



**THE COLLEGE OF INTERNATIONAL SECURITY AFFAIRS
NATIONAL DEFENSE UNIVERSITY**

Student Name: COL William “Bill” Stephens, United States, Army
International Regional Defense Fellowship Program Class of 2021

Thesis Title: To Infinity and Beyond: China’s Space Program as a Method of Irregular Warfare

**Thesis Submitted in Partial Fulfillment of the
Master of Arts in Strategic Security Studies**

DISCLAIMER

THE OPINIONS AND CONCLUSIONS EXPRESSED HEREIN ARE THOSE OF THE INDIVIDUAL STUDENT AUTHOR AND DO NOT NECESSARILY REPRESENT THE VIEWS OF THE NATIONAL DEFENSE UNIVERSITY, THE DEPARTMENT OF DEFENSE OR ANY OTHER GOVERNMENTAL ENTITY. REFERENCES TO THIS STUDY SHOULD INCLUDE THE FOREGOING STATEMENT.

ABSTRACT

This thesis examines the question of whether China is using its space program as a method of irregular warfare with the goal of displacing the United States as the global hegemonic leader. The literature examining the Chinese space capabilities typically examine how the space program can be used as a means to fight future wars, however, it fails to recognize that the campaign is much more expansive than military might. This thesis briefly examines the history of the Chinese space and lunar programs and applies the irregular warfare framework and methodology to these programs using China's interactions with countries in Africa as case studies. After examination of Sino-African partnerships and applying this evidence to the irregular warfare framework, it concludes that China is utilizing its space and lunar exploration programs as a method of irregular warfare. It further concludes these programs will allow China to replace the United States as the world's hegemonic leader, obtain access to the next generation of technology, expand its military superiority, and potentially corner the raw material needed for alternative energy production. The final portion examines the strategic response which could be considered by the United States as the target of the irregular warfare campaign. The response suggests that the United States must first recognize that China is conducting the irregular warfare campaign and then engage in an effective strategy to counter-act the economic, societal, and political vulnerabilities, build credibility through international partnerships, and engage in multiple disparate lines of effort.

TABLE OF CONTENTS:

CHAPTER 1: INTRODUCTION, HISTORY, LITERATURE REVIEW.....3

CHAPTER 2: STRATEGIC ESTIMATE.....17

CHAPTER 3: COUNTERPOINT.....40

CHAPTER 4: STRATEGIC RESPONSE.....47

CHAPTER 5: CONCLUSION.....68

BIBLIOGRAPHY69

LIST OF FIGURES

Figure 1 - China's Triumph Over the US	17
Figure 2 - CASC Logo and Logo Meaning	23
Figure 3 - Roadmap for Chinese MCF Development	34
Figure 4 - Sites of Successful Moon Landings	42
Figure 5 - Map of Helium-3 dispersion on the Moon	42
Figure 6 - Long March Booster System with Partner Agencies	50

CHAPTER 1: **INTRODUCTION, HISTORY AND LITERATURE REVIEW**

This thesis examines the question of whether China is using its space program as a method of irregular warfare with the goal of neutralizing the United States as a threat to its goal of achieving global hegemony. For purposes of this paper, a campaign of irregular warfare is defined as a “struggle to influence populations and affect legitimacy.”¹ After examination of Chinese actions in Africa, specifically in the emerging satellite technology sector and the lunar exploration sector, the inevitable conclusion must be a resounding yes. Specifically, China is utilizing its space and lunar exploration programs as a method of irregular warfare, to obtain access to the next generation of technology, expand its military superiority, obtain the raw material needed for nuclear fusion energy production, allowing it unlimited power to expand in the future.

Before examination and analysis of how it is part of an irregular warfare campaign, it is useful to examine the goals, the core tenants, and the history of China’s space program. China has explicitly stated the end goal of its space program is to surpass the United States and become a “strong space power (航天强国)” and achieve “the great dream” by 2045, before the 100-year anniversary of the founding of the Communist Party in 2049.² China’s aerospace industry follows “three key spirits” which could be considered guiding tenants in the pursuit of these goals. The three spirits are: “the traditional” spirit, the “two bombs-one satellite” spirit, and the “crewed space” spirit.”³

¹ Marks, Thomas A., and Ucko, David. *Violence in Context: Mapping the Strategies and Operational Art of Irregular Warfare*, pgs. 206-233, February 2018.; Ucko, David, “Crafting Strategy for Irregular Warfare: A Framework for Analysis and Action, p 26.

² China’s Space Narrative, p. 16.

³ Silk, Molly. “China Is Evolving a Distinct Space Culture.” *TheDiplomat.Com*, 21 2021, <https://thediplomat.com/2021/03/china-is-evolving-a-distinct-space-culture/>.

These “spirits” are considered the soul of the program and provide a deep connection to the country’s history and underlying virtues, a connection and remembrance to the beginning roots of the space industry in China, including the struggle of the Chinese people during that period, and they embody the virtues which will continue to propel the Chinese towards space domination.⁴ The first spirit, the “traditional spirit” consists of the spirit of Chinese ancient traditions and underlying values, primarily related to Confucius’ teachings, including balance, community, family, righteousness, and loyalty to the State.⁵ The second spirit is the “two bombs-one satellite” and refers to the origins of the Chinese aeronautical programs when, using extremely limited resources during a period of national strife in the 1960s and earlier, it was still able to develop the atomic bomb in 1964, and an intercontinental ballistic missile program, as well as develop and launch a satellite, the Dongfanghong, in 1970.⁶ The third spirit refers to the current era, specifically, the achievement in 2003 of crewed space flight despite not yet being one of the global space powers at that time.⁷ These “three spirits” permeate the culture of the Chinese aerospace industry.

As to the origins of the space program, as described in the “two bombs – one satellite” spirit, the Chinese have been developing ground control (otherwise known as telemetry, tracking, and control stations) technology since the 1950s with the help of the

⁴ “党史学习教育专题.” *SpaceChina.com*, 7 Apr. 2021, <http://zhuanti.spacechina.com/n3151488/n3151628/c3174638/content.html>.

⁵ Silk, Molly, “China Is Evolving a Distinct Space Culture.”

⁶ Id.

⁷ As per the China Aerospace Science and Technology Corporation’s English translated webpage, “The three big spirits of aerospace are the concrete manifestation, inheritance and development of aerospace culture in different historical periods. It is the product of the combination of the great national spirit and the aerospace practice. It is the soul of China’s aerospace industry and the soul of China’s aerospace corporate culture.” “航天三大精神_中国航天科技集团有限公司.” *SpaceChina.com*, <http://www.spacechina.com/n25/n142/n154/n178/index.html>. Accessed 11 Apr. 2021.

then-Soviet Union, a major space power at the inception of the space race.⁸ In the 1970s, instead of the Soviets assisting the Chinese, it was the United States. During this period, the U.S. and China were cooperating in tracking U.S. satellites, using technology and equipment provided by the U.S., and it was the developments made during this period that allowed China to successfully launch its first satellite, the Dongfanghong 2 in 1984.⁹

Historically, China's aerospace sector was almost exclusively dominated by the State. More private corporations have entered the market after 2014 due to commercial lending policy changes, however, the sector is still heavily influenced by the People's Liberation Army (PLA) or subsections of the PLA, and the technology is used for advancing China's military capabilities. Chinese government aerospace organizations consist of two main departments, the China National Space Administration (CNSA)¹⁰ and the Chinese Aerospace Science and Technology Center (known as CASC).^{11,12} As per the CNSA, it is:

