Emergency Response, wielding its expertise in remote

147 "Participants | Countries and Regions: Republic of India," APRSAF, accessed February 7, 2019, https://www.aprsaf.org/participants/countries/india.php.

148 "Executive Committee (ExCOM)," APRSAF, accessed February 7, 2019, https://www.aprsaf.org/about/excom.php; "APRSAF Task Force Final Report," APRSAF, December 13, 2012, https://www.aprsaf.org/about/pdf/TF_Report_(Final-13Dec12).pdf.

149 Hui, "The Spatial Information Corridor Contributes to UNISPACE+50."

150 ISRO, "International Cooperation."

sensing technology to benefit disaster-plagued nations. India leverages its participation in multilateral associations outside the UN to advance its space-related interests on the world stage as well. India is active in both the International Institute of Space Law and Inter-Agency Debris Coordination Committee, offering more opportunities to influence international norms of state behavior.[151] India's active engagement with multilateral agencies like those previously described serve to advance India's vision of a rules-based space order and offer a proactive effort to dissuade China's provocative activity in space.

A relatively new development in India's civil space program is its space science initiatives geared towards students. By investing in human capital, India has promoted its prospects for innovation in the long term which could be key in its struggle to surpass China in space. One program has sent student-built satellites into orbit, having launched *Kalamsat*, built on a 3D printer, in January 2019.[152] *Kalamsat* was built by students from the organization Space Kidz India, a group that provides mentorship to students interested in science and technology, representing the role civil society is playing in India's civil space strategy.[153] ISRO also plans to develop a set of space-focused research hubs near academic institutions in support of its commercial incubator program, representing yet another element of India's investments in space-related education.[154]

India's academic efforts also reinforce its diplomatic approach to space power through exchanges. India serves as the host for the Centre for Space Science and Technology Education for Asia and the Pacific which offers degrees to students from across the region.[155] Additionally, ISRO has sponsored another program with support from

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[151] ISRO, "International Cooperation.".

[152] "Isro Launches India's First Student-Made Satellite in Its First Space Programme for 2019," *India Today*, accessed February 7, 2019, https://www.indiatoday.in/education-today/news/story/isro-is-launching-india-s-first-student-made-satellite-tomorrow-in-its-first-space-programme-for-2019-1437248-2019-01-23.

[153] India Today, "Isro Launches India's First Student-Made Satellite in Its First Space Programme for 2019"; "About Us," Space Kidz India, accessed April 13, 2019, https://www.spacekidzindia.in/about-us/.

[154] Surendra Singh, "Isro to Set up 12 Incubation, Research Centres to Promote Space R&D," *Times of India*, October 14, 2018, https://timesofindia.indiatimes.com/india/isro-to-set-up-12-incubation-research-centres-to-promote-space-rd/articleshow/66206451.cms.

[155] ISRO, "International Cooperation."

the United Nations Office for Outer Space Affairs (UNOOSA) for international students, bringing young scholars from 45 developing countries together to collaborate on small satellite development.[156] These efforts collectively signify ISRO's investment in India's long term approach to soft space power. By investing in the human capital of its own citizens and its image as a leader in space science among the international community, India is expanding the scale and scope of its outreach beyond its traditional policies which relied primarily on space applications for development.

ISRO has continued to invest in its civil space capabilities, emphasizing its traditional strengths while also expanding the scope of its space-related capacity. Both the INSAT and GSAT constellations have grown to incorporate military applications in to their longstanding commercial purposes, representing the multipurpose capacity of India's civilly administrated constellations. One communications satellite, *GSAT-9*, was proclaimed as a "gift" from India to fellow South Asian nations to promote regional unity, representing the civil constellation's new role in regional diplomacy.[157] Given China's targeting of small South Asian nations with "debt trap" diplomacy, India's generous offer counters China's expanding regional influence and places it in stark contrast to a transactional, aggressive China.[158] While the expansion of civil satellite constellations like the *GSAT* series exemplifies India's commitment to leadership in the earth observation and satellite communications domains, ISRO has also ventured into new territory, namely the fields of astronomical observation and space exploration.

India's civil space program has surprised many international observers with the scale and scope of its space exploration missions. Much of India's newfound attention to

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156 Sandhya Ramesh, "ISRO to Launch Free Satellite Training Programme for Students from Developing Nations," *ThePrint*, June 21, 2018, https://theprint.in/science/isro-to-launch-free-satellite-training-programme-for-students-from-developing-nations/72948/.

157 "India Rejects Pakistan's Help in SAARC Satellite Project," *Times of India*, July 1, 2015, https://timesofindia.indiatimes.com/india/India-rejects-Pakistans-help-in-SAARC-satellite-project/articleshow/47897310.cms; "Indian Media: 'Space Diplomacy' in South Asia," BBC, July 1, 2014, https://www.bbc.com/news/world-asia-india-28102799; "GSLV-F09 / GSAT-9," ISRO, May 5, 2017, https://www.isro.gov.in/launcher/gslv-f09-gsat-9.

158 "China's New Super Weapon against India: Neighbourhood Debt Traps," *Economic Times*, March 14, 2018, https://economictimes.indiatimes.com/news/defence/chinas-new-super-weapon-against-india-neighbourhood-debt-traps/articleshow/63296724.cms.

space science and exploration has been driven by China's high-profile *Shenzhou* taikonaut missions, *Chang'e* lunar exploration missions, and other similar projects. In 2008, a PSLV launched the *Chandrayaan-1* lunar probe carrying scientific payloads from European and American organizations.[159] Although the mission reached the moon successfully and conducted over 3,400 lunar orbits,[160] communication with the satellite was lost in August 2009 when it crashed into the moon, frustrating the project's foreign collaborators since ISRO did not previously disclose the probe's technical weaknesses.[161] Although China beat India to the moon, India managed to beat China to Mars by launching the *Mangalyaan* spacecraft in 2013 without international assistance. As the first Asian nation to reach Mars orbit, India relished in its victory over more established regional space powers to achieve this milestone. An official from the Indian Institute of Science proclaimed that "people will see India as a destination for high-end projects" following ISRO's successful journey to the Red Planet, and Prime Minister Narendra Modi boasted that the mission "[cost] less than it takes to make a Hollywood movie."[162] Modi was not exaggerating, as the mission cost only $74 million,[163] signaling that India could very well outpace China's space exploration missions in the future without taking drastic financial measures.

India has capitalized on the strong techno-nationalist sentiment following *Mangalyaan* to achieve more objectives in space ahead of China. The *Chandrayaan-2* lunar mission is currently planned for July of 2019.[164] ISRO describes the mission as "totally indigenous" and plans to land a semi-autonomous rover to analyze soil from the lunar

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159 "Chandrayaan-1," ISRO, accessed February 7, 2019, https://www.isro.gov.in/Spacecraft/chandrayaan-1.

160 ISRO, "Chandrayaan-1."

161 Moltz, *Asia's Space Race*, 132.

162 Karan Singh, "India Beats China to Mars," AllGov India, September 24, 2014, http://www.allgov.com/india/news?news=854336.

163 Charles Riley, "India's Mars Mission Cost Less than 'Gravity' Movie," CNN, September 25, 2014, https://money.cnn.com/2014/09/25/news/india-mars-cost/index.html.

164 "After Israel's Failed Moon Mission, ISRO Treads Cautious Path; Postpones Chandrayaan Launch to July," *Economic Times*, April 25, 2019, https://economictimes.indiatimes.com/news/science/after-israels-failed-moon-mission-isro-treads-cautious-path-postpones-chandrayaan-launch-to-july/articleshow/69046416.cms.

surface.[165] Though the program aims to deliver India a "first" in space, as the rover is intended to explore the previously untouched South Pole, the mission has been delayed multiple times and may not launch as intended.[166] In addition to a return to the moon, ISRO is planning a follow-on mission to Mars and its first spacecraft mission to Venus in the early 2020s.[167] China has yet to explore Venus, offering India another feasible victory in the regional space race.

Among the most noteworthy of India's civil space developments is its official dedication to a manned-space flight mission. A successful manned spaceflight mission would not only mark an especially significant step toward catching up with China's manned *Shenzhou* spaceflight program, but also place India in one of the most select clubs among spacefaring nations. Although many nations have sent astronauts into space aboard foreign launchers, only the United States, Russia and China have independently launched astronauts into space.[168] In December of 2018, the Indian government set aside $1.43 billion for an astronaut mission, the first manned spaceflight mission conducted totally by ISRO.[169] The *Ganganyaan* project promises to send three astronauts into space and will receive collaborative assistance from CNES and Roscomos.[170] While France and Russia will not assist India in directly placing the astronauts in space, they will assist India in

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165 "GSLV-Mk III / Chandrayaan-2 Mission," ISRO, accessed February 7, 2019, https://www.isro.gov.in/gslv-mk-iii-chandrayaan-2-mission.

166 Chethan Kumar, "Chandrayaan-2 Not to Blast off on Jan 3, Isro yet to Fix Launch Date," *Times of India*, January 1, 2019, https://timesofindia.indiatimes.com/india/chandrayaan-2-not-to-blast-off-on-jan-3-isro-yet-to-fix-launch-date/articleshow/67331218.cms; Economic Times, "After Israel's Failed Moon Mission, ISRO Treads Cautious Path; Postpones Chandrayaan Launch to July."

167 "Budget 2017: ISRO Gets Funds for 2nd Mars Mission, Maiden Venus Venture," *Business Standard India*, February 12, 2017, https://www.business-standard.com/article/pti-stories/with-an-eye-on-venus-and-mars-isro-attempts-mega-world-record-117021200083_1.html.

168 "Astronaut," Encyclopedia Britannica, August 24, 2018, https://www.britannica.com/topic/astronaut.

169 Zeenat Saberin, "India Approves Budget for First Manned Space Mission in 2022," Al Jazeera, December 28, 2018, https://www.aljazeera.com/news/2018/12/india-approves-budget-manned-space-mission-2022-181228194441300.html.

170 "Collaboration with India in Space," Roscosmos, accessed February 7, 2019, https://www.roscosmos.ru/25573/; Saberin, "India Approves Budget for First Manned Space Mission in 2022."

aspects related to space medicine and astronaut training, respectively, prior to the launch.[171] The *Ganganyaan* mission is projected for 2021.[172]

C. CONCLUSION

The long-standing rivalry between China and India shows little signs of warming, especially in the context of space power competition. Advancements in India's space-strategic calculations are part of a larger national effort to preserve India's status as a regional power and close the power disparity with China. To India, China's rise is a zero-sum game with dire consequences should it fail to meaningfully compete with its northern adversary. In response to Chinese military modernization, the Indian space program has expanded its focus from civilian applications to incorporate military support roles. India's nuclear arsenal and BMD programs have also benefitted from repurposed technology and expertise, signaling New Delhi's commitment to countering China's regional aggression. Additionally, India's commercial space sector is receiving unprecedented support from the national government that aims to counter China's early steps toward developing a commercial space industry. Though not without its weaknesses, India's budding space economy is on an upward trajectory with a high upside potential. Diplomatically, India has promoted its status as a major space power and regional leader through its diplomatic initiatives at regional forums and the UN.

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171 "India, France to Collaborate on ISRO's Gaganyaan Human Space Mission," *Hindustan Times*, September 6, 2018, https://www.hindustantimes.com/india-news/india-france-to-collaborate-on-isro-s-gaganyaan-human-space-mission/story-ps9Vx3RlthKZZYlUG5y3TN.html; Jayanth Jacob, "India Seeks Russia's Help for Gaganyaan Mission to Put Man in Space by 2022," *Hindustan Times*, September 22, 2018, https://www.hindustantimes.com/india-news/india-seeks-russia-s-help-for-gaganyaan-mission-to-put-man-in-space-by-2022/story-gWcaQbUQUNxCoTam9RmvaJ.html.

172 Vikram Gopal, "ISRO Set for April Launch of Chandrayaan-2 after Missed Deadline,"*Hindustan Times*, January 11, 2019, https://www.hindustantimes.com/india-news/isro-set-for-april-launch-of-chandrayaan-2-after-missed-deadline/story-BjMmDmHQ5lqU5yijS8qfJN.html.

III. JAPAN

Japan has witnessed China's rise as a great power with suspicion and concern. Japan's regional prominence has gone largely unchallenged from the end of World War II until the early 2000s, but China's rapid development now threatens to undermine Japan's status as a regional power. China has successfully overtaken Japan as the world's second largest economy by GDP, increased its power projection capabilities, and grown more assertive in its foreign policy, much to Tokyo's dismay. These factors have driven strategic shifts within Japan to balance against China. Japan is also threatened by China's rise as a space power, as China's space power strategy threatens Japan's national security and its ability to wield economic and diplomatic influence across Asia. Accordingly, Japan has reformed its space policy to incorporate militarized security applications, expand the scale and scope of its diplomatic outreach, and break into the global commercial space market. This chapter will analyze these reforms in Japan's space strategy that have been driven by China's rise as a major space power and discuss the relevant regional security implications. The analysis will begin by detailing the history of Japan's space program. Next, Japan's strategic reform will be examined across the civil, commercial, and military domains while assessing how they address the growing Chinese threat. The conclusion will summarize the chapter's key findings.

A. HISTORY OF JAPAN'S SPACE PROGRAM

The history of Japan's space program is characterized by successive strings of failures and resounding successes**,** tracing its origins back to World War II. During the Second World War, Imperial Japan experimented with three rocket-based platforms dedicated to military use: a rocket-propelled kamikaze airplane, and two experimental jet fighters with rocket-assisted capabilities. The first of Japan's experiments with rocketry was based on the Messerschmitt Me 163 jet fighter.[173] Nazi Germany transferred the blueprints for the rocket powered Messerschmitt Me 163 interceptor during a covert

[173] Moltz, *Asia's Space Race*, 47.

submarine mission toward the end of the war.[174] This transfer spurred development of the J8M Shushui and Ki-200 aircraft for the Imperial Navy and Army Air Force, respectively, but a problematic rocket motor precluded the planes' operationalization.[175] The Nakajima Kikka was another product of technology sharing between the Axis powers, inspired by the Messerschmitt Me 262 fighter. The Kikka boasted rocket-assisted takeoff, but was also plagued by experimental failures and never saw combat service.[176] The kamikaze plane Ohka was the only rocket-assisted platform Japan successfully fielded during the war, employing it against American forces in the Battle of Okinawa in the spring of 1945.[177]

Following Japan's surrender and the ensuing Allied occupation, Japan was prevented from developing aerospace technology, but civilian experimentation with rocketry was permitted following the San Francisco Peace Treaty of 1951.[178] The University of Tokyo began experimenting with sounding rockets soon after in 1955 and became the host of the newly founded Institute of Space and Aeronautical Science (ISAS) in 1964.[179] ISAS faced early headwinds, as the organization could not place Japan's first satellite into orbit even after four successive trials between 1966 and 1969.[180] The National Space Development Agency of Japan (NASDA) was then founded in 1969 and was tasked with improving Japan's technical space capacity while ISAS emphasized progress in space science.[181] Then, in 1969, to overcome the difficulties plaguing domestic rocketry, Japan

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[174] Moltz, 47.

[175] Sebastien Roblin, "The Super Scary Legend of Nazi Germany's Me-163 Rocket Fighters," *National Interest*, November 25, 2016, https://nationalinterest.org/blog/the-buzz/the-super-scary-legend-nazi-germanys-me-163-rocket-fighters-18494.

[176] Russell Lee, "The History of Japan's First Jet Aircraft," National Air and Space Museum, September 28, 2016, https://airandspace.si.edu/stories/editorial/history-japans-first-jet-aircraft.

[177] M.G. Sheftall, *Blossoms in the Wind: Human Legacies of the Kamikaze* (New York: Penguin, 2005), 141; Bernard Millot, *Divine Thunder: The Life and Death of the Kamikazes* (New York: McCallard, 1970), 124; cited in Moltz, *Asia's Space Race*, 2012, 46–47.

[178] Moltz, *Asia's Space Race*, 47.

[179] Steven Berner, *Japan's Space Program: A Fork in the Road?* (Santa Monica, CA: RAND, 2005), 3, https://www.rand.org/pubs/technical_reports/TR184.html.

[180] Berner, 3.

[181] "Brief History / History of Japanese Space Research," ISAS, 2008, http://www.isas.jaxa.jp/e/japan_s_history/brief.shtml.

brokered an agreement with its American ally to secure proven launch vehicle technology.[182] However, according to RAND analyst Steven Berger, "the terms of the agreement prohibited re-exporting of the technology by Japan, which effectively precluded Japan from marketing any of the resulting launchers in the international market for launch services."[183]

Japan's space program was further constrained in 1969 following the signing of the Peaceful Purposes Resolution (PPR) and by strict interpretations of the post-war constitution. The PPR supplemented the Outer Space Treaty (OST) of 1967, which outlined the non-aggressive use of space by world powers, collectively forming a remarkably peaceful space policy relative to other space powers.[184] Strict interpretations of Article 9 of Japan's post-war constitution also constrained some space-related developments. According to British security analyst and professor Columba Peoples, under the PPR, Japan's space bureaucracy felt that military-space developments were unconstitutional, as Article 9 precluded the maintenance of "land, sea, and air forces, as well as other war potential."[185] While the international norm established by the Cold War superpowers interprets the OST as allowing for passive militarization, to include missions such as information gathering, the previously mentioned legal constraints guided Japan's space program throughout the remainder of the Cold War.

While China was preoccupied with internal instability following the Cultural Revolution, throwing nearly all but its launch vehicle program into disarray,[186] Japan's space program continued to utilize American technology, overcoming early obstacles and cementing its regional supremacy in space. In 1970, Japan not only launched its first satellite, *Ohsumi*, after years of mistrials, but also became the first regional state to orbit a

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[182] Berner, *Japan's Space Program*, 3.

[183] Berner, 3.

[184] Columba Peoples, "A Normal Space Power? Understanding 'security' in Japan's Space Policy Discourse," *Space Policy* 29, no. 2 (2013): 136, https://doi.org/10.1016/j.spacepol.2013.03.001.

[185] Peoples, 136.

[186] Moltz, *Asia's Space Race*, 79–80.

spacecraft.[187] NASDA also began developing the N-1 launcher, based on the U.S. Delta launch vehicle, relying heavily on both American technical expertise and components.[188] The N-1 was later used to launch the test satellite *Kiku* in 1975.[189] The N-2 project commenced in 1976, but the program was also heavily dependent on assistance from the United States.[190] These cooperative projects provided Japan's space agencies with experience and the technical capacity necessary to begin developing fully indigenous capabilities. By the end of their service in 1987, N-series launchers had launched 15 satellites.[191] However, Japan could not market the N-series given the high degree of American input, leading to the development of indigenous launch vehicles in the 1980s.[192]

The 1980s marked the beginning of this shift to full indigenous development. In 1981, ISAS was renamed the Institute of Space and Astronautical Science, administered by the Ministry of Education, as part of a larger bureaucratic reorientation.[193] The newly reorganized ISAS engaged in a variety of scientific and space exploration missions during the 1980s. *Suisei* and *Sakigake*, two observational probes, successfully passed Halley's Comet in 1985 alongside probes from both sides of the Iron Curtain.[194] Equally important to the missions' success was the formation of the Inter-Agency Consultative Group, an intermediary between Japan's space agencies and their international partners.[195] In 1986 NASDA conducted the H-I's inaugural launch, which utilized Japanese technology in most of the second stage and all of the third stage.[196] While the H-I symbolized a significant step toward Japan's objectives in the heavy launch sector, the first stage utilized American

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[187] Lele, *Asian Space Race*, 96–97; ISAS, "Brief History / History of Japanese Space Research."

[188] Berner, *Japan's Space Program*, 3–4.

[189] ISAS, "Brief History / History of Japanese Space Research."

[190] Berner, *Japan's Space Program*, 4–6.

[191] "NASDA History," JAXA, accessed November 23, 2018, http://global.jaxa.jp/about/history/nasda/index_e.html.

[192] Berner, *Japan's Space Program*, 5–8.

[193] ISAS, "Brief History / History of Japanese Space Research."

[194] ISAS, "Brief History / History of Japanese Space Research."

[195] ISAS, "Brief History / History of Japanese Space Research."

[196] Berner, Japan's Space Program, 5–6.

components, precluding commercial operations with the launcher.[197] However, Japanese corporations eyed prospects in commercial satellite technology at this time while the government participated in some studies with the United States during the SDI period, despite the constraints posed by Japan's PPR.[198]

Despite progress made during the Cold War, Japan's space program faced headwinds in the late 1990s and early 2000s. In 1992, China, Pakistan, and Thailand formed the Asia Pacific Multilateral Cooperation in Space Technology and Applications organization (AP-MCSTA).[199] The AP-MCSTA organized a series of conferences to promote mutual cooperation in space related developments across Asia and represented China's initial venture into space diplomacy.[200] The AP-MCSTA threatened Japan's outreach efforts and constituted a direct effort at competition between the rival states. In 1993, Japan established APRSAF in response.[201] Japan has utilized APRSAF to compete with its Chinese-led counterpart by establishing working ties with major and developing space powers alike such as India, Vietnam, Indonesia, Thailand, Mongolia, South Korea, and Australia through its own annual forum.

Japan's commercial ventures in space also faced headwinds during this time. The H-2 launcher, the first totally indigenous Japanese rocket, suffered a string of consecutive failures in the late 1990s and never carried a commercial payload by the end of its lifespan.[202] Ambitious plans for commercial satellite producers were also constrained by high development costs and superior international competition.[203] Although Japan had clearly achieved more in space than China by this time, China's ability to launch satellites

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197 Berner, 5–6.

198 Pekkanen and Kallender-Umezu, *In Defense of Japan*, 41, 180–186.

199 "Asia Pacific Space Cooperation Organization (APSCO)," Pakistan Space and Upper Atmosphere Research Commission, accessed January 29, 2019, http://www.suparco.gov.pk/pages/apsco.asp.

200 Pakistan Space and Upper Atmosphere Research Commission, "Asia Pacific Space Cooperation Organization (APSCO)."

201 "About APRSAF," APRSAF, accessed December 5, 2018, https://www.aprsaf.org/about/.

202 Berner, *Japan's Space Program*, 9–10.

203 Pekkanen and Kallender-Umezu, *In Defense of Japan*, 42–44.

cheaply represented another challenge to Japan's space outreach and desired competitiveness in the launch services segment. Coupled with the economic downturn in Japan throughout the 1990s, commercial space industries were forced to consolidate and received meager government support compared to that a decade prior.[204]

Furthermore, North Korea launched its Taepodong-1 missile over Japan's airspace and territory in 1998, renewing security concerns and debates surrounding Japan's strict interpretation of the peaceful use of space. In response, Japan launched a series of Information Gathering Satellites (IGS), optical observation satellites meant to provide intelligence and reduce Japan's reliance on American intelligence assets.[205] Despite this intent, and the program's contracting to Mitsubishi, the initial satellites relied on technology from the United States.[206] The initial IGS constellation was placed under the oversight of the Cabinet Intelligence Office instead of the Japan Self-Defense Force (JSDF) as the PPR still constrained the military's role in space security policy at the time.[207] Japan also signed a three-year MoU with the United States to begin expanded cooperation in BMD.[208] The primary focus of the MoU was to research and develop an enhanced version of the sea-based American SM-3 interceptor missile and expand the scope of the U.S. Theater Missile Defense (TMD) initiative.[209] This favorable collaborative basis is rooted in the shared use of the Aegis combat system, a target-tracking radar system that serves as a pillar of the U.S. naval BMD system, between the JMSDF and U.S. Navy.[210]

Despite these challenges, post-Cold-War Japan did not go without its successes. Japan successfully launched a lunar probe in 1990 and was a founding member of the

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[204] Pekkanen and Kallender-Umezu, 42–44.

[205] Berner, *Japan's Space Program*, 17–18.

[206] Moltz, *Asia's Space Race* 56.

[207] Christopher Hughes, "Japan's Remilitarization," *The Adelphi Papers* 48, no. 403 (December 2008): 48, https://doi.org/10.1080/05679320902955237.

[208] Michael Sirak, "United States, Japan Finalize Deal on Navy Theater Wide Cooperation," *Inside Missile Defense* 5, no. 17 (August 25, 1999): 12.

[209] Sirak, 12.

[210] Sirak, 12.

International Space Station (ISS).[211] Japan also streamlined its space bureaucracy in 2003 by bringing its existing space agencies—NASDA, ISAS, and the National Aerospace Lab—under the Japan Aerospace Exploration Agency (JAXA) in 2003.[212] This reform aimed to reduce bureaucratic friction caused by pooling space-related resources into one overarching administration.[213] By this time, Japan had also sent four astronauts into space to help assemble the ISS.[214] However, China completed its first successful manned spaceflight mission, *Shenzhou V,* this same year. *Shenzhou V* constituted an unexpected challenge to Japan's preeminence as the regional leader in science and technology, raising questions surrounding Japan's competitiveness in space.[215]

Having beaten Japan to an independent manned spaceflight mission, China's techno-nationalist ambitions posed an increasing challenge to Japan's regional leadership. Liberal Democratic Party official Tameo Kawamura felt that Japan needed to reshape its approach to space policy to avoid falling behind China. Accordingly, Kawamura launched a comprehensive internal initiative with support from fellow Diet members and industry leaders.[216] According to American space analyst James Clay Moltz, the Kawamura initiative "called for a shift from science to applications, a more streamlined administration, and the freedom to pursue military uses of space."[217] In the aftermath of China's 2007 ASAT launch, China's first major military-space demonstration, the Diet urgently fulfilled Kawamura's ambitions, producing the first major shift in Japan's space strategy since the adoption of the PPR almost 40 years prior: the Basic Space Law (BSL).