[T]he government agency of the People's Republic of China responsible for civil space management and international space cooperation, and it performs the corresponding management responsibilities of the government.¹³ ...On

⁸ Wood, Peter; Stone, Alex; Lee, Taylor A., *China's Ground Segment, Building the Pillars of a Great Space Power*, ISBN 9798719347652, China Aerospace Studies Institute, March 1, 2021.

https://www.airuniversity.af.edu/Portals/10/CASI/documents/Research/Space/2021-03-01%20Chinas%20Ground%20Segment.pdf?ver=z4ogY_MrxaDurwVt-R9J6w%3d%3d pg 15;

<https://www.airuniversity.af.edu/Portals/10/CASI/Conference-2020/CASI%20Conference%20China%20Military%20Space-Institutions%20and%20Capabilities-%20Raji.pdf?ver=2PhK-I9TwUQIIzScikGxgw%3D%3D>, 15.

⁹ Id., 15.

¹⁰ "China National Space Administration." *CNSA.Gov.Cn/English*, 24 May 2018, <http://www.cnsa.gov.cn/english/n6465645/n6465650/c6768437/content.html>.

¹¹ "Company Profile." *English.Spacechina.Com*, <http://english.spacechina.com/n16421/n17138/n17229/index.html>. Accessed 11 Apr. 2021.

¹² , Rajeswari Rajagopalan. *China's Growing Military Space Prowess: Institutions and Capabilities*. Chinese Aerospace Studies Institute, Sept. 2020, p. 17,

<https://www.airuniversity.af.edu/Portals/10/CASI/Conference-2020/CASI%20Conference%20China%20Military%20Space-Institutions%20and%20Capabilities-%20Raji.pdf?ver=2PhK-I9TwUQIIzScikGxgw%3D%3D>. citing: S. Chandrashekar and N. Ramani, "China's Space Power & Military Strategy – the role of the Yaogan Satellites," International Strategic & Security Studies Program (ISSSP), National Institute of Advanced Studies (NIAS), July 2018, http://isssp.in/wp-content/uploads/2018/07/Chinas-Space-Policy_July2018.pdf

¹³ <http://www.cnsa.gov.cn/english/n6465645/n6465650/c6768437/content.html>

behalf of the Chinese government, organize or lead activities such as foreign exchanges and cooperation in the aerospace field.¹⁴

The CASC is a state owned enterprise which originated from China's military unit, the Fifth Research Institute of the Ministry of Defence, but now consist of "8 large R&D and production complexes, 11 specialized companies, 13 listed companies and a number of directly affiliated units."¹⁵ While there has been a high level of state-sponsored research and civil/military fusion over the last 60 years, there has also been a rapid increase in private companies entering the space sector.¹⁶ As of July 2020, there were over 100 aerospace companies¹⁷ with approximately 30 percent of these companies still

¹⁴ "机构简介." *CNSA.gov.cn*, <http://www.cnsa.gov.cn/n6758821/index.html>. Accessed 11 Apr. 2021. As per its website, the CNSA also encompasses additional organizations including: The National Space Administration's Lunar Exploration and Space Engineering Center, established in 2004 ("responsible for the overall technology and management of lunar exploration projects; responsible for engineering technology, overall design and implementation; drafting overall plans and development procedures, formulating overall development requirements and overall technical documents"); The National Space Administration Earth Observation and Data Center, established in 2010("responsible for the implementation, organization and management of the major scientific and technological project of high-resolution Earth observation system"), Space Remote Sensing Demonstration Center of the National Space Administration, established 2004 ("direct development of civil aerospace, facing the needs of national economic development and the direction of international aerospace-related scientific and technological development); The Space Law Center of the National Space Administration, established 2017, ("the overall support organization for the rule of law and space work of the National Space Administration"); China Space Law Society ("a national academic organization composed of relevant state departments, space law research institutions, space science and technology research and application institutions, and space law and policy research experts and scholars.")

¹⁵ *China Aerospace Science and Technology Corporation (spacechina.com)*, As per its website: "As the leading force of China's space industry and one of China's first innovative enterprises, CASC has 8 large R&D and production complexes, 11 specialized companies, 13 listed companies and a number of directly affiliated units. CASC is mainly engaged in the research, design, manufacture, test and launch of space products such as launch vehicle, satellite, manned spaceship, cargo spaceship, deep space explorer and space station as well as strategic and tactical missile systems." See: english.spacechina.com/n16421/n17138/n17229/index.html

¹⁶ The importance of the Chinese civil/military fusion cannot be overstated as it is not merely a collaboration, such as what exists in the United States. For an excellent analysis of how the civilian sector and the military sector are mutually symbiotic, intertwined, and integrated, see China's Aerospace Studies Institute publication: China's Military and Civil Fusion Strategy, found at the following url: https://www.airuniversity.af.edu/Portals/10/CASI/documents/Research/Other-Topics/CASI_China_Military_Civil_Fusion_Strategy.pdf

¹⁷ Xin, Guan, and Jin Yang. "New Money: China's Private Space Start-Ups Lift Off." *CGTN*, 10 July 2020, <https://news.cgtn.com/news/2020-07-10/New-Money-China-s-private-space-start-ups-lift-off-S0jCrO1Yzu/index.html>; CASI, China's Space Narrative, p. 29, <https://www.airuniversity.af.edu/Portals/10/CASI/Conference-2020/CASI%20Conference%20China%20Space%20Narrative.pdf?ver=FGoQ8Wm2DypB4FaZDWuNTQ%3d%3d>

being State-funded, in whole or in part.¹⁸ This is mainly due to the State Counsel's release of Guo Fa [2014] No. 60,¹⁹ which was a declaration that private loans and funding could be used "[t]o encourage the private capital's participation in China's construction of civilian space infrastructure," including construction of, launching, and operating various satellite systems."²⁰ This declaration provided the intended effect, resulting in opening lines of capital for new, private or semi-private, aerospace companies, with over 80 companies being started since 2014.²¹

Regarding control of the aerospace industry assets and their potential military application, since 2015, the People's Liberation Army Strategic Support Force (PLASSF) has the primary responsibility for coordinating the methods of electronic warfare, including space and cyber warfare.^{22,23} The PLA Space Systems Department (SSD) [航天系统部] a service of the PLA's Strategic Support Force [解放军战略支援部队], has been the main entity in charge of data to establish information dominance, including the operational control of data derived from satellites, such as from ground control

¹⁸ Xin, Guan, and Jin Yang. "New Money: China's Private Space Start-Ups Lift Off." *CGTN*, 10 July 2020, <https://news.cgtn.com/news/2020-07-10/New-Money-China-s-private-space-start-ups-lift-off-S0jCrO1Yzu/index.html>

¹⁹ China Public Private Partnerships Center. *Guiding Opinions of the State Council on Innovating the Investment and Financing Mechanisms in Key Areas and Encouraging Social Investment*. China Public Private Partnership Council, 16 Nov. 2014, <http://www.cpppc.org/en/zy/994006.jhtml>.

²⁰ China Public Private Partnerships Center. *Guiding Opinions of the State Council on Innovating the Investment and Financing Mechanisms in Key Areas and Encouraging Social Investment*. China Public Private Partnership Council, 16 Nov. 2014, <http://www.cpppc.org/en/zy/994006.jhtml>.

²¹ Xin, Guan, and Jin Yang. "New Money: China's Private Space Start-Ups Lift Off." *CGTN*, 10 July 2020, <https://news.cgtn.com/news/2020-07-10/New-Money-China-s-private-space-start-ups-lift-off-S0jCrO1Yzu/index.html>; CASI, China's Space Narrative, p. 29, <https://www.airuniversity.af.edu/Portals/10/CASI/Conference-2020/CASI%20Conference%20China%20Space%20Narrative.pdf?ver=FGoQ8Wm2DypB4FaZDWuNTQ%3d%3d>

²² China Space Institutions and Capabilities, pg 2, Sept. 2020 <https://www.airuniversity.af.edu/Portals/10/CASI/Conference-2020/CASI%20Conference%20China%20Military%20Space-Institutions%20and%20Capabilities-%20Raji.pdf?ver=2PhK-19TwUQIIZScikGxgw%3D%3D>

²³ S. Chandrashekar and N. Ramani, "China's Space Power & Military Strategy – the role of the Yaogan Satellites," International Strategic & Security Studies Program (ISSSP), National Institute of Advanced Studies (NIAS), July 2018, http://issp.in/wp-content/uploads/2018/07/Chinas-Space-Policy_July2018.pdf P. 23 f

operations, tracking and navigation.²⁴ Ground control infrastructure is under a separate entity, the China Satellite Launch and Tracking Systems Department [中国卫星发射测控系统部].²⁵ This entity helps other countries build ground control and launching stations. While its government affiliation is unclear,²⁶ as indicated previously, the civil/military fusion in China, including in the space sector, cannot be overstated and this entity is an example of this fusion. Its leadership is a mixture of civilian and high-level PLA personnel, and organizationally, it contains PLA units embedded in the structure.²⁷

There is a significant amount of literature regarding China's space program and how it is being used as a means of military strength, economic expansion, and global influence. In addition, there is a broad consensus that absent any counterbalancing actions by the U.S. or other space agencies, such as the European Space Agency, China is on a trajectory to potentially dominate outer space technology, exploration, and lunar exploitation. In reviewing the literature, while there is a large amount of research and consensus on China's military capabilities that utilize the technology developed in the aerospace industry, there is a gap as to how the space program and the lunar programs are part of an irregular warfare strategy for China.

One of the earliest discussions as to how China began to reorient its military towards space applications is "China's Military Role in Space," by Dan Cheng.²⁸ This article was written in 2012 and provided excellent insight as to how China was using its

²⁴ CASI - Chinas Gound Segment (3-1-21), pg 20, 21

²⁵ Wood, Peter; Stone, Alex; Lee, Taylor A., *China's Ground Segment, Building the Pillars of a Great Space Power*, ISBN 9798719347652, China Aerospace Studies Institute, March 1, 2021.

https://www.airuniversity.af.edu/Portals/10/CASI/documents/Research/Space/2021-03-01%20Chinas%20Ground%20Segment.pdf?ver=z4ogY_MrxaDurwVt-R9J6w%3d%3d, pg 22, 23

²⁶ Wood, Peter, et. al, *China's Ground Segment*. pg 22, 23

²⁷ Id.

²⁸ Cheng, Dean. "China's Military Role in Space." *Strategic Studies Quarterly* 6, no. 1 (2012): 55-77.

economy to grow the space programs and military might especially as it was written before the 2015 reorganization of the space programs in the People's Liberation Army when the Strategic Support Forces (SSF) was formed and is now responsible for most technology used in military responses.²⁹ At the time the article was written, it was presumed that China would continue to develop its space technology as a means of conducting tactical and operational warfare against other countries which had a large reliance on space capabilities, such as the United States' use of Global Positioning Satellite (GPS) for precision-guided bombs.³⁰ Further, from a tactical perspective, it was illustrated that China would use space-based technology, in combination with a large geographically dispersed network of robust supporting ground infrastructure, to provide it with informational strategic advantages without the same vulnerabilities as other countries with large, more centralized satellite observation networks.³¹ The article accurately predicted that satellite technology and a large ground infrastructure support system would allow greater capabilities for offensive and defensive operations in space, information dominance, and help ensure space deterrence.³²

There is a contrary argument in the literature that China is not, and will not, engage in a space race for dominance nor will it engage in attacks against United States satellites or systems as these attacks would provide limited strategic value or benefits.³³ In a well-researched paper, Jaganath Sankaran argues that while the U.S. must continue to advance its space and satellite capabilities, China would gain little military advantage

²⁹ Bowe, Alexander. *China's Pursuit of Space Power Status and Implications for the United States*. US-China Economic and Security Review Commission, 2019.

³⁰ Cheng, Dean. "China's Military Role in Space." 71.

³¹ *Id.*

³² *Id.*

³³ Sankaran, Jaganath. "Limits of the Chinese antisatellite threat to the United States." *Strategic Studies Quarterly* 8, no. 4 (2014): 19-46. Antisatellite actions are actions taken to destroy or disable a satellite.

if it elected to attack the U.S. in the space domain.³⁴ The paper also proposes that since neither side would gain a large tactical advantage by using anti-satellite (ASAT) offensive operations, that the U.S. could instead focus on cooperation versus competition with China and the “U.S. should use all available diplomatic leverage to partner with China and share [space situational awareness] data to make it a part of the global space community.”³⁵ The paper also proposes ground rules for space operations, similar to arms control agreements, which have been traditionally rejected by the U.S., and asserts that the U.S. failure to cooperate is “short-sighted and flawed,” as failure to engage feeds into the belief that the U.S. is a threat to China.³⁶ This article, written in 2014, is in direct contrast to the earlier article written in 2012 which indicated the U.S. is in danger of failing to take the Chinese space program as a serious threat to U.S. national security.

Since both of those articles were written, China has continued to develop its space and lunar programs, and the programs have become additional means of influence, while the economy became its own line of effort in the competition with the United States. “China’s Space Power & Military Strategy - The Role of the Yaogan Satellites,” by S. Chandrasheker and N. Ramani, published in 2018, demonstrates the evolution of the Chinese space program from 2014 to 2018 and how, as of 2018, China was fully capable of engaging the United States in space.³⁷ This article reflects how one satellite program is illustrative of Chinese ambitions to replace the United States as the pre-eminent space power and makes the compelling argument that China is using the satellite program as a

³⁴ Id.

³⁵ Sankaran, Jaganath. "Limits of the Chinese antisatellite threat to the United States.", pg 36.

³⁶ Id, at 37.

³⁷ S. Chandrashekar and N.Ramani, “China’s Space Power & Military Strategy – the role of the Yaogan Satellites,” ISSSP Report No. 02-2018. Bangalore: International Strategic and Security Studies Programme, National Institute of Advanced Studies, July 2018.

method of warfare to “fight and win local wars under informationization conditions.”³⁸

The article masterfully demonstrates how the capabilities of the Yaogan satellite system, along with the reorganization of the PLA to flatten command and control of information and assets, provides military commanders exceptional operational and strategic capabilities, giving China major tactical advantages during any engagement. While this article illustrates the tactical advantages of the satellite program, it was limited in scope to military tactics versus China’s overall strategy.