The BSL, alongside other post-Cold War reforms, collectively aimed to address the challenges presented by China's emergence as a major space power and aspiring regional

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211 Lele, *Asian Space Race*, 104; "History of the ISS Project," JAXA, May 25, 1999, http://iss.jaxa.jp/iss/history/index_e.html.

212 Lele, *Asian Space Race*, 97.

213 Lele, 97.

214 "History of Japan's Manned Space Activities," JAXA, accessed December 3, 2018, http://iss.jaxa.jp/astro/history_e.html.

215 Moltz, *Asia's Space Race*, 93.

216 Moltz, 57.

217 Moltz, 57.

hegemon. While the BSL outlined civilian guidelines for space diplomacy and commercial activity, it is most significant for allowing the military use of space.[218] To compete with China's growing regional presence, militarized space assets allow Japan's military to embrace enhanced C4ISR capabilities amidst its ongoing process of military normalization. Although the BSL reiterated the desire for the peaceful use of space and upheld the role of space in societal development in accordance with previous doctrine,[219] the Diet's official embrace of the militarization of space is a clear response to increased saber rattling from its most powerful adversary: China.

B. CONTEMPORARY SHIFTS IN SPACE STRATEGY

1. Military

From a security standpoint, the implications of the BSL are clear in the context of China's shift towards a regional power projection strategy from one of external defense. The BSL provides the SDF with a potential for space-enhanced combat effectiveness by allowing for military-space capabilities in a break from Japan's historical norm. Most notably, the BSL allowed for the militarization of space, departing from the constitutional and PPR-derived policy which precluded Japan from developing military-space capabilities.[220] Pekannen and Kallender-Umezu argue that the passing of BSL indicated Japan's intent to incorporate security into its space strategy after having developed an initial degree of capacity prior to 2008.[221] They explain how Japanese corporations found safe haven from the myriad of challenges that hindered their ability to compete by securing contracts from the American and Japanese security-bureaucracies. Furthermore, they claim Japan has taken advantage of manufacturers' willingness to produce military technology, coupled with the shifts detailed in BSL, to militarize space in response to Chinese military development. Projects they find evident of this trend include the previously mentioned work on SDI, IGS, and terrestrially-based BMD collaboration.

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[218] Moltz, 65.

[219] Basic Space Law, No 43, (2008) http://stage.tksc.jaxa.jp/spacelaw/country/japan/27A-1.E.pdf.

[220] Peoples, "A Normal Space Power?," 139–40.

[221] Pekkanen and Kallender-Umezu, *In Defense of Japan*, 8–9, 246.

While these projects commenced prior to the passing of the BSL, the legislation allowed the JSDF to play a larger role in space security. Before 2008, as previously explained in reference to the IGS constellation, the JSDF did not operate security-related hardware in space. However, Article 14 of the BSL allowed the state to utilize space in a manner that would "contribute to the national security of Japan."[222] After the BSL went into effect, the JSDF could not only operate existing assets, such as the IGS program formerly under civilian oversight, but also manufacture satellites going forward.[223] While the IGS project has continued to the present under the JSDF, the MoD and JSDF also launched two military dedicated communications satellites, *Kirameki-2* and *Kirameki-1*, to improve command and control capabilities in 2017 and 2018, respectfully.[224] The force-multiplying capabilities provided by these militarized space assets will benefit Japan's efforts to counter the growing Chinese military presence across the Pacific, especially in strategic hotspots like the contested Senkaku/Diaoyu islands and South China Sea. As Japan maintains its strategic interests at these locations, effective maritime patrols will become increasingly necessary amidst China's assertive foreign policy. Such patrols stand to benefit from space-derived information and C4ISR capabilities provided by Japan's network of military satellites.

The Quasi-Zenith satellite navigation constellation offers similar military utility. Japan's Quasi-Zenith constellation can serve as both an augment to the U.S. operated GPS and an independent regionally focused system.[225] China recognizes the American military's dependence on GPS, making it a likely target should hostilities breakout between the two powers. Using Quasi-Zenith, Japan can operate its own space-based navigational platform for military and civilian should GPS be disabled. Although Quasi-Zenith provides enhanced navigational coverage across territorial Japan, the network's unique figure-eight

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222 Basic Space Law, No 43, (2008) http://stage.tksc.jaxa.jp/spacelaw/country/japan/27A-1.E.pdf.

223 "Information Gathering Satellite (IGS) Series," Jane's by IHS Markit, May 5, 2017, https://janes-ihs-com.libproxy.nps.edu/Janes/Display/jsd_a182-jsd_.

224 Ministry of Defense of Japan, *Defense of Japan 2018*, (accessed December 5, 2018), http://www.mod.go.jp/e/publ/w_paper/pdf/2018/DOJ2018_Digest_1204.pdf.

225 "What Is the Quasi-Zenith Satellite System (QZSS)?," JAXA, accessed April 14, 2019, http://qzss.go.jp/en/overview/services/sv02_why.html.

orbital pattern also provides coverage across the entirety of the East Asia-Oceania region.[226] As the JSDF becomes more active outside mainland Japan, especially in geopolitical hotspots like the South China Sea, this enhanced independent navigational capacity will be of increasing benefit to the JSDF as it counters China's regional presence. Although not of the same global scale China's Beidou aims to reach, Quasi-Zenith offers Japan an important regionally focused capability and address potential vulnerabilities.

The nuclear threat posed by China and North Korea has yielded to an elevated role for BMD in Japan's space strategy. Though not considered weaponized space assets as they are currently employed, Japan's Aegis-equipped platforms and SM-3 missile interceptors constitute a potential ASAT weapon. The United States and Japan jointly developed the SM-3 series of missile interceptors following the North Korean Taepodong launch in 1998.[227] The United States intercepted one of its own unresponsive intelligence satellites with this interceptor in February of 2008 following China's ASAT launch the previous year.[228] Given the interceptor's demonstrated success against satellites, and that the United States and Japan have made a decade's worth of improvements to the SM-3 series since this exercise, Japan clearly has a potential interceptor for an ASAT weapon. Japan also employs the Aegis combat system, a targeting platform for missile defense, and has announced plans to acquire even more Aegis platforms to address rising threats. According to Japan's 2017 and 2018 Defense White Papers, Japan will stage two new Aegis Ashore systems under the Ground Self-Defense Force,[229] and procure two new Aegis-equipped destroyers to field a total of eight sea-based defense systems.[230] Coupled together, the SM-3 and Aegis combat system, at sea and ashore, represent Japan's road to ASAT capability on land and sea should it choose to repurpose these technologies.

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226 Masahuru Kugi, "QZSS Update: ICG-13 Providers System and Service Updates," National Space Policy Secretariat, November 5, 2018, http://www.unoosa.org/documents/pdf/icg/2018/icg13/06.pdf.

227 Pekkanen and Kallender-Umezu, *In Defense of Japan*, 182–85.

228 "Standard Missile-3 (SM-3) (RIM-161A/B/C/D)," Jane's by IHS Markit, November 22, 2018, https://janes-ihs-com.libproxy.nps.edu/Janes/Display/jnw_0075-jnw_.

229 Ministry of Defense of Japan, *Defense of Japan 2018*.

230 Ministry of Defense of Japan, *Defense of Japan 2017*, (accessed December 5, 2018), http://www.mod.go.jp/e/publ/w_paper/pdf/2017/DOJ2017_3-1-2_web.pdf.

Japan's strategic leadership has also indicated its desire to incorporate space security as a larger piece of the defense apparatus to compete with China's military modernization. Not only is the Japanese government facilitating cooperation between JAXA and the JSDF,[231] but the JSDF is also dedicated to improving its space monitoring and debris-tracking capabilities amidst China's increased activity in space. In 2015, the United States and Japan established a Space Cooperative Working Group (SCWG) and updated the Guidelines for U.S.-Japan Defense Cooperation, a set of principles last modified in 1997.[232] The SCWG has identified areas of cooperation for the U.S. and Japan in order to promote collective space security and assist the JSDF in its transition to becoming a space-integrated force. In 2016, the MoD allocated approximately $2 million toward designing a debris-tracking network meant to not only improve space situational awareness (SSA) but also to reduce reliance on JAXA and the United States.[233] The MoD will use these blueprints to establish an SSA-dedicated facility as well as a military center for earth observation by FY 2022.[234] Additionally, Japan's National Defense Program Guidelines for FY2019 prescribed the following policies as part of a comprehensive space security agenda: the creation of an air force unit dedicated to space operations, an emphasis on disrupting adversaries' information warfare capabilities, the use of space assets if attacked, an increase in space-based cooperation with the United States, and leadership in fostering cooperative norms of international space behavior.[235]

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[231] Jon Grevatt, "Japan Looks to Develop Space Technologies for Defence," Jane's by IHS Markit, July 4, 2018, https://janes-ihs-com.libproxy.nps.edu/Janes/Display/FG_968301-JDIN.

[232] Ridzwan Rahmat, "Japan Details Areas of Co-Operation with U.S. under New Outer Space Working Group," Jane's by IHS Markit, May 13, 2015, https://janes-ihs-com.libproxy.nps.edu/Janes/Display/jdw58613-jdw-2015..

[233] Julian Ryall, "Japan Plans Satellite, Space Debris Monitoring Network," Jane's by IHS Markit, August 19, 2016, https://janes-ihs-com.libproxy.nps.edu/Janes/Display/jdw62875-jdw-2016.

[234] Kosuke Takahashi, "Japan Plans to Set up a Space Corps," Jane's by IHS Markit, November 21, 2018, https://janes-ihs-com.libproxy.nps.edu/Janes/Display/FG_1294702-JDW.

[235] Ministry of Defense of Japan, *National Defense Program Guidelines for FY 2019 and Beyond*, (December 18, 2018), http://www.mod.go.jp/j/approach/agenda/guideline/2019/pdf/20181218_e.pdf.

2. Commercial

Japan's commercial space industry has shown remarkable progress from the troubled 1990s, now competing with China for market share in the global space economy. As previously mentioned, Pekkanen and Kallender-Umezu argue that Japan's space corporations found a lifeline by securing lucrative contracts from the government to produce military-space technology following the passing of the BSL. Japan's conglomerates also began capitalizing on a resurgence of research and collaboration on military projects with the United States amidst the industry's weakness.[236] This is not to say that Japan's commercial space industry became a military-industrial complex. Instead, Japan's commercial space industry, though still facing fierce international competition and internal challenges, has embraced shifts initiated by the BSL to survive by producing military satellites and related hardware for the first time.

The BSL also called for increased public-private cooperation in addition to what had proceeded by the time of its implementation. Article 4 of the BSL states that Japan shall "strengthen the technical capabilities and international competitiveness of the space industry and other industries of Japan," while Article 16 details how the Japanese government can promote the domestic space industry by providing top-down assistance in the form of tax incentives and use of their services.[237] These measures can be directly inferred as state-led means to support commercial activity outside the ongoing security-related projects that Pekannen and Kallender-Umezu identify as the saving grace for the troubled corporations.[238] Given the rapid expansion of the international space economy, many Asian nations are competing to secure their foothold in this segment before they are crowded out. Japan is no different and has invested heavily in its launch services industry to compete with China in this increasingly important domain.

Prior to the BSL, Japan's commercial space industry was hindered by the absence of a reliable launcher and crowded out of the international market by more efficient

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[236] Pekkanen and Kallender-Umezu, *In Defense of Japan*, 72–92.

[237] Basic Space Law, No 43, (2008). http://stage.tksc.jaxa.jp/spacelaw/country/japan/27A-1.E.pdf.

[238] Pekkanen and Kallender-Umezu, *In Defense of Japan*, 248.

competitors like China. The BSL's initiatives supplemented technical progress made by the commercial sector to produce an operating commercial launch program. In 2007, Mitsubishi Heavy Industries (MHI) was granted oversight of the H-IIA launch program, one year prior to the passing of the BSL.[239] The first commercial launch for the H-IIA occurred in 2015 when MHI launched *Telstar 12V* for a Canadian corporation.[240] Despite the breakout into the global market, the H-IIA's success can be mainly attributed to its use by the Japanese government. *Telestar 12V* remains H-IIA's only commercial launch; however, the H-IIB, a variant of the H-IIA, has reliably launched a series of foreign satellites to the ISS.[241] While the H-IIB was authorized for commercial service under MHI in 2012,[242] it has yet to conduct such a launch, leaving the H-IIA as Japan's primary commercial launcher.