Two recent reports, both by the China Aerospace Studies Institute, a division of the United States Air Force’s Air University, are critical to understanding the current capabilities of China, as well as the importance of the narrative of the Chinese space programs. A report published in 2021, “China’s Ground Segment: Building the Pillars of a Great Space Power” extensively discusses the history of the Chinese space program, the development of large infrastructure in support of space technology, and the reorganization of the PLA to maximize the military effectiveness of the space program,³⁹ as was foretold in the 2012 article by Dan Cheng. This report conducts a full review of source documents and speeches to crystalize China’s ambitions for space, which are driven by building an infrastructure that is both geographically dispersed and decentralized. Further, it provides insight into how China is using its influence with multiple partners across the world to build ground stations in other countries, providing it with a means of soft power projection. This report provides a sharp focus on Chinese

³⁸ Ibid, 4.

³⁹ Wood, Peter; Stone, Alex; Lee, Taylor A., *China’s Ground Segment, Building the Pillars of a Great Space Power*, ISBN 9798719347652, China Aerospace Studies Institute, March 1, 2021. https://www.airuniversity.af.edu/Portals/10/CASI/documents/Research/Space/2021-03-01%20Chinas%20Ground%20Segment.pdf?ver=z4ogY_MrxaDurwVt-R9J6w%3d%3d

ambitions and how the space program is a continuation of a method to increase military power/capabilities. It further provides the history of the space program, illustrates how the lunar program nests within China's overall military and economic objectives, and provides the timeline of milestones for the programs. Of note, the report indicates that China intends to join "the front rank of global Great Space Powers" by 2030 and "take the lead, comprehensively become a Great Space Power" by 2050.⁴⁰ This illustrates that military might is not just the end goal of the space program; it is also a means to develop China's economy. As early as 2015, the Chinese Ministry of Finance was jointly supporting the space program as it would help "build a technologically advanced, highly efficient civil infrastructure system with global coverage that supports economic and social development domestically and globally," including building a mega infrastructure project with "coverage wherever [China has] national interests."⁴¹

An earlier report by the same organization, issued in October 2020, entitled "China's Space Narrative, Examining the Portrayal of the U.S.-China Space Relationship in Chinese Sources and its Implications for the United States" offers a brutally honest viewpoint after examination of the evidence in concluding the "Chinese space program presents military, economic, and political challenges to the United States."⁴² In the report, the China Aerospace Studies Institute(CASI) examines the role of the CCP and how the advances in the space sector support the CCP's "political, economic, and military interests," as well as the CCP's goals to make "China rich, strong, and proud."⁴³ The authors make the critical point that China is seeking to become the "enlightened,

⁴⁰ Wood, Peter, et al. *China's Ground Segment, Building the Pillars of a Great Space Power*. p. 8

⁴¹ Ibid, 10, 11.

⁴² Pollpeter, Kevin, Timothy Ditter, Anthony Miller, and Brian Waidelich. "China's Space Narrative." China Aerospace Studies Institute, (2020). Preface & p. 7.

⁴³ Pollpeter, Kevin, et. al, "China's Space Narrative." Preface & p. 9

benevolent hegemon whose power and legitimacy derive from its ability to fulfill other countries' security and economic needs - in exchange for their acquiescence to Chinese leadership.”⁴⁴

The United States Congress is actively tracking the capabilities and potential threats posed by the Chinese space programs. In a March 2020 report, *China's Space and Counterspace Capabilities and Activities*, the U.S.-China Economic and Security Review Commission concludes that China's investments in the space program will have a “significant influence on U.S. interests, both militarily and strategically.”⁴⁵ Among the various areas of development, the two discussed in this paper are the exploration/lunar space goals and the expansion of satellite capabilities. The report confirms that the agencies responsible for space exploration, including lunar exploration, are not government civilian organizations as in the United States, but are military organizations.⁴⁶ It concludes that one reason China is investing in the lunar exploration missions is the immediate implementation and use of Helium-3, a compound found in large quantities on the moon, as an alternative energy source.⁴⁷ It further finds that China is at the forefront of developing alternative energy production, including solar and wind power, space solar power, and Helium-3 can be an additional alternative energy source for China on both the Earth as well as in space.⁴⁸ The report further reviews the development of the satellite program, dual-use technology, most notably the expansion

⁴⁴ ⁴⁴ Pollpeter, Kevin, et. al, “China's Space Narrative.” Preface p. 10, citing Yan Xuetong, “The Age of Uneasy Peace, Chinese Power in a Divided World,” Foreign Affairs (2019), <https://www.foreignaffairs.com/articles/china/2018-12-11/age-uneasy-peace>.

⁴⁵ Gabriel Alvarado, Mark Stokes, Emily Weinstein, and Ian Easton. “China's Space and Counterspace Capabilities and Activities.” The U.S.-China Economic and Security Review Commission, March 30, 2020. https://www.uscc.gov/sites/default/files/2020-05/China_Space_and_Counterspace_Activities.pdf

⁴⁶ Ibid.

⁴⁷ Ibid, 37.

⁴⁸ Ibid.

through the BeiDou⁴⁹ company, and concludes these programs may allow China to increase domination of the outer space atmosphere as well as to increase influence through partnership programs.⁵⁰ For example, the expansion of China's GPS allows it to use this data in multiple civilian sectors while simultaneously severing other countries' reliance on American GPS systems. These actions further cement reliance on China, including reliance on weapons produced in China and sold to other countries, which increases Chinese influence in those locations, while these same international partnerships allow China to take advantage of improvements in its own technology.⁵¹ In summary, the report finds that "the preservation of the CCP's monopoly on power as an overriding goal, a growing space presence consolidates the Party's domestic and international legitimacy."⁵²

The prevailing literature and reports on Chinese capabilities typically discuss the space program's military strengths and weaknesses, the ends-ways-means, economic efforts, etc. However, missing from the prevailing literature is an analysis that ties together each line of effort and provides a viewpoint as to how the space and lunar programs align for one cohesive strategy, specifically, how China is using these programs as a strategy in conducting irregular warfare. Several reports touch on the concept of China building legitimacy through space and lunar programs, however, they fail to tie this pursuit of legitimacy to a campaign of irregular warfare.

⁴⁹ "BeiDou (BěiDǒu 北斗, named after the Big Dipper) Navigation Satellite System (BDS)" see: Belt and Road Initiative - China's Space Silk Road, cited previously, www.beltroad-initiative.com

⁵⁰ Gabriel Alvarado, Mark Stokes, Emily Weinstein, and Ian Easton. "China's Space and Counterspace Capabilities and Activities."88.

⁵¹ Ibid, 88, 101.

⁵² Ibid, 101.