The experience of the H-IIA and H-IIB following the BSL represents how the new legislation has benefitted Japan's commercial launch industry, but Japan's launch industry still suffers from stronger competition. The H-IIA suffers from an inefficient price per kilogram ratio, diminishing its appeal to international customers (see Table 2). Comparing Japanese and Chinese launchers with similar specifications, the H-IIA carries 2,000 kg less than the Long March 3B/E launchers and costs over $3,200 more per kilogram to launch than its Chinese counterpart into LEO.[243] China holds an advantage in geosynchronous orbit (GEO) launches over the H-IIA as well, as the Long March 3B/E costs almost $10,000 less per kilogram of cargo to launch.[244] Japan's promising H-III launcher, on the other hand, can carry the same payload as an H-IIA into LEO for $20 million less than a Chinese Long March 3B/E model, with savings of $800 less per kilogram. Furthermore, a H-III can

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239 "H-IIA, H-IIB, and H-III," Jane's by IHS Markit, February 18, 2017, https://janes-ihs-com.libproxy.nps.edu/Janes/Display/jsd_0345-jsd_.

240 Jane's by IHS Markit, "H-IIA, H-IIB, and H-III."

241 Jane's by IHS Markit, "H-IIA, H-IIB, and H-III."

242 "MHI to Begin Launch Service Business Using H-IIB Rockets," Mitsubishi Heavy Industries, Ltd., September 27, 2012, https://www.mhi.com/news/story/1209271577.html.

243 Tartar and Qiu, "The New Rockets Racing to Make Space Affordable."

244 Federal Aviation Administration, *The Annual Compendium of Commercial Space Transportation: 2018*, 172.

put cargo into GEO for $5,000 less per kilogram than the Long March 3B/E. Despite this advantage, China plans to retire this booster by 2020.[245] Its successors, the Long March 5, 6, and 7, could all offer superior efficiency and eliminate the H-III's advantage once they come into full service, although estimated price specifications are currently unavailable for the Chinese rockets in development.[246]

Table 2. Japanese and Selected Chinese Launch Vehicle Specifications[247]

LAUNCH VEHICLE	PRICE PER LAUNCH	LEO CARGO	GEO CARGO	PRICE PER KG (LEO)	PRICE PER KG (GEO)
H-IIA	$90 million	10,000 kg	4,000 kg	$9,000	$22,500
H-III	$50 million	10,000 kg	6,500 kg	$5,000	$7,700
Epsilon	$39 million	700-1,200 kg	X	$32,500-$55,700	X
Long March 4B	$30 million	4,200 kg	1,500 kg	$7,100	$20,000
Long March 3B/E	$70 million	12,000 kg	5,500 kg	$5,800	$12,700

The Epsilon Launcher, an indigenous lightweight launch vehicle, could provide Japan's commercial space industry a much-needed boon for the longer term. Jointly produced by JAXA and IHI Aerospace,[248] the Epsilon possesses a plethora of advantages over the aging H-II that could allow Japan to earn market share in the crowded launch services industry. With a launch cost estimated at half of the H-IIA's, and amidst the

[245] Federal Aviation Administration, *The Annual Compendium of Commercial Space Transportation: 2018*, 172.

[246] Federal Aviation Administration, 180-186.

[247] Adapted from Federal Aviation Administration, *Annual Compendium of Commercial Space Transportation: 2018*, and Tartar and Qiu, "The New Rockets Racing to Make Space Affordable." Price per kg (GEO) calculated by the author. Ratios are rounded to the nearest hundred. Lowest price estimates are included when no set figure is available.

[248] Masamichi Hoshi, Ryotaro Yamada, and Sayuka Nakajima, "Japan Rocket Launch Gives Crucial Lift to Private Space Business," Nikkei Asian Review, accessed January 28, 2019, https://asia.nikkei.com/Business/Business-Trends/Japan-rocket-launch-gives-crucial-lift-to-private-space-business.

continuing market demand for smaller satellites, the Epsilon could attract more customers than its predecessors, a prerequisite for sustainable price competitiveness.[249] Such improvements include an onboard autonomous inspection feature and an improved mobile control infrastructure, allowing Epsilon launches to be conducted within seven days of one another compared to 42 for the retired M-V launcher.[250] The increased efficiency and frequency promised by the Epsilon Launcher have the potential to capture a share of the launch services industry in a manner not before possible with other launchers in Japan. However, based on estimates by the Federal Aviation Administration, the Epsilon will suffer an incredibly high price per kilogram ratio.[251] If Japan cannot deliver more competitive specifications as intended, the Epsilon may be crowded out by more efficient alternatives in China and elsewhere. While Japan's progress in the launch services industry is promising, it is not clear whether it will be able to outcompete China in the long term.

Despite the disadvantages posed by Japan's fleeting hold on comparative advantage over China in the heavy launch services industry, as well as the disparity in commercial launches conducted by Japan and other major space powers,[252] Japan aims to stimulate its commercial space industry through its support of start-ups. Chinese start-ups have attracted almost $500 million in investment funding since 2016,[253] and Japan has responded by offering its own start-ups generous financial assistance. Japan's start-ups stand to benefit from a $940 million state-owned fund, representing another manifestation of Article 16 of the BSL.[254] Start-ups like iSpace have also secured contracts from NASA to design the

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249 Hoshi, Yamada, and Nakajima.

250 "Epsilon Launch Vehicle Online Brochure," JAXA, accessed January 28, 2019, http://global.jaxa.jp/activity/pr/brochure/files/rocket07.pdf.

251 Federal Aviation Administration, *The Annual Compendium of Commercial Space Transportation: 2018*, 140.

252 "Worldwide Commercial Space Launches," Bureau of Transportation Statistics, accessed December 5, 2018, https://www.bts.gov/content/worldwide-commercial-space-launches.

253 Michael Sheetz, "China Increases Investment in Emerging Private Space Industry," CNBC, October 10, 2018, https://www.cnbc.com/2018/10/10/china-increases-investment-in-emerging-private-space-industry.html.

254 Michael Sheetz, "Japan Offers $940 Million to Boost Nation's Space Startups," CNBC, March 20, 2018, https://www.cnbc.com/2018/03/20/japan-offers-940-million-to-boost-nations-space-startups.html.

Artemis-7 lander, reinforcing the strong economic ties between Japan and its closest ally.[255]

As seen in the United States, a style of commercially-led, "bottom-up" innovation has smoothed bureaucratic friction and conserved precious funding for space projects, offering a cost-effective alternative to state-led innovation.[256] Although Japan's commercial space initiatives have yet to produce this model, they could serve as another success of selective industrial promotion, which has served Japan well historically. Additionally, Japan could take the early strides towards the network-centric system Moltz describes. However, Japan's technocratic history stands as a formidable obstacle to a potential network-driven model of U.S. caliber. Despite Japan's steps towards empowering the private sector in space-related activity, JAXA's heavy role in directing space activity and the relative weakness of Japan's space industry preclude it from reaching the United States' degree of network-based innovation. Nonetheless, China is much less likely to adopt this model than Japan, offering Tokyo a promising glimmer of hope in its commercial battle with the Chinese commercial space industry.[257] Should its industrial strategy succeed, Japan could at least progress toward this outcome, improving efficiency and possibly pulling ahead of China in the process.

3. Civil

Japan has had to fight to retain its status as the leading space power and technological leader in Asia in light of China's contemporary space achievements. Once the BSL was passed, Japan had a concrete series of guidelines that outlined the new role of Japan's space administration amidst rising competition from China. These objectives shaped the role of Japan's civil space agency and continue to influence Japan's space power strategy, primarily in the use of soft-space power. While many of the resolutions in the

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255 "Japanese Startup among Firms Chosen for NASA's Moon Delivery Bid," *Japan Times Online*, November 30, 2018, https://www.japantimes.co.jp/news/2018/11/30/national/science-health/japanese-startup-among-firms-chosen-nasas-moon-delivery-bid/.

256 Moltz, "From Nations to Networks: The Changing Dynamics of Twenty-First Century Space Power," 78–80.

257 Moltz, 85–87.

BSL reiterated the need for ongoing activity such as "Improvement of the Lives of the Citizenry" and the "Advancement of Industries," the BSL also reformed the internal workings of Japan's civil space bureaucracy and directed Japan's space diplomacy strategy abroad.[258]

Japan's space bureaucracy received renewed support from the government at large following the passing of the BSL. Collectively, the actions constituted by the BSL defined the scope of Japan's space activity within a competitive framework following China's achievements in space. First, the BSL declared that the Cabinet would establish the Strategic Headquarters for Space Development, an administration tasked with carrying out the Basic Space Plan; this Plan outlined specific commercial, civil, and security-related strategic objectives and their basis for execution.[259] Second, the BSL detailed the requirements of the state in space policy. One such requirement is that the state must strengthen coordination among local governments, universities, private corporations, and other actors to more effectively achieve these objectives, outlined in Article 10.[260] Last, the BSL emphasized the ongoing need to promote ongoing objectives such as environmental preservation, educational advancement, and the peaceful use of space.

The BSL also shaped the international functions of Japan's civil space program in the new competitive context. Throughout the PPR era of Japan's space program, projects such as the previously mentioned Halley's Comet mission and development of the ISS provided Japan's space bureaucracy with both experience in multilateral space projects and diplomatic capital it could use to attain future objectives. While Japan's civil space program has historically worked with international partners, the BSL outlined concrete objectives and policies for space-related diplomacy. The Ministry of Foreign Affairs' (MFA) Official Space Diplomatic Policy outlines specific areas of focus for international cooperation in accordance with Article 6 of the BSL: "international rulemaking for the utilization of space," "promoting international cooperation regarding space," and "ensuring

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[258] Basic Space Law, No 43, (2008).

[259] Office of the Cabinet of Japan, *Implementation Plan of the Basic Plan on Space Policy*, FY 2017, https://www8.cao.go.jp/space/english/basicplan/2017/basicplan.pdf.

[260] Basic Space Law, No 43, (2008).

space security."[261] While Japan faces many geopolitical security risks, it also emphasizes the need to address global threats among its international partners to promote "human security."[262] Threats to human security include risks posed by space debris and natural disasters.[263] The official MFA policy aims to combat these problems by engaging in outreach measures to garner support for a rules-based space order.

Japan's diplomatic outreach strategy aims to counter China's regional influence by fostering strong relations with other space-faring nations. While evidence of space-related diplomatic cooperation between Japan and the United States is plentiful,[264] Japan's space program especially embraces diplomacy with nations across the Asia-Pacific concerned with China's regional ambitions. Shared concerns over China's quest for hegemony have brought Japan and India closer than ever before. Japan and India held their first comprehensive space dialogue in March of 2019.[265] The dialogue brought JAXA and ISRO officials together to discuss a range of important topics: such topics include "space security, bilateral cooperation…their space industries, global navigation satellite [systems, SSA,] space-related norms and other areas of mutual interest."[266] This type of exchange is evidence of Japan's bilateral measures to counter China's rise, as both India and Japan are competing fiercely to promote their technological merit. This space summit represents a willingness to externally balance against China and could serve as a foundation for bilateral security-related projects in the future.

The unprecedented use of Japanese Official Development Assistance (ODA) funding to promote Vietnam's space program is especially noteworthy, given the clear

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[261] "Japan's Space Diplomatic Policy," accessed December 5, 2018, https://www.mofa.go.jp/policy/outer_space/pdfs/space_diplomatic_policy.pdf.

[262] Watanabe, "Japan's Space Strategy: Diplomatic and Security Challenges," 288.

[263] Ministry of Foreign Affairs of Japan, "Japan's Space Diplomatic Policy."

[264] For examples, see official press releases from JAXA and NASA, or *Joint Statement on the Fifth Meeting of the U.S. Japan Comprehensive Dialogue on Space*, U.S. Department of State, (Washington D.C., 2018) https://www.state.gov/r/pa/prs/ps/2018/07/284429.htm.

[265] "The First Meeting of the Japan-India Space Dialogue," Ministry of Foreign Affairs of Japan, March 8, 2019, https://www.mofa.go.jp/press/release/press4e_002368.html.

[266] Ministry of Foreign Affairs of Japan, "The First Meeting of the Japan-India Space Dialogue."

effort towards external balancing this initiative represents. In this regard, Japan's space-related assistance to its partners promotes not only its diplomatic aim of human security, but also its geopolitical goal of preserving national security amidst China's rise. In 2011, Japan offered loans of approximately 35–40 billion yen (JPY) to Vietnam.[267] This instance marked the first time Japan had utilized ODA funding to promote an international space program.[268] By 2015, Japan and Vietnam had collectively invested 54 billion JPY in the Vietnam Space Center Project (VNSC).[269] While the strategic calculation by Japan to invest mass amounts of capital into Vietnam's young space program is certainly conducive towards promoting human-and-space security, the geopolitical significance of and motivation for this bilateral cooperation cannot be ignored. By leveraging its status as a leader in space technology, Japan can not only develop political capital with emerging regional space powers, but also influence these states to balance against China through cooperation on dual-use projects like the previously mentioned earth observation satellites.