For purposes of this paper, a campaign of irregular warfare is defined as a “struggle to influence populations and affect legitimacy” and it will be demonstrated that the Chinese are using the space program and lunar exploration as a method of irregular warfare.⁵³ To understand how the Chinese are using the space and lunar programs as a method of irregular warfare, it is important to understand the analysis and methodology of irregular warfare, including the strategic analysis and the strategic response framework.⁵⁴ As part of the initial strategic analysis for an irregular warfare campaign, the following questions of the actor/actions must be engaged:

1. What is the threat group doing politically?
2. How is the group exploiting domestic alliances to better reach its objective?
3. How is violence used in support of its political project?
4. How is non-violence used?
5. What is the role of the internationalization of the group’s struggle?⁵⁵

As part of the strategic estimate and framework, the “problem” must be determined, the “roots” of the problem examined; the “frame and narrative” by the antagonistic must be understood; the “threat strategy”, including the ends-ways-means and the center of gravity by the antagonist must be examined; and finally, the “present response” by the party facing the aggression must be fully understood.⁵⁶ Once these questions are examined during an initial analysis focusing on the malign actor, a strategic response may be formulated by utilizing a similar framework and the same questions from the perspective of the actor/actions responding to the original antagonist. As part of a strategic response, the following framework should be utilized: concept of response,

⁵³ Marks, Thomas A., and Ucko, David. "Gray zone in red: China revisits the past." (2021): 1-24.

⁵⁴ Marks, Thomas A., and Ucko, David. "Violence in Context: Mapping the Strategies and Operational Art of Irregular Warfare," pgs. 206-233, February 2018.; Ucko, David, "Crafting Strategy for Irregular Warfare: A Framework for Analysis and Action, p 26, 27.

⁵⁵ Ibid.

⁵⁶ Ucko, Crafting Strategy for Irregular Warfare: A Framework for Analysis and Action. 36.

legal authority, assumptions, implementation, and risk assessment & mitigation. Each of these aspects of a response must be reviewed and formulated to provide an effective response.⁵⁷

Using the IW framework provides the only satisfactory analysis of the various actions by China regarding its space and lunar programs and will provide a basic framework for crafting an appropriate response. This framework will be utilized herein using countries in Africa to illustrate the IW campaign. However, China is using the same IW campaign in multiple regions of the world, including in the Pacific and Central America.⁵⁸ A full analysis of each of these regions is outside the scope of this paper. However, regardless of the region discussed, the same framework and analysis will result in the same conclusion – that China is using its space and lunar programs as a method of engaging in irregular warfare against the United States.

⁵⁷ Ucko, “Crafting Strategy for Irregular Warfare: A Framework for Analysis and Action,” 36.

⁵⁸ As illustrated by the joint Chinese and Venezuelan satellite programs in which China developed and launched sensing satellites for Venezuela Clark, Stephen. *China Successfully Launches Earth-Imaging Satellite for Venezuela – Spaceflight Now*. <https://spaceflightnow.com/2017/10/09/china-successfully-launches-earth-imaging-satellite-for-venezuela/>. Accessed 10 Apr. 2021. China has similar programs with four other Latin-American countries, including a major collaborative effort with Brazil in the China-Brazil Resources Satellite program. Klinger, Julie Michelle. "A brief history of outer space cooperation between Latin America and China." *Journal of Latin American Geography* 17, no. 2 (2018): 46-83.

CHAPTER 2: STRATEGIC ESTIMATE

The irregular warfare analysis framework begins with a discussion of the problem. In this instance, the problem is that the United States faces increased global competition from China as the latter pursues its goal of displacing the United States as the global hegemon. As part of this broader effort, China has engaged with multiple countries, including African countries, in the emerging satellite technology sector and lunar resources race to replace the United States as the world's undisputed world leader of space exploration. In short, China is using its space and lunar programs to establish its legitimacy as the world leader in the aerospace industry.



Figure 1 - China's Triumph Over the US⁵⁹

By establishing itself as the legitimate leader, overshadowing the United States, China strengthens its political and economic influence throughout the world. To gain legitimacy, it is building a strong network of partners across the world, with the intent to

⁵⁹China on the way to space domination, Illustration by Yuko Shimizu; Ibold, Sebastian. "Belt and Road Initiative - China's Space Silk Road." *Belt and Road Initiative* (blog), May 14, 2018. <https://www.beltroad-initiative.com/space-silk-road/>, last accessed 11/10/2020 with picture credit to Popular Science Magazine, October 2016 issue.

engage with each of these partners to the exclusion of the United States. The emerging technologies developed in the space program and the lunar program will maximize China's ability to gain a significant economic advantage in the long term and will allow China to be the world leader in space, the most economically secure country, and the global leader in the energy sector.

China is rapidly developing its space and satellite program in combination with partner countries and these programs are an extension of Chinese influence through soft power, especially in Africa. While Africa is not the only region of the World in which China is engaged in partnerships, the countries around the Equator are attractive partners for launching satellites, as this geographic band allows space payloads to break free from the Earth's gravitational pull more quickly due to the higher speed of the Earth's rotation at the Equator. In other words, it is easier to get into orbit faster, using less fuel, all while carrying a heavier payload.⁶⁰ Currently, as of July 2020, there are 20 African countries that have some type of space program and China has known space-related engagements with 18 of these countries. Activities include launching satellites, collaborative research projects, and developing components for the Chinese Chang'E lunar program.⁶¹

The roots of the symbiotic partnership with African countries are based upon a balance between fear and need and the space/lunar programs are an extension of this

⁶⁰ "Basics of Space Flight - Solar System Exploration: NASA Science." *NASA Solar System Exploration*, <https://solarsystem.nasa.gov/basics/chapter14-1/>. Accessed 9 Apr. 2021. Note that this does location is not as equally advantageous for missions to other planets.

⁶¹ Space in Africa, *African Space Industry Now Generating Over USD 7 Billion Annually, To Exceed 10 Billion by 2024.*, Space in Africa, June 11, 2019; Klinger, Julie. *China, Africa, and the Rest: Recent Trends in Space Science, Technology, and Satellite Development*. 38, Johns Hopkins School of Advanced International Studies, p. 26, <https://static1.squarespace.com/static/5652847de4b033f56d2bdc29/t/5ecdb4ab6dad0e25fa0feb06/1590539437793/WP+38+-+Klinger+-+China+Africa+Space+Satellites.pdf>. These 20 countries include: Algeria, Angola, Botswana, Burkina Faso, Egypt, Ethiopia, Gabon, Ghana, Ivory Coast, Kenya, Libya, Mauritius, Morocco, Nigeria, Rwanda, South Africa, Sudan, Tunisia, Uganda, Zimbabwe, List of Space Agencies in Africa - Space in Africa (africanews.space)

dynamic. China fears that it will not be able to compete with the United States in great power competition. Further, it needs additional resources and markets to continue economic growth, which will ensure the CCP remains in power. African countries need economic growth and global power equity and fear not being able to achieve either at present without international partners.

In the past, before its rise in power and influence, China has traditionally feared that if it is not able to compete with the other great powers, it risks being subjugated by these countries again, similar to the age of imperialism in the 1800s. The CCP fears being replaced by a Western form of government, such as an American-style republic/democracy. Democracy itself is an existential threat as it values the individual over the party/government. This is the opposite of China's perceived priorities which put the Party/State over personal interest. China needs an open space that is rich in resources to build and consolidate power as a global superpower. Africa can provide China with the power and influence it needs without the need for military confrontation or for seizing another region by force.

Economically, China needs continued resources to feed its economy and markets to export Chinese products to. Africa has the resources to feed this insatiable need for resources and markets. The Belt and Road Initiative, including the Digital Belt and Road Initiative as well as the Space Silk Road Initiative, will allow China to build a physical and electronic supply route through multiple countries with multiple allies, each with independent resources. Xi Jinping, the President of China, has stated many times in speeches that the biggest bottleneck to Africa's success is its insufficient infrastructure

and infrastructure is the leading priority when these countries request assistance.⁶²

Infrastructure can be the building of main supply routes such as roads, bridges, shipping terminals, and train networks. However, equally important is the building of reliable power grids, communication networks, and internet connectivity.