Japan's success through APRSAF remains conducive to Japan's emphasis on space diplomacy by promoting human security, and the forum has become a much greater success than China's alternative organization. Japan's diplomatic competition with China has continued into the new millennium, evident in the foundation of the Asia Pacific Space Cooperation Organization (APSCO) in 2008 from the former AP-MCSTA.[270] One contributing factor to the disparity between the two organizations' participation is China's "heavy hand" in cooperative settings.[271] Geopolitical considerations and the disparate expertise of the organizations' contributing parties have also allowed APRSAF to possess a greater deal of space-based diplomatic outreach over APSCO. Participation in APRSAF has increased substantially since the initial conference in 1993, having brought together

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267 "Japan to Aid Space Projects in Vietnam," European Association of Remote Sensing Companies, accessed January 29, 2019, http://earsc.org/news/japan-to-aid-space-projects-in-vietnam.

268 European Association of Remote Sensing Companies, "Japan to Aid Space Projects in Vietnam."

269 "Vietnam – Japan Cooperation in Space Technology," VNSC, 2015, https://vnsc.org.vn/en/activities/vietnam-japan-cooperation-in-space-technology/.

270 "Secretary General of APSCO," APSCO, accessed April 14, 2019, http://www.apsco.int/html/comp1/content/MessagefromSG/2018-06-26/18-154-1.shtml.

271 Moltz, *Asia's Space Race*, 32.

385 organizations from 29 countries and 9 international organizations at the 2018 forum.[272] In comparison, APSCO currently only brings together eight member states.[273] While most states are active in APRSAF vice APSCO, some elect to contribute to both institutions, namely Pakistan, Turkey, Mongolia, and China itself. APRSAF's success as an annual forum has significantly promoted Japan's interests in space among its growing array of participants. However, the scale of China's SIC within BRI poses a significant challenge to Japan's success in regional space diplomacy. While APSCO remains in APRSAF's shadow, the SIC offers member-nations access to Chinese space services as part of a larger investment in domestic infrastructure. Without the narrower, space-specific requirements of APSCO, the SIC could undercut Japan's leadership in regional space diplomacy.

Japan's space strategy also seeks to constrain China's space behavior through international institutions. By utilizing its diplomatic clout and status as a major space power at the UN, Japan can effectively represent the interests of states which stand to benefit from Japan's proposed space norms at both the regional and international levels. Juxtaposed with China's actions which promote instability, like its 2007 ASAT launch, Japan promotes norms and institutional constraints which enhance its image as a responsible leader in space.[274] Within the UN, Japan has most notably contributed to the peaceful use of space through its efforts as part of UN-COPUOS.[275] JAXA also collaborates with UNOOSA on a variety of projects, such as deploying cube satellites from the Japan-owned Kibo module of the ISS.[276] The Kibo module is currently the only section of the ISS that can deploy cube satellites, providing Japan with a point of leverage and specialized expertise on the

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[272]"APRSAF-25," APRSAF, accessed January 29, 2019, https://www.aprsaf.org/annual_meetings/aprsaf25/overview.php.

[273] "APSCO Member States," APSCO, accessed March 9, 2019, http://www.apsco.int/AboutApsco.asp?LinkNameW1=APSCO_Member_States&LinkCodeN=11.

[274] Ministry of Foreign Affairs of Japan, "Japan's Space Diplomatic Policy."

[275] Ministry of Foreign Affairs of Japan.

[276] KiboCUBE: UN / Japan Cooperation Programme," UNOOSA, "accessed January 28, 2019, http://www.unoosa.org/oosa/en/ourwork/psa/hsti/kibocube.html.

international stage.[277] Additionally, Japan was the only nation to invoke the Outer Space Treaty (OST) following China's ASAT test, seeking to constrain its rival's behavior through an internationally recognized accord.[278] Collectively, these efforts represent the targeted scope of Japan's space diplomacy strategy, as it works through bilateral, regional multilateral institutions, large-scale international organizations, and treaties in pursuit of its strategic aims.

Japan has continued its space exploration missions to promote techno-nationalism and supplement its "human security" approach to space diplomacy. By investing in projects dedicated to space science, Japan has been able to largely recover from the damage to national prestige in space following *Shenzhou V* and other Chinese projects.[279] In 2009, Japan launched *GOSAT*, a platform meant to gather data on the relationship between greenhouse gasses and climate change.[280] JAXA also launched the Venus climate orbiter *Akatsuki* in 2010 which collects data on the planet's extreme climate and weather patterns.[281] Japan's recent accomplishments in space exploration also include the ongoing asteroid mission, *Hayabusa II*,[282] which is building upon the successes of its predecessor launched in 2003, *Hayabusa I*,[283] by conducting tests and bringing back samples gathered from the asteroid's surface.[284] Japan also launched *GOSAT II* in 2018, a more precise and

277 UNOOSA, "KiboCUBE: UN / Japan Cooperation Programme."

278 Carin Zissis, "China's Anti-Satellite Test," Council on Foreign Relations, February 22, 2007, https://www.cfr.org/backgrounder/chinas-anti-satellite-test.

279 Moltz, *Asia's Space Race*, 57–59.

280 "Greenhouse Gases Observing SATellite 'IBUKI' (GOSAT)," JAXA, accessed January 29, 2019, http://global.jaxa.jp/projects/sat/gosat/.

281 "Venus Climate Orbiter 'AKATSUKI' (PLANET-C)," JAXA, accessed January 29, 2019, http://global.jaxa.jp/projects/sat/planet_c/.

282 Elaine Lies, "Japan Probe Arrives at Asteroid after Nearly Four-Year Space Odyssey," Reuters, June 27, 2018, https://www.reuters.com/article/us-space-japan-probe-idUSKBN1JN0F1.

283 "Asteroid Explorer 'HAYABUSA' (MUSES-C)," JAXA, accessed January 29, 2019, http://global.jaxa.jp/projects/sat/muses_c/.

284 "Hayabusa2 Latest Status, the Successful First Touchdown," JAXA, February 22, 2019, http://www.isas.jaxa.jp/en/topics/002051.html.

capable successor to *GOSAT*.[285] The *GOSAT* and *Hayabusa* class missions promote JAXA's image as a leader in space science and an organization dedicated to promoting human security to the benefit of all.

Significant achievements could be just over the horizon for JAXA in its quest to explore the universe and compete with China's high-profile missions. Japan is planning to launch a manned mission to the moon and will begin designing an appropriate lunar lander in 2020.[286] A successful manned mission to the moon would have significant implications for perceptions of Japan's technological capabilities. Most notably, such a mission would challenge China's ambition to be viewed as the dominant technological power in Asia, especially following China's recent mission on the dark side of the moon. An unmanned mission to Mars's two moons, Phobos and Deimos, which will bring back materials from the surface, is also in the works.[287] While China has beaten Japan to some achievements in space such as independent manned spaceflight, and will continue to chart out other firsts based on current projections,[288] Japan remains committed to its planned mission sets and charting its own unique path of firsts in the region and the solar system.

C. CONCLUSION

Shifts in Japan's space strategy aim to comprehensively address the rising threat presented by China's ascension as a major space power. Although Japan's strategy has evolved gradually in response to commercial and security-related obstacles, the shift from a solely peaceful policy to a militarized, comprehensive approach is best outlined in the BSL. In the midst of China's rise, Japan's space strategy strengthens the nation's security apparatus by employing militarized space assets for intelligence collecting, adopting a

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285 "Greenhouse Gases Observing SATellite-2 'IBUKI-2' (GOSAT-2)," JAXA, accessed January 29, 2019, http://global.jaxa.jp/projects/sat/gosat2/.

286 Thisanka Siripala, "Japan Heads for the Moon," *Diplomat*, accessed December 5, 2018, https://thediplomat.com/2018/09/japan-heads-for-the-moon/.

287 "MMX - Martian Moons EXploration," JAXA, accessed January 29, 2019, http://mmx.isas.jaxa.jp/.

288 Nupur Shaw, "India and Japan Awaken to Risks of Superpower Space Race," Nikkei Asian Review, January 8, 2019, https://asia.nikkei.com/Spotlight/Asia-Insight/India-and-Japan-awaken-to-risks-of-superpower-space-race.

comprehensive BMD system, and fostering strong working relationships between the civilian space bureaucracy and the MoD. These trends reinforce Japan's balancing with the United States against China and are clearly seen in the high degree of security-driven space cooperation. As Japan continues to undergo a process of military normalization, the increasing integration with the United States in the security domain will help ease its fear of abandonment by its American ally while building its own capacity. This two-pronged approach to security allows Japan to externally balance with the United States against China while also enhancing its own capabilities. While ongoing cooperation with the United States remains a top priority, Japan's indigenous achievements signify the country's dedication to strengthening the alliance through its own capabilities.

From a soft power perspective, Japan's diplomatic strategy aims to counter China's growing regional influence among other concerned states by promoting mutually beneficial projects and institutional norms. Commercially, Japan hopes to reinforce this approach by securing a larger share of the launch services market and taking the early steps toward the network-driven style of space-related innovation like that seen in the United States. Although Japan faces intense competition from its mainland rival, it has postured itself accordingly to compete with China in the space domain.

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IV. VIETNAM

Vietnam's history in space differs from that of India and Japan. Having only recently established an independent space agency, Vietnam is limited in its space-related capabilities and expertise. However, despite its relative inexperience, Vietnam's establishment of an applications-based space program has altered its strategic outlook and opportunities in the midst of China's rise. As relations between China and Vietnam remain contentious, complicated by a history of border disputes and the ongoing crisis in the South China Sea, the diplomatic and security-related opportunities provided by Vietnam's space program help it externally balance against China. Vietnam is also internally balancing against China by enhancing its own technological capabilities. This chapter examines Vietnam's developing space power strategy and how it has departed from its intended civilian-space orientation in response to China's hegemonic ambitions. It begins with a brief history of Vietnam's history in space, followed by detailed analysis of the country's current military, commercial, and civil approaches to the space domain. The chapter concludes by summarizing the previous sections' key findings.

A. HISTORY OF VIETNAM'S SPACE PROGRAM

Vietnam is both a late-developing nation and a late space power. After breaking free of Japanese occupation and French colonial rule, Vietnam was unable to concentrate its resources toward a space program, as it was embroiled in a civil war with the U.S.-backed South and the consequent post-war reconstruction and consolidation efforts. Vietnam's border war with China, beginning in 1979, further distracted national attention away from space. While China had formerly supported North Vietnam during the war against its southern counterpart and the United States, Hanoi's increasingly close ties with the Soviet Union and its invasion of Cambodia spurred a Chinese military response, complicating bilateral relations.[289]

[289] Minh Quang Nguyen, "The Bitter Legacy of the 1979 China-Vietnam War," *Diplomat*, February 23, 2017, https://thediplomat.com/2017/02/the-bitter-legacy-of-the-1979-china-vietnam-war/.

However, Vietnam participated in the Soviet Intercosmos program in fellowship with the Warsaw Pact in 1980, promoting relations with Moscow and national pride after decades of domestic instability. Pham Tuan, a fighter pilot during the Vietnam War, rode aboard Soyuz 37 to the *Salyut 6* space station, spending just over a week in space.[290] Following Tuan's return to Earth and Vietnam's accession to UN-COPUOS, Vietnam began using UN Development Program satellite data, but still did not maintain any assets in space of its own.[291] Following the Doi Moi reforms, Vietnam's initiatives to promote economic liberalization starting in the mid-1980s, Vietnam entered a period of explosive economic growth. This opening of Vietnam's economy provided it with the capital necessary to sustain its own satellite program, making a national space program feasible for the first time.[292]

In 1995, Vietnam commenced the early pre-development stages of the *VINASAT* project.[293] According to American space and security analyst Robert Harding, "As a communications platform, Vinasat-1 was intended to give Vietnam telecommunications autonomy and free up an estimated US$10–15 million in annual leasing fees that was previously paid for access to other countries' telecom satellites."[294] In 2002, the Vietnamese government officially commissioned the development of the *VINASAT-1* program.[295] Vietnam placed the program under the oversight of the state-owned telecommunications company Vietnam Posts and Telecommunications Group (VNPT),[296] conducive with the goal of unifying the country's rural and urban demographics.

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290 "Phạm Tuân: Vietnamese Pilot and Cosmonaut," Encyclopedia Britannica, accessed February 19, 2019, https://www.britannica.com/biography/Pham-Tuan.

291 Harding, *Space Policy in Developing Countries*, 180–81; "Members of the Committee on the Peaceful Uses of Outer Space," UNOOSA, accessed February 19, 2019, http://www.unoosa.org/oosa/en/members/index.html.

292 Harding, *Space Policy in Developing Countries*, 180.

293 Pham Anh Tuan, "Recent Development & Furute [Sic] of Space Technology in Vietnam," November 21, 2007, https://www.aprsaf.org/data/aprsaf14_data/day2/P12_SPACE%20TECHNOLOGY%20IN%20VIETNAM.pdf.

294 Harding, *Space Policy in Developing Countries*, 181.

295 Tuan, "Recent Development & Furute [sic] of Space Technology in Vietnam."

296 Tuan.

Vietnam remained committed to a development-minded space program, even in the wake of China's emergence as a formidable regional space power. In 2006, Vietnam implemented the Master Plan for Space Technology Development of Vietnam up to 2020, a series of six guidelines for the nation's approach to space.[297] The Master Plan focused on developing the framework and legal guidelines for space policy, space infrastructure, technical expertise, and manufacturing capability, and emphasized self-development and satellite applications.[298] Vietnam also signed an MoU in space science and applications with JAXA, the space agency which would become Vietnam's most generous benefactor in the years to come.[299] Furthermore, in 2007, the Space Technology Institute was established to produce small satellites to fulfill the Master Plan.[300] Japan came to Vietnam's aid in developing and launching these microsatellites, but not before the *VINASAT* program was complete.

Years of planning came to fruition in the late 2000s. *VINASAT-1* was successfully launched from the Guiana Space Center in April 2008 and was transferred to the Vietnamese government's control four months later.[301] According to Harding, in order to manage this and future satellites, Vietnam built two control stations in the Hay Tay and Binh Duong provinces.[302] The new decade also commenced with the formal establishment of the Vietnam National Satellite Center in 2011.[303] The Vietnam National Satellite Center was later rebranded as the Vietnam National Space Center (VNSC), the country's official

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297 Tuan.

298 Tuan.

299 "20th Asian – Pacific Regional Space Agency Forum (APRSAF-20)," VAST, February 11, 2014, http://www.vast.ac.vn/en/international-cooperation/international-cooperative-activities/1627-20th-asian-pacific-regional-space-agency-forum-aprsaf-21; Tuan, "Recent Development & Furute [Sic] of Space Technology in Vietnam."

300 Harding, *Space Policy in Developing Countries*, 181.

301 Collin Koh Swee Lean, "Vietnam's Master Plan for the South China Sea," *Diplomat*, February 4, 2016, https://thediplomat.com/2016/02/vietnams-master-plan-for-the-south-china-sea/; Harding, *Space Policy in Developing Countries*, 181.

302 Harding, *Space Policy in Developing Countries*, 181.

303 "History of Establishment and Development," VNSC, February 2, 2016, https://vnsc.org.vn/en/about/history/.

independent space agency.[304] The VNSC was funded through an ODA loan from Japan.[305] Then in May 2012, another Vietnamese communications satellite, *VINASAT-2,* was placed into orbit from the Guiana Space Center.[306] *VINASAT-2* was also overseen by the VNPT and manufactured by Lockheed Martin.[307] While it had taken four months for Lockheed to transfer control of *VINASAT-1* to Vietnam, it only took two months for its successor, due to Vietnam's evolving space-related capabilities.[308] VNSC's investments in the *VINASAT* class communication satellites and other spacecraft have improved the well-being of Vietnamese society in a number of ways. The *VINASAT* program has had a remarkable impact on the telecommunications industry and development of rural communities under the oversight of VNPT. *VINASAT-1* provided Vietnam with the ability to provide the entirety of its rural population telephone and television services,[309] and *VINASAT-2* provided even more commercial bandwidth amidst the maxing out of *VINASAT-1*'s near 2012.[310]

Vietnam's space power strategy was forced to adapt to the shifting regional balance of power following the completion of the *VINASAT* program. China's regional ambitions, namely those in the South China Sea, directly threatened Vietnam's strategic interests in the early 2010s. The historical legacy of the Sino-Vietnamese border dispute during the Cold-War intensified as a result of this Chinese territorial assertiveness. According to Joshua Kurlantzick, a Senior Fellow for Southeast Asia at the Council of Foreign Relations, China began to more aggressively enforce claims to 90% of the South China Sea during

304 "NOTIFYING OF CHANGE OF ORGANIZATION NAME," VNSC, July 17, 2017, https://vnsc.org.vn/en/activities/notifying-of-change-of-organization-name/.

305 VNSC.

306 "Vietnam's Second Satellite in Position," *People's Army Newspaper,* May 31, 2012, http://en.qdnd.vn/politics/news/vietnam-s-second-satellite-in-position-431082.

307 "Vietnam's Second Satellite in Position."

308 Koh Swee Lean, "Vietnam's Master Plan for the South China Sea."

309 Global Security, "Vinasat," accessed February 19, 2019, https://www.globalsecurity.org/space/world/vietnam/comm.htm.

310 "VINASAT 2," Gunter's Space Page, accessed February 19, 2019, https://space.skyrocket.de/doc_sdat/vinasat-2.htm.

this time. [311] He claims that China's posturing forced Vietnam to respond with in-kind territorial assertiveness. According to security analysts Zachary Abuza and Nguyen Nhat Anh, this Chinese assertiveness has caught Vietnam off guard, leaving it to invest quickly in a variety of ISR assets, such as earth-observation satellites and surveillance drones.[312] Given the disparity of power between Vietnam and China, Vietnam pursued remote-sensing satellites which provided both civilian and military utility. These responses followed a series of escalating incidents in 2012, when China detained Vietnamese fishermen near the Paracel islands and conducted illegal fishing operations by the Scarborough Shoal.[313] Vietnam responded with legislation reiterating sovereignty over the Paracel and Spratly Islands,[314] but China's aggressive island-building campaign has only intensified in the aftermath of this declaration.

Vietnam pursued increasingly close ties with Japan amidst this backdrop. Prior to escalating tensions in the South China Sea, the security-related implications of cooperation between Vietnam and Japan in the space domain were modest at best. Up until this period, bilateral cooperation between the two powers was limited to development-oriented projects aligned with Vietnam's civilian-minded space power strategy. However, the shared security threat posed by China increased the kinds of assistance JAXA provided to Vietnam. While Vietnam continued its cooperation with other established space powers, the relationship with Japan proved to be in a tier of its own. As part of the security-driven expansion of cooperation, Japan facilitated the launch of most of Vietnam's earth observation satellites, the construction of Vietnam's major space infrastructure, and the early stages of indigenous capability.

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311 Joshua Kurlantzick, "A China-Vietnam Military Clash," Council on Foreign Relations, September 23, 2015, https://www.cfr.org/report/china-vietnam-military-clash.

312 Zachary Abuza and Nhat Anh Nguyen, "Vietnam's Military Modernization," *Diplomat*, October 28, 2016, https://thediplomat.com/2016/10/vietnams-military-modernization/.

313 "China's Maritime Disputes," Council on Foreign Relations, accessed February 20, 2019, https://www.cfr.org/chinasea; "China Frees Vietnamese Fishermen Held on Paracel Islands," BBC, April 21, 2012, https://www.bbc.com/news/world-asia-17796451.

314 "China's Maritime Disputes."

VNREDSAT-1 was Vietnam's first successful earth observation platform launched amidst escalating tensions with China. *VNREDSat-1*, a remote-sensing satellite largely funded by French ODA, was launched in 2013 following the failed *F-1* project.[315] According to the Deputy Prime Minister, Nguyen Thien Nhan, *VNREDSat-1* gave Vietnam the capability to process imagery of the entirety of the country without external assistance.[316] Japan launched *PicoDragon*, an imaging satellite produced with Japanese assistance, and deployed it from the ISS this same year.[317] The project has been described by the Vietnam National Space Center as a "significant milestone for the Made in Vietnam satellite's strategy," as it was the first satellite produced entirely in-country; the only work done in Japan was a series of prelaunch tests.[318]

Vietnam's Japanese ODA-financed construction plans came to fruition in the mid-late 2010s as well. The Center of Human Resource Development in Space Technology in Hanoi was completed in 2016, the Nha Trang Observatory was finished in 2017, and the long-awaited Space Center in Hoa Lac High Tech Park was opened in Hanoi in 2018.[319] Most recently, *MicroDragon*, a microsatellite intended for remote sensing over Vietnam's coastal areas, was launched in January of 2019 onboard JAXA's Epsilon launcher.[320] VNSC continues to make progress in other related projects with Japan that carry implications for regional security. The *LOTUSAT-1* and *LOTUSAT-2*, a pair of disaster monitoring satellites designed in Japan and built by Vietnam, are expected to launch in

315 "Satellite Guards the Nation," VietNam News, September 5, 2013, http://vietnamnews.vn/society/244402/satellite-guards-the-nation.html; Koh Swee Lean, "Vietnam's Master Plan for the South China Sea."

316 "Satellite Guards the Nation."

317 "Made-in-Vietnam Micro Satellite Sends First Signals," *People's Army Newspaper*, November 20, 2013, http://en.qdnd.vn/economy/news/made-in-vietnam-micro-satellite-sends-first-signals-444208.

318 VNSC, "History of Establishment and Development"; "Profile of the PicoDragon Satellite," VNSC, October 11, 2015, https://vnsc.org.vn/en/projects/profile-of-the-picodragon-satellite/.

319 VNSC, "History of Establishment and Development."

320 "Vietnam's MicroDragon Satellite Enters Space," *People's Army Newspaper*, January 18, 2019 http://en.qdnd.vn/social-affairs/news/vietnam-s-microdragon-satellite-enters-space-502148.

2019 and 2020, respectively.[321] These satellites are based on Japan's *ASNARO-2* SAR platform,[322] and will ultimately provide Vietnam valuable SAR-derived imagery.[323] This is especially significant given the regional climate and weather patterns, as SAR technology is able to produce clear images even in inclement weather and darkness.[324]

Vietnam's progress in space since the turn of the millennium is truly remarkable, having possessed no space assets in 2000, to utilizing a multifaceted array of satellites and research centers less than two decades later. While Japan has certainly played a large role in facilitating these achievements, Vietnam's government remains committed to providing as much domestic support as possible. Prime Minister Nguyen Xuan Phuc recently declared that the government would "offer all possible support to Vietnamese scientists and engineers to develop space technology" in pursuit of "space sovereignty" and high-level satellite engineering capabilities.[325]

India has also contributed to Vietnamese space developments. ISRO announced that it would build a satellite data receiving station in Ho Chi Minh City, one which would grant Vietnam access to imagery over the South China Sea from India's proven earth observation satellites.[326] This strategic chess move by India, announced in 2016, has been described as a form of "quid pro quo" by an anonymous Indian government official, who declared that the center will "enable Vietnam to receive IRS pictures directly, that is,

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321 "Japan to Export Earth Observation Satellite to Vietnam," Vietnam Plus, September 20, 2016, https://en.vietnamplus.vn/japan-to-export-earth-observation-satellite-to-vietnam/99271.vnp; "ASNARO 2," Gunter's Space Page, accessed February 19, 2019, https://space.skyrocket.de/doc_sdat/asnaro-2.htm; "Vietnam to Launch Micro Dragon Satellite by Late 2018," VAST, May 30, 2018, http://www.vast.ac.vn/en/news/activities/1819-vietnam-to-launch-micro-dragon-satellite-by-late-2018.

322 The *LOTUSAT-2* is sometimes called the *ASNARO-2*; the former is the Vietnamese name for the original satellite from Japan, the latter.

323 "ASNARO 2."

324 "Synthetic Aperture Radar," Lockheed Martin, accessed March 9, 2019, https://www.lockheedmartin.com/en-us/products/synthetic-aperture-radar.html.

325 "PM Pledges All Possible Support for Space Technology Development," *People's Army Newspaper*, January 22, 2019, http://en.qdnd.vn/social-affairs/news/pm-pledges-all-possible-support-for-space-technology-development-502237.

326 Radhakrishna Rao, "India's Satellite Monitoring Facility in Vietnam Upsets China," Indian Defense Review, January 30, 2016, http://www.indiandefencereview.com/news/indias-satellite-monitoring-facility-in-vietnam-upsets-china/.

without asking India… [including] parts of China of interest to Vietnam."[327] While the station could certainly serve civilian purposes, it also reflects the growing military potential for Vietnam's space program in light of the threat from China.

B. CONTEMPORARY SHIFTS IN SPACE STRATEGY

1. Military

Vietnam's dedication to preserving sovereignty in the face of China's aggression in the early 2010s has driven the militarization of its traditionally development-minded space program. Although Vietnam does not maintain any military-specific space assets, it has employed its existing civil assets to enhance national security through their dual-use capabilities. In general, the ambiguity surrounding dual-use technologies is clarified by a nation's policy on how to employ them. Vietnam's policy has gradually shifted to incorporate security applications and military utility amidst China's growing challenge to Vietnam's territorial sovereignty. While China's Nine-Dash line claims have fueled concerns among many regional states, destabilizing incidents in the region have especially fueled Hanoi's interest in advanced maritime and ISR assets to protect its sovereignty.