This expansion of infrastructure and cementing of relationships will fulfill China's need for additional partners in the future in the event there is a larger conflict and gain partners for so-called mutually beneficial economic relationships. African countries are willing to engage in these partnerships based upon the need for technology, a desire for a greater role internationally, and the fear of not being perceived as legitimate global partners which can provide equitable consideration in a partnership. African countries need partnerships to assure growth and gain global stature, as most are currently not major global players politically or economically. The only way to gain power rapidly is through collective partnerships and economic influence. These countries are cognizant of their respective tremendous potential, such as being rich in resources and human capital, and seek opportunities to capitalize on these resources. Partnerships with China are a natural expansion of pre-existing long-term relationships and commonality of history.

China frames the narrative of U.S. space and lunar exploration as one built on oppression and China offers African countries an alternative redemptive path. China claims that Western powers, as represented by the United States, engage in exploitation and oppress the world through capitalism, which is an extension of democracy. This message has resonance as both China and several African nations suffered under Western

⁶² Reuters. "China Is Not Funding 'vanity Projects' in Africa, Chinese President Xi Jinping Says." *CNBC*, 3 Sept. 2018, <https://www.cnb.com/2018/09/03/chinas-president-xi-jinping-on-belt-and-road-initiative-in-africa.html>.; Shepard, Wade. "What China Is Really Up To In Africa." *Forbes*, 3 Oct. 2019, <https://www.forbes.com/sites/wadeshepard/2019/10/03/what-china-is-really-up-to-in-africa/>.

colonialism or economic imperialism. China frames its narrative to illustrate that it has cast off the oppression, leading to economic superiority, and as such, it is a country to emulate. China's vision is that this alternative path towards independence is possible through mutual acceptance, partnership, and mutual collaboration.

The "America First" rhetoric plays right into this diagnostic frame. Where China says partnership – America says, "America first!" China apportions the blame for some of the discord around the world and in Africa on the United States' engagement of a capitalistic regime of oppression across the world, including oppressing countries that are struggling to achieve global influence and trying to meddle in private and internal affairs of state. China can claim that African countries that are struggling to be part of the technological revolution are prohibited from doing so due to the inherent racism of the United States, which only views other countries as a resource to control as capitalism is the new colonialism.

The Chinese Communist Party's (CCP) goal is to remain in power, and it can accomplish this by illustrating the legitimacy of the political regime which currently exists.⁶³ The political regime has produced remarkable economic prosperity and growth, thus illustrating the legitimacy of the Party. As the Party has produced immense prosperity in the past, it must remain in power for the future so this growth can continue. If it remains in power, the past, which was often characterized by oppression and poverty, will be overcome, and tomorrow's future will be even greater than the past or the present⁶⁴ China offers a chance for select countries to help develop its space program,

⁶³ Syk, Marcus. *If You Want to Get Rich, First Build a Road, A Study on Chinese Trade Network Building in Eurasia*. Lund University, May 2018, <http://lup.lub.lu.se/luur/download?func=downloadFile&recordOid=8947664&fileOid=8947665>. 12

⁶⁴ Ibid.

climb the ladder of technology associated with the program, and build a stronger, more prosperous economy.

Throwing off the shackles of servitude and oppression by every African citizen is central to the prognostic framing of China in Africa. China can suggest that the United States' capitalistic system is an extension of that oppression and it is trying to control the rise of African nations as these nations seek to increase their technology base and space programs. The reliance on the American GPS technology is an example of a shackle of capitalism that serves only to keep African countries bound in subservience. The African countries should seek other partners, including willing partners like China. By throwing off American repression and joining China, there will be economic prosperity and growth in African countries, especially in the area of outer space emerging technologies. In the new world order, Africans will be at the forefront of technology innovations with China, as an equal partner. The only costs which these countries must pay is to join China and other partners in the Belt and Road Initiative so that all citizens may enjoy mutual acceptance, economic prosperity, and freedom from Western influence.

There are multiple reasons why a country in Africa should be inspired to join China in its space and lunar exploration missions; however, the most important is equality, both political and economic. China's message is that it is only interested in being a full and equitable partner and it is willing to provide any partner with the technology to help all of humanity. For the African partners, this is a welcome motivation as each realizes that China's assistance will potentially encourage economic growth and wealth, which in turn will produce domestic and international power and influence. China stresses that the advances are "open, equal, mutually beneficial, and inclusive" especially

for countries in need or just entering the space sector.⁶⁵ The very logo of the Chinese Aerospace Science and Technology Corporation (CASC) is a testament to the motivational framing of China to any partner.



“China Aerospace Science and Technology Corporation’s logo is composed of straight lines, circles, alphabets and an arrow. The arrow symbolizes the soaring launch vehicles, the energetic aerospace staff and the thriving aerospace cause. It also looks like the mandarin Chinese character “ren”, an example of our company’s business concept—people-oriented and working together. The three concentric circles are symbols of the first, second and third cosmic velocities, which indicate the features of [the] aerospace industry. As the lines of the circles become thicker from inside out, they can also show a momentum of development and growth.”

66

Figure 2 - CASC Logo and Logo Meaning

The narrative is that by joining China in pursuit of a better life and society through technology, a country will receive this technology for free, which can then be used for humanitarian purposes, to improve the quality of life for the people of the country, and to build a country based upon an economy without Western reliance or interference. China’s implied promise with this technology is that the people in that country will never be hungry or thirsty again.⁶⁷

The promise of free technology that can alleviate human suffering, hunger, and thirst has a powerful appeal. For countries not blessed with abundant accessible natural

⁶⁵ China’s Space Narrative, p. 20, citing Shi Zhongjun, “Chinese Space Cooperation: Build a Common Destiny for Humankind - A Presentation by Permanent Mission of the People’s Republic of China to the United Nations and Other International Organizations in Vienna,” (Zhongguo de hangtian hezuo: goujian mingyun gongtongti he zao fuquan renlei - Zhongguo zai wei ye na lianheguo juban hangtian hezuo zhuti chuan jiehui; 中国的航天合作: 构建命运共同体和造福全人类 —— 中国在维也纳联合国举办航天合作主题宣介会), Permanent Mission of the People’s Republic of China to the United Nations and Other International Organizations in Vienna, June 21, 2018, <http://www.chinesemission-vienna.at/chn/hyyfy/t1570725.htm>.

⁶⁶ China Aerospace Science and Technology Corporation. “Our Logo.” *English.Spacechina.Com*, <http://english.spacechina.com/n16421/n17138/n2357695/index.html>.

⁶⁷ These are all real technologies that can be utilized, as is more fully explained in further sections of the paper. Qing-bo ZHOU, Qiang-yi YU, Jia LIU, Wen-bin WU, Hua-jun TANG. “Perspective of Chinese GF-1 High-Resolution Satellite Data in agricultural Remote Sensing Monitoring.” *Journal of Integrative Agriculture*, vol. 16, no. 2, 2017, pp. 242–51, <https://www.sciencedirect.com/journal/journal-of-integrative-agriculture/vol/16/issue/2>.

resources, it is a promise of hope and great riches in the future. This is reflected in the African Union (AU) Science, Technology, and Innovation Strategy for Africa 2024:

The AU Science, Technology and Innovation Strategy for Africa (STISA) places science, technology, and innovation at the epicentre of Africa's socio-economic development and growth and emphasises the impact the sciences can have across critical sectors such as agriculture, energy, environment, health, infrastructure development, mining, security and water among others. The strategy envisions an Africa whose transformation is led by innovation and which will create a *Knowledge-based Economy*. STISA is anchored on six (6) priority areas namely:

- i. Eradication of Hunger and Achieving Food Security
- ii. Prevention and Control of Diseases
- iii. Communication (Physical and Intellectual Mobility)
- iv. Protection of our Space
- v. Living together in peace and harmony to build the society
- vi. Wealth Creation⁶⁸

Once the technology is developed, it can generate significant returns on that investment, but the African countries acknowledge that investment is required both financially and politically before these programs come to fruition. Again, referencing the STISA framework, "Conducive political and financial environment is a requirement for strengthening creativity and technological innovation that brings about entrepreneurship in new technological frontiers such as nanotechnology."⁶⁹ Financially, China has indicated that it will provide the capital to fund technology growth and train personnel and it will do all of this because of the mutual respect for partners versus any global power leadership ambitions.⁷⁰ Politically, China offers a vision of the world where African countries are equal global partners versus being relegated to the role of a "third

⁶⁸ *Education, Science & Technology / African Union*. <https://au.int/en/education-science-technology>. Last Accessed 12 Dec. 2020. (Alternative spellings in the original.)

⁶⁹ African Union Commission. "Science, Technology and Innovation Strategy for Africa 2024." *Science, Technology and Innovation Strategy 2024*, 2019, p. 52, https://au.int/sites/default/files/documents/38756-doc-stisa_science_tech_innovation_strategy.pdf. , 23

⁷⁰ Nantulya, Paul. "Chinese Hard Power Supports Its Growing Strategic Interests in Africa." *Africa Center for Strategic Studies*, 17 Jan. 2019, <https://africacenter.org/spotlight/chinese-hard-power-supports-its-growing-strategic-interests-in-africa/>.

world country" to be ignored on the global stage. Further, China has indicated that it “respects the legitimate interests and values of nations, regardless of their social systems or their level of development.”⁷¹ This can be a powerful incentive to countries that are newly formed, which have been marginalized in the past or have been exploited/subjugated by colonial powers.

China’s development of its aerospace program in conjunction with African partners does help these partners achieve greater advancements in technology, especially through data collection and collaboration, but it is not done solely for altruistic reasons. This mutual development provides China with greater soft power influence and it mutually benefits China by enabling even greater technological breakthroughs in China’s aerospace industry which will also enable advances in its military.⁷² For example, if a country develops a new type of satellite or artificial intelligence for guidance of an existing satellite in conjunction with a Chinese corporation or using Chinese venture capital, China will immediately have access to this leading-edge innovative technology and can immediately use this technology in improving its own civilian and/or military programs, such as in conjunction with its highly developed missile system, or market this technology to others, increasing its economic prosperity.⁷³

⁷¹ China’s Space Narrative, p. 20, citing Ambassador Fu Ying, Fu Ying, “China’s Vision for the World: A Community of Shared Future,” *The Diplomat*, June 22, 2017, <https://thediplomat.com/2017/06/chinasvision-for-the-world-a-community-of-shared-future/>

⁷²“The aim of the [Digital Belt and Road Program] program is to improve environmental monitoring, promote data sharing, and support policymaking using big data on Earth observations. The program involves more than making Chinese data available to others; it also aims to address the digital divide, raise awareness of the potential benefits of Earth observations, and increase international collaboration.” Borowitz, Mariel. “Earth Observing Satellites and Open Data Sharing in China.” *China Research Center*, 5 Feb. 2020, https://www.chinacenter.net/2020/china_currents/19-1/earth-observing-satellites-and-open-data-sharing-in-china/, quoting Xinming, T. (2018). *International Service and Application: China’s Ziyuan and Surveying and Mapping Satellites*. GEO Week 2018: Asia-Oceania Day. Kyoto, Japan.

⁷³ Brown, Michael, and Pavneet Singh. "China’s technology transfer strategy." *Silicon Valley, CA: Defense Innovation Unit Experimental Report* (2018)., 2018, 8, 10, 12, 13, [https://admin.govexec.com/media/diux_chinatechnologytransferstudy_jan_2018_\(1\).pdf](https://admin.govexec.com/media/diux_chinatechnologytransferstudy_jan_2018_(1).pdf)

China freely acknowledges its use of aerospace technology for military purposes. According to the China Aerospace Science and Technology Center (CASIC), its corporate mandate is to “secure peace with aerospace technology” and ensure “military–civilian integration development” to empower the military with the latest technology.⁷⁴ For China’s partners, the message is even more clear: “your security–our responsibility.”⁷⁵

As of 2018, 45 countries in Africa had signed bilateral agreements with China’s State Administration for Science, Technology, and Industry for National Defense (SASTIND) to share defense-related technology and build partner military capacity.⁷⁶ China believes that military/civilian dual-use programs should be fostered as these will develop an industrial base in multiple countries, which will then launch new economic opportunities through emerging technologies.⁷⁷ This shared technology and increased partner capacity provides greater military strength to China by giving it increased technologies as well as multiple locations China can utilize if necessary. While China has not engaged in direct military conflict against the United States via its space program nor has it engaged in military conflict against African countries/citizens to ensure cooperation with the satellite and lunar programs, the increased capabilities provide China with a

⁷⁴ China Aerospace Science and Technology Center. “ABOUT US - Introduction of CASIC.” *CASIC-English*, <http://www.casic.com/n189298/n189314/index.html#:~:text=CASIC%20takes%20%22empowering%20the%20army%20with%20science%20and,always%20adhered%20to%20%22national%20interest%20above%20all%20else%22>. Accessed 14 Dec. 2020

⁷⁵ Id.

⁷⁶ Nantulya, Paul. “Chinese Hard Power Supports Its Growing Strategic Interests in Africa.” In addition, an appendix of the agencies and engagements can be found at: Klingler, Julie. *China, Africa, and the Rest: Recent Trends in Space Science, Technology, and Satellite Development*. 38, Johns Hopkins School of Advanced International Studies, p. 10-13, <https://static1.squarespace.com/static/5652847de4b033f56d2bdc29/t/5ecdb4ab6dad0e25fa0feb06/1590539437793/WP+38+-+Klingler+-+China+Africa+Space+Satellites.pdf>

⁷⁷ China Aerospace Science and Technology Corporation, “Space Technology Applications.” <http://english.spacechina.com/n16421/n17215/n2003172/index.html>

stronger military and an ability to engage in military actions using these various platforms and locations should the need arise in the future, as part of its active defense.⁷⁸

Militarily, China can easily bring defense forces into strategic locations to ensure cooperation. The military base in Djibouti is often cited as the first Chinese base on the continent, however, it is arguably the second military base built by China in Africa. The first base China built is located in the city of Swakopmund, Namibia. The China Space Tracking, Telemetry and Command Station is a tracking facility completed in July 2001 in a strategic harbor location and is a dual-use asset operated by the Xi'an Satellite Control Centre (XSCC), also known by the military designation of Base 26 by the Peoples Liberation Army Strategic Support Force.⁷⁹ This satellite tracking facility is a small but strategically important center and could easily provide ground orientation guidance for multiple civilian and military purposes. Thus, for either the Djibouti or Swakopmund locations, China could coordinate an influx of troops at militarily consequential locations.