While Vietnam's space-based ISR assets remain administered by the civilian-bureaucracy, not the Vietnamese military, the military has garnered more influence over national space policy as regional threats have evolved. According to Singaporean security analyst Collin Koh Swee Lean, the Chairman of the National Research Program on Space Science and Technology Nguyen Khoa Son argued in 2008 that "if we [Vietnam] have our own satellite, we can respond more promptly to natural disasters and be more active in defense and security activities."[328] However, VNPT's *VINASAT-1* was Vietnam's only asset in orbit by the end of 2008 and was devoted exclusively to civilian use. Then, in 2013, following Vietnam's declaration of ownership of the Paracel and Spratly Islands and in the run-up to launching *VNREDSat-1*, Prime Minster Nguyen Tan Dung expanded the

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[327] Sanjeev Miglani and Greg Torode, "India to Build Satellite Tracking Station in Vietnam That Offers Eye on China," Reuters, January 24, 2016, https://in.reuters.com/article/india-vietnam-satellite-china/india-to-build-satellite-tracking-station-in-vietnam-that-offers-eye-on-china-idINKCN0V309W.

[328] Koh Swee Lean, "Vietnam's Master Plan for the South China Sea."

composition of the Vietnam Space Committee, an institution devoted to fulfilling the Master Plan through 2020, to include representatives from the Ministry of Defense.[329] Vietnam's shift from rhetoric to concrete institutional shifts has coincided with evolutions in its technical capacity, illustrating a trend of increased willingness to engage in military-space activity as threats increase. The Deputy Minister of Natural Resources and the Environment, Nguyen Thai Lai, provided further evidence of a shifting policy, as he declared that *VNREDSat-1* allows Vietnam to preserve sovereignty over its contiguous and maritime territorial possessions.[330]

Given Vietnam's increasing technical capabilities and shift in space-security rhetoric, a consensus has emerged that Vietnam is utilizing its civil satellites to conduct ISR operations over the South China Sea in a departure from historical norms. According to Koh, despite the relatively less precise resolution *VNREDSat-1* provides compared to international competitors, it carries significant ISR potential nonetheless.[331] Koh also argues that as Vietnam progresses towards larger, more capable satellites like the planned *LOTUSAT* series, its ISR capabilities over the South China Sea will continue to converge with those of other established space powers. Furthermore, the leader of the Natural Remote Sensing Department, Nguyen Xuan Lam, explained how the *VNREDSat-1* serves in "monitoring offshore key waters and islands with remote sensing technology," providing further evidence of the nation's transition to security applications of space technology.[332]

However, Vietnam's military space strategy would not be sustainable by relying solely on dual-use assets like *VNREDSat-1*. Part of the challenge facing Vietnam's ISR aspirations is that its space-based assets must cater to both geopolitical and natural security

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329 "VN Space Committee Further Perfected," VietNam Breaking News, January 7, 2013, https://www.vietnambreakingnews.com/2013/01/vn-space-committee-further-perfected/; Jane Perlez, "Vietnam Law Claims Spratly Islands, Angering China," *New York Times*, June 21, 2012, https://www.nytimes.com/2012/06/22/world/asia/china-criticizes-vietnam-in-dispute-over-islands.html.

330 "Remote Satellite Programme Reviewed after Successful Year," Voice of Vietnam, May 6, 2014, https://english.vov.vn/society/remote-satellite-programme-reviewed-after-successful-year-276073.vov.

331 Koh Swee Lean, "Vietnam's Master Plan for the South China Sea."

332 "Vietnam to monitor waters, islands using satellite," Tuoi Tre News, February 25, 2014, http://b1.tuoitrenews.vn/news/society/20140225/vietnam-to-monitor-waters-islands-using-satellite/9050.html.

threats such as typhoons, landslides, and flooding. Without specifically military dedicated assets in space, Vietnam will not be able to achieve the degree of ISR capability to fully monitor increasing Chinese military activity on its own. The recent trend toward accepting internationally-based assistance in earth observation represents part of a two-track strategy to solve this problem.[333] Such collaboration could fill current gaps in capability and capacity in the short term, while allowing Vietnam time to develop more advanced surveillance platforms for use in the long term.[334]

India's satellite center in Vietnam marks an unprecedented form of security assistance by the South Asian power. This center is India's only satellite station which offers data accessibility to the host-nation, a decision motivated by India's increasing security concerns fueled by China's rise and India's increasing military ties with Vietnam.[335] According to ISRO official Deviprasad Karnik, in addition to providing Vietnam high resolution imagery from a well-respected earth-observation constellation, India benefits from the expanded coverage provided by a center stationed in Vietnam,[336] representing a continuation of their increased bilateral military cooperation into space. Despite the new center's description as a civilian system by both India and Vietnam, their increasingly aligned interests makes it highly likely that it will be used for military ISR operations.

Considering the space-related assistance from foreign powers and shared geopolitical interests, it can be deduced that Vietnam is externally balancing with Japan against China given China's increasingly threatening position to Vietnamese interests in Southeast Asia. The same can be said for India, as India has cooperated with Vietnam by facilitating both space-surveillance projects and conventional military assistance.[337] The

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[333] Koh Swee Lean, "Vietnam's Master Plan for the South China Sea."

[334] Koh Swee Lean.

[335] Sanjeev Miglani and Greg Torode, "India to Build Satellite Tracking Station in Vietnam That Offers Eye on China."

[336] Miglani and Torode.

[337] Rahul Bedi, "India, Vietnam to Conduct First Joint Naval Exercise," Jane's 360, May 21, 2018, https://www.janes.com/article/80206/india-vietnam-to-conduct-first-joint-naval-exercise.

space-based aspects of these relationships confirm the external-balancing effort by Vietnam to counter China through bilateral cooperation.

2. Commercial

Although Vietnam aspires to compete in the global space economy, its space program has yet to achieve the requisite domestic capacity, precluding commercial competition with China. While Vietnam's investments in space assets have yielded commercial utility in a variety of domestic industries, Vietnam's commercial space interests are limited to a narrow range of services. Vietnam has marketed its remote-sensing images to compete with Thailand, the second of the only two Southeast Asian countries to compete in this sector of the space economy.[338] However, the absence of a rocketry program precludes the development of a launch services industry, which would require significant expertise and capital investment. Furthermore, despite Vietnam's standing among the most tech-friendly of Southeast Asian nations, possessing over 3,000 start-ups,[339] the business climate and difficulties in finding qualified personnel hinder Vietnam's commercial space development.

3. Civil

Vietnam's civil space program has been the focal point of the nation's achievements in space. It has not only accomplished many of the development-oriented objectives it was intended to but has also paved the way for the previously mentioned security-related capabilities to counter China's regional activity. Emphasizing economic development, Vietnam has chosen to pursue solely communications and remote-sensing satellites to better integrate the rural population, enhance agricultural production, and mitigate the effects of natural disasters. With regard to space diplomacy, Vietnam relies most heavily on bilateral cooperation. Vietnam has benefitted from these partnerships not only by working with more experienced space powers, promoting domestic capacity in the

338 "Vietnam to monitor waters, islands using satellite."

339 "Vietnam's Tech Innovation Renaissance," BBC, Video, 2:36, March 1, 2018, https://www.bbc.com/news/av/business-43196792/vietnam-s-tech-innovation-renaissance.

space domain, but also by strengthening relations with larger powers to promote external balancing. Harding identifies bilateral cooperation as one of the three key pillars of Vietnam's space strategy, alongside space applications and satellite control.[340] Not surprisingly, much of the cooperation between VNSC and international space agencies aims to bolster Vietnamese proficiency in the two latter fields.

Japan has emerged as Vietnam's most significant patron in space from both a diplomatic and geopolitical perspective, as the regional power's generosity has facilitated nearly all of Vietnam's major achievements in space. While Japan has certainly reaped diplomatic capital from its development-oriented assistance to Vietnam, promoting its own image among regional states and Vietnam's capacity to address humanitarian crises, the JAXA-VNSC relationship is best analyzed through a realist lens. Japan's generous investments in VNSC's human capital, technical capacity, and dual-use spacecraft constitute a direct effort to enhance Japanese-Vietnamese relations in the face of a rising China. The special relationship between JAXA-VNSC has also laid a firm foundation for future security-related cooperation between Japan and Vietnam in other domains.

Having benefitted from American technology transfers and cooperation during its early years as a spacefaring nation, Japan understands how to best help Vietnam achieve its space-related objectives. Although the two nations may not appear to be the most likely security-partners, especially given the legacy of Japanese occupation during World War II, their shared concern over China's regional ambitions has produced a mutually beneficial relationship between the two nations. Following the 2006 MoU between JAXA and the Vietnam Academy of Science and Technology (VAST), the bilateral cooperation between Vietnam and Japan increased in both scale and scope. In 2015, VAST, Vietnam's Water Resources Department, and JAXA signed another MoU to monitor and alleviate natural disasters.[341] The arrangement facilitated data sharing in the aftermath of natural disasters, the creation of an imagery database, the enhancement of Vietnam's capability to utilize

340 Harding, *Space Policy in Developing Countries*, 172.

341 "MoU on Application of Space Technology for Prevention and Mitigation of Natural Disasters," VAST, October 15, 2015, http://www.vast.ac.vn/en/news/activities/1717-mou-on-application-of-space-technology-for-prevention-and-mitigation-of-natural-disasters.

space-based earth observation capabilities, and the formation of domestic programs with support from JAXA.[342] The partner nations reached yet another agreement in 2017 that built upon the framework from the 2015 MoU. This agreement promoted the DataCube database, a space-derived information database like that mentioned in the 2015 MoU, which is used to monitor the environment in Vietnam.[343] This assistance would come from JAXA's high-resolution ScanSAR *ALOS-2* satellite which would store images of Vietnam in the aforementioned database.[344] Currently, to alleviate the ongoing shortage of space experts in Vietnam, VNSC is funding 50 staff members to study satellite engineering in Japan, and 32 more to study technical applications.[345] The Aerospace Application Center is also expected to open in Ho Chi Minh City in 2020.[346] Even as Vietnam attains more independent space capabilities, based upon other notable examples of bilateral space cooperation between asymmetric space powers, the JAXA-VNSC relationship is unlikely to slow.

Cooperation at the multilateral level is another element of Vietnam's approach to space diplomacy. By participating in Japan's APRSAF, Vietnam has effectively coordinated with other notable space powers, enhancing its bilateral relations with similar China-fearing states. Vietnam has participated in ARPSAF since the 11th session in 2004[347] and has co-hosted the forum with Japan twice. In 2008, Vietnam hosted the 15th session with the theme of "Space for Sustainable Development," and again in 2013 with the theme of "Values from Space: 20 Years of Asia-Pacific Experiences."[348] While the former theme is clearly aligned with Vietnam's initial space-related objectives, at the latter

342 "MoU on Application of Space Technology for Prevention and Mitigation of Natural Disasters."

343 "Vietnam, Japan Seal Satellite Data Exchange Deal," VietNam Net, September 19, 2017, https://english.vietnamnet.vn/fms/science-it/186676/vietnam--japan-seal-satellite-data-exchange-deal.html.

344 "Vietnam, Japan Seal Satellite Data Exchange Deal."

345 VNSC, "History of Establishment and Development."

346 VNSC.

347 "Annual Meetings | APRSAF-11," APRSAF, accessed February 19, 2019, https://www.aprsaf.org/annual_meetings/aprsaf11/meeting_details.php.

348 "Annual Meetings | APRSAF-15," APRSAF, accessed February 19, 2019, https://www.aprsaf.org/annual_meetings/aprsaf15/meeting_details.php; "Annual Meetings | APRSAF-20," APRSAF, accessed February 19, 2019, https://www.aprsaf.org/annual_meetings/aprsaf20/meeting_details.php.

session, Vietnam introduced a new workshop devoted entirely to cooperation, consisting of six proposals for potential areas of partnership.[349] This addition to the agenda is representative of both Vietnam's desire to enhance regional cooperation towards mutually beneficial objectives in space and to take advantage of its agenda-setting power when provided the opportunity. Vietnam also stands to benefit from SIC as part of BRI. However, while Vietnam can certainly benefit from some of the services SIC promises to provide, it will likely limit growing dependent on these offerings given the conflicting security interests with China.

Vietnam has certainly benefitted from its involvement in APRSAF, but its membership in the Association of Southeast Asian Nations (ASEAN), by contrast, has provided little utility. This is largely because of ASEAN's slow bureaucratic processes, its mandate for consensus, and its lack of collective expertise in space. The "ASEAN way" is a slow, deliberative process that has admittedly achieved political objectives after extended debate, but given the more pressing issues on the organization's agenda, major achievements for the association in space lie far in the future.[350] Additionally, given the organization's emphasis on collective agreement, any potential joint missions would be subject to a long development phase with numerous revisions until all members are satisfied with the final product. Security projects meant to counter China would be especially scrutinized, given the member-states' many different perceptions of China. The majority of ASEAN's membership is also relatively inexperienced in space.[351] Furthermore, as Moltz explains, "current forms of regional cooperation fit models of political and economic 'influence building' and are relatively limited, rather than fitting the ESA model of significant cooperation in major joint space ventures among peers."[352]

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349 "Final Announcement: The 20th Session of the Asia-Pacific Regional Space Agency Forum (APRSAF-20)," APRSAF, November 26, 2013, https://www.aprsaf.org/annual_meetings/aprsaf20/pdf/meeting_details/AP20_Final_Announcement.pdf.

350 The term "ASEAN way" is widely used in literature in reference to the organization's unique political processes.

351 Chukeat Noichim, "ASEAN SPACE ORGANIZATION in the Beginning of ASEAN Community Era," November 18, 2010, http://www.unoosa.org/pdf/pres/2010/SLW2010/03-04.pdf.

352 James Clay Moltz, "Asian Space Rivalry and Cooperative Institutions: Mind the Gap," in *Asian Designs: Governance in the Contemporary World Order* (Ithaca: Cornell University Press, 2016), 133.

While ASEAN's Sub-Committee on Space Technology and Applications has some missions planned with external partners, including China, as well as with the Southeast Asia Astronomy Network, the details of these arrangements are vague and could easily fail to produce an outcome.[353] Considering these factors, in pursuit of its own space security, Vietnam is best suited avoiding dependence on ASEAN.

C. CONCLUSION

Vietnam is an up and coming space power in Southeast Asia. Though it remains far behind the regional powerhouses like China, India, and Japan, it has certainly benefitted from Japanese assistance and technology transfers to leapfrog over its peer-level competitors. Vietnam has successfully exploited the new avenues for external balancing provided by its space program by cooperating with Japan, converging with more established space powers much more quickly than it would without external assistance while enhancing national security. Though not yet able to compete in the commercial space sector, Vietnam has certainly made significant strides in space since Phan Tuam rode aboard a Soviet spacecraft almost 40 years ago. Now with a formal organizational structure and part of a larger institutional framework, VNSC oversees an evolving array of dual-use spacecraft conducive with national efforts on both the civilian and military sides of the spectrum. As China and Vietnam continue to stand off in the South China Sea, Vietnam's diplomatic and security-focused relationships with developed space powers will enhance its ability to meaningfully compete against a much more powerful rising China.

[353] For details of these projects, see Leong Keong Kwoh, "ASEAN SCOSA: Subcommittee on Space Technology and Applications," September 17, 2018, http://artsa.gistda.or.th/wp-content/uploads/2018/09/17_-_SCOSA-1.pdf.,

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V. CONCLUSION

This thesis has examined three Asian states' space-strategic responses to China's rise as a multifaceted space power. Evidence from the case studies indicates that India, Japan, and Vietnam have all leveraged their space capabilities to balance against China, aligning with the realist framework and supporting the hypothesis proposed in Chapter I. Interestingly, in addition to balancing internally, the three countries have also responded to the threat from China by externally balancing with each other. This phenomenon demonstrates a partial desire to overcome the competitive dynamics of space power competition in Asia to address the security threat from China. The shift among previously exclusively peaceful Asian space programs to incorporate military space applications is especially noteworthy, as weaponized and militarized space posturing marks a stark departure from historical tendencies. The countries' revamped commercial and civil space dynamics also signify a newfound motivation to compete with China's soft power strategy. These trends have significant implications for the United States' role in preserving regional stability. U.S. policy should accordingly approach these countries' developments in space as opportunities to expand American leadership in the region. This chapter will prescribe recommendations for U.S. space policy in the region, following comparative analysis of the case studies' strategic shifts. The thesis will conclude by summarizing key themes and suggesting avenues for future research.

A. COMPARATIVE ANALYSIS

As described in the previous chapters, Japan, India, and Vietnam previously neglected the potential military utility of their space programs in favor of fulfilling civil ambitions. This thesis finds that from a military-space perspective, Asian nations are orbiting military-dedicated and dual-use civilian ISR satellites to address China's growing military presence in the region (see Table 3). India and Japan have also launched satellite navigation constellations and military-dedicated communications satellites to promote the readiness of their forces. By supplementing their terrestrial forces with militarized space

assets, these countries are better prepared to engage China as its military becomes more active in the Indo-Pacific region.

Table 3. Comparative Military-Space Responses

	INDIA	JAPAN	VIETNAM
ISR SATELLITES	X	X	X
BUREAUCRATIC REORGANIZATION	X	X	X
REVISED DOCTRINE	X	X	
MILITARY-DEDICATED SATELLITES	X	X	
COMMUNICATIONS SATELLITES	X	X	
ASAT WEAPON	X		

Furthermore, the three countries' militaries have benefitted from organizational restructuring and revised doctrine. By incorporating space as a warfare domain in joint military doctrine, reorganizing existing institutions, and facilitating coordination between civilian and military space bureaucracies, the countries have enhanced their militaries' organizational capacity to confront China across the region. India stands as an outlier because of its weaponized ASAT deterrent. As explained in Chapter II, by repurposing its existing BMD program, India has matched China's demonstrated ASAT capability in-kind, signaling a strong commitment to national defense in the wake of China's weaponization of space.

From a commercial perspective, for the time being, India and Japan have etched out their own respective comparative advantages to compete with China in the global launch services industry. However, as previously mentioned, in each of these cases, the upcoming Long March 5, 6, and 7 could ultimately erode these advantages over the long term. India's and Japan's inclinations to privatize elements of their launch services programs are a proactive response to this prospect, offering sustainability and efficiency in the long term while also offering a politically salient contrast to the subsidized, state-run

model employed by China. The pragmatic motive to lower production costs for profit alone certainly plays a role in these decisions. However, the potential for diplomatic capital provided by a highly competitive launch services industry is another incentive for India's and Japan's embrace of privatization. By offering efficient launches to developing space powers, India and Japan can build strong relationships with the many nations looking to capitalize on the commercial utility offered in space. This commercial outreach undercuts similar soft power efforts by China and is enhanced by the potential efficiency offered by contributions from Japan's and India's private sectors.

India and Japan have also institutionalized support for their rising commercial space start-ups. While China's commercial space actors have attracted a significant amount of investment, Japan's state-sanctioned fund constitutes a meaningful competitive response, currently standing larger than the whole of China's commercial space investment.[354] Additionally, India's space-related incubators will enhance the nation's competitiveness, especially in the battle between Make in India and Digital India versus Made in China 2025. Although the rise of commercial start-ups in Japan and India are welcome developments, given the historical legacy of state intervention in the economy, it is unlikely that these two countries will be able to reap the benefits of the "netocracy" conceptualized by Moltz to the same extent as the United States.[355] The same can be said for Vietnam. However, if Vietnam is to compete with China in the global space economy, it is best suited finding a niche market in the commercial space industry given the immense head start taken by the region's leading space powers.

In the civil space arena, these countries' strategic shifts signal a strong willingness to collaborate with foreign partners in an expanding array of arrangements. Given that strategic competition has acted as one of the primary drivers of space-based cooperation among regional states,[356] the increase in multilateral civil-space cooperation is

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354 Sheetz, "China Increases Investment in Emerging Private Space Industry"; Sheetz, "Japan Offers $940 Million to Boost Nation's Space Startups."

355 Moltz, "From Nations to Networks: The Changing Dynamics of Twenty-First Century Space Power," 78.

356 Moltz, Asia's Space Race, 32.

unsurprising. However, the increase in regional participation in APRSAF indicates states are willing to somewhat overcome techno-nationalist competition with each other to focus on responding to the threat from China. All three countries remain active in APRSAF and have sought to exercise leadership in the organization, demonstrating their commitment to shared norms. Despite these accomplishments, China's inclusion of the SIC as part of BRI poses a meaningful response to APRSAF's success. APRSAF will likely remain a key instrument of the three countries' diplomatic space strategies versus China's new initiative.

These countries have each engaged in bilateral cooperation with each other as well. The implementation of an annual space dialogue between India and Japan represents each state's recognition of the importance of forming space security partnerships in light of the threat from China. India's mutually beneficial collaboration with Vietnam follows this observation as well. However, JAXA's ongoing support of VNSC stands as an especially significant example of bilateral space diplomacy. As a result of Japanese patronage, Vietnam has emerged as one of the region's most capable developing space powers and is now able to employ high-quality earth observation technology to protect its sovereignty in the presence of Chinese activity in the South China Sea. The JAXA-VNSC model of space diplomacy is a successful example of mutually beneficial cooperation and balancing within the balance of power framework.

B. IMPLICATIONS

The degree of collaboration among these countries in the space domain carries significant strategic implications. This cooperation extends across both the civil and military aspects of space policy, representing a convergence of strategic calculations among the selected countries. As the United States aims to compete with China's grand strategy in the Indo-Pacific, hard and soft space power opportunities should be exploited. International relations scholar Stephen Walt argued that alliances are most likely to form when states balance against a shared threat.[357] Considering the increasing degree of collaboration between India and Japan in the space domain, as well as the growing scope

[357] Stephen M. Walt, "Alliance Formation and the Balance of World Power," *International Security* 9, no. 4 (1985): 33, https://doi.org/10.2307/2538540.

of Indian and Japanese cooperation with Vietnam, there is strong support for Walt's argument in the contemporary regional dynamic. While these countries are unlikely to sign a formal alliance to counter China's regional aggression, the alignment of their interests still supports the general principle Walt argues. This triangular alignment of interests has driven space-related cooperation among the selected countries and constitutes a strategic opportunity for the United States, given its shared interest in competing with China.

C. PRESCRIPTIONS

As the United States' regional strategy continues to address Chinese hegemonic ambitions, it should take advantage of shifting regional space power strategies to promote strong relationships and extend its influence among Asian states. The triangular alignment among Japan, India, and Vietnam in the space domain constitutes an unprecedented opportunity for American space leadership in the Indo-Pacific. The United States should welcome the aligning interests of its partners and allies in the region and support multilateral relations in the space domain. As the world's premier space power, the United States should engage partners in the Indo-Pacific in mutually beneficial arrangements across the military, commercial, and civil space domains so as to institutionalize regional cooperation in the space domain.

The U.S. military's expertise in employing militarized space assets provides the United States with a unique opportunity amidst the embrace of space militarization by its regional partners. By offering military-space applications training to space cadre from India, Japan, and Vietnam, the United States can enhance the military-to-military relations with regional partners balancing against China. Additionally, the joint development of military-space technologies, combined military exercises incorporating space applications, and other capacity-building initiatives could go a long way toward promoting interoperability with regional nations aligned against China. Such proactive cooperation would address the disparity of experience in military-space operations among our partners, increasing their ability to deter Chinese regional assertiveness. However, the United States should approach the weaponization of space, like that constituted by India's ASAT demonstration, carefully. While U.S. policy should generally be supportive of partner states

internally balancing against China, it should also condemn destabilizing activity like kinetic ASAT exercises in favor of establishing responsible norms of space behavior, given the risks posed by debris in the commons of space.

Commercially, while the United States has an interest in promoting the development of its own commercial space industry, it should also strive to facilitate cooperation with partner nations to undermine China's state-subsidized space services. By artificially driving down the prices of its marketed space services, China can undercut other commercial vendors to promote its diplomatic relations.[358] Allowing American companies the freedom to launch on partner nations' rockets would promote the comparative advantage of global launch providers, including those based in the United States. Reducing trade barriers in the global space economy would allow the United States and its partners to effectively compete with China's artificially low prices of space exports by reducing costs and increasing demand. By swaying vulnerable, cash-poor nations forced to launch with China toward efficient offerings from the United States and its partners, the U.S-led partnership can enhance relations with regional states at China's expense. While profit motive is certainly a significant factor driving commercial space competition, the diplomatic and strategic implications of commercial competition with China present a mutually beneficial outcome for the United States and its partners through the specialization of launch services and other commercial space offerings.

From a civil perspective, the United States should increase its bilateral and multilateral cooperation with regional space powers. Joint space projects such as *Nisar* (the joint NASA-ISRO earth observation satellite described in Chapter II) not only represent an efficient alternative to costly unilateral programs, but also enhance the working relationship between NASA and its international colleagues. Furthermore, although multilateral cooperation is often inhibited by the collective action problem without effective organization and leadership, the United States is well positioned to play this role in the region and produce truly remarkable outcomes. Multilateral space exploration and

358 Moltz, "From Nations to Networks: The Changing Dynamics of Twenty-First Century Space Power," 77.

space science missions would signal the convergence of regional states' interests to Beijing. Engagement with APRSAF should continue as well, as the forum's significance in the region will only increase as SIC becomes a more viable instrument of Chinese space diplomacy. The United States should also consider the Japan-style ODA approach to capacity building in the space domain. Japan's success in constructively engaging Vietnam across a variety of space-related development projects should serve as a model for U.S. development policy in the region, especially in the context of Chinese infrastructure investments through BRI.

D. CONCLUSION

Space power dynamics across Asia have been radically altered as a result of China's ambitions beyond the atmosphere. China's evolving space power strategy has driven shifts in the strategic calculations of its regional adversaries. Asian states have responded to China's rise as a space power by employing military space assets, promoting commercial competitiveness, utilizing space diplomacy, and conducting prestigious space science missions to promote techno-nationalism. The shifts among India's, Japan's, and Vietnam's space power strategies in response to Chinese activity constitute an opportunity for American leadership in the Indo-Pacific in the context of the return to great power competition.

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