While the military threat and potential control in multiple locations is very real, China does not necessarily need to use this overt threat as its use of propaganda is incredibly effective in swaying hearts and minds to join in China's dream. For example, in 2019, Liu Yang, a Chinese Taikonaut, otherwise known as an astronaut in the United States, and the first Chinese woman in space on the Shenzhou 9 mission, visited Namibia and this visit was highly publicized by the

⁷⁸ Fravel, M. Taylor. *Active Defense: China's Military Strategy Since 1949*. Princeton University Press, 2019.

⁷⁹US-China Economic and Security Review Commission, *China's Strategic Aims in Africa*, May 8, 2020. <https://www.uscc.gov/hearings/chinas-strategic-aims-africa>. 135: Dreher, A., Fuchs, A., Parks, B.C., Strange, A. M., & Tierney, M. J. (2017). *Aid, China, and Growth: Evidence from a New Global Development Finance Dataset*. AidData Working Paper #46. Williamsburg, VA: AidData. <https://china.aiddata.org/projects/1336>

Chinese official news outlet. A quote from this article illustrates how effective this visit was in winning hearts and minds. One young girl is quoted as saying, "I like Liu Yang. As a woman, she can match any man. She shows what she can do, which means we can make it, too."⁸⁰ Further, according to the local ambassador, "China and Namibia continue to cooperate in the fields of aerospace based on equality and mutual benefit. China's aerospace development cannot be separated from the support of Namibia. The visit will further strengthen the friendship between the two countries and two peoples."^{81,82} These examples illustrate the effectiveness of the narrative which China is disseminating via media propaganda.

Building on the propaganda, China is willing to train partner country citizens as a strategy of soft power projection and pursuing non-violent means of influence.⁸³ African countries engaged in the space program with China are assured that the technology transfer and training programs on how to use this technology in the future is the bedrock of the agreement and they will be able to continue to build a space program on this stable foundation. As per one working paper, "International satellite partnerships undertaken on the part of African space programs proceed with the express understanding that the transfer of know-how and technology is a cornerstone of the agreement" and is sometimes used as a

⁸⁰ 周冰, Xin Hua. "Visiting Astronauts Inspire Namibian Youngsters." *ChinaDaily.Com.Cn*, 9 Aug. 2019, <https://www.chinadaily.com.cn/a/201908/28/WS5d65d5a2a310cf3e355683f0.html>.

⁸¹ Id. For an interesting read, pursue the Chinese space race to put a woman in space. The story of Liu Yang is fascinating in itself. She was the first female taikonaut in space and she was sent to space on June 16, 2012, which was the anniversary date the first female cosmonaut was sent into space – a clear reference that China has assumed the mantle of space dominance from the Russians. More information on both of these fascinating individuals can be found here: https://cpcchina.chinadaily.com.cn/2012-12/03/content_15981597.htm; <https://www.britannica.com/biography/Valentina-Tereshkova>

⁸² This was the second visit by Chinese Taikonauts. Yang Liwei, (the first Chinese Taikonaut) visited Namibia in 2010. XinHua. "Visiting Astronauts Inspire Namibian Youngsters." *ChinaDaily.Com.Cn*, 9 Aug. 2019.

⁸³ Eleanor Albert, "China's Big Bet on Soft Power," Council on Foreign Relations, Backgrounder, February 9, 2018. <https://www.cfr.org/backgrounder/chinas-big-bet-soft-power>.

“Learning by Doing” approach.⁸⁴ Under this approach, the country which is contracting for a product will send experts, including scientists and engineers, to the contractor’s location and these individuals will work at that location during all of the phases of the contract, starting with the initial design of the satellite and will continue to work on all additional phases, including the final launch⁸⁵

In addition to providing technology and training, China is engaged in a multi-faceted effort to build allies across multiple countries which are not necessarily part of the elected government but nonetheless hold power and influence in their particular region.⁸⁶ An example of building a connected regional network of allies across multiple countries, in multiple regions, including the remote regions in Africa, is the Square Kilometer Array (SKA) telescope project. China is one of the main proponents in building the SKA telescope, with collection sites spanning thousands of miles in remote regions in South Africa.⁸⁷ This telescope will be so advanced and gather so much data that “entirely new computer technologies will need to be invented to process it all.”⁸⁸ China will be the main processor of this data using the second-fastest supercomputer in the world, Tianhe-2.⁸⁹ Each of the regions where these telescopes are installed will benefit as they will require new infrastructure to support these arrays of telescopes - including new roads in remote areas, electricity to power the equipment (which can also

⁸⁴ Klinger, Julie. *China, Africa, and the Rest: Recent Trends in Space Science, Technology, and Satellite Development*. 38, Johns Hopkins School of Advanced International Studies, p. 26, <https://static1.squarespace.com/static/5652847de4b033f56d2bdc29/t/5ecdb4ab6dad0e25fa0feb06/1590539437793/WP+38+-+Klinger+-+China+Africa+Space+Satellites.pdf>, 10.

⁸⁵ Ibid, 10.

⁸⁶ Ibid.

⁸⁷ Versfeld, Allen. “SKA Africa: What The World’s Biggest Telescope Means For Africa’s Development.” *Space in Africa*, 17 Dec. 2019, <https://africanews.space/ska-africa-what-the-worlds-biggest-telescope-means-for-africas-development/>.

⁸⁸ Ibid.

⁸⁹ Africa, Space in. “China Set To Build Regional Data Centre To Crunch Data From the SKA Telescope.” *Space in Africa*, 26 Aug. 2019, <https://africanews.space/china-set-to-build-regional-data-centre-to-crunch-data-from-the-ska-telescope/>.

be used to bring power to remote areas), and internet cable/infrastructure for data transfer. Also, presuming that the agreements obligate local residents to be employed versus Chinese nationals, each region will have new jobs for each phase of construction and jobs for continued maintenance at each site location.⁹⁰ This initiative will increase the goodwill towards China and gain allies in almost every remote region as well as nationally.

China is building additional goodwill not just through building projects in remote locations, but also through humanitarian projects, such as using its partnership with the Belt and Road countries to provide data that can increase crop yields significantly. The Gaofen high-resolution (GF-1) satellite, primarily used for agricultural monitoring, provides data on multiple factors which influence crop yields and using data obtained from observations, analysts can more accurately predict crop growth and estimate crop yield for an area. The satellite observations and data collections can assist for the entire growth cycle by observing the region for optimum moisture conditions to plant (which alone can increase/decrease plant mortality rates by 25-35%), determine moisture conditions in targeted communities to allow for precision irrigation, monitor vegetative growth, and monitor which crops will require targeted fertilizer use and/or blight monitoring.⁹¹ Further, with constant monitoring, the farmers in that region can engage in precision harvesting as crops in different areas have different peak growth rates and

⁹⁰ Versfeld, Allen. "SKA Africa: What The World's Biggest Telescope Means For Africa's Development." *Space in Africa*, 17 Dec. 2019, <https://africanews.space/ska-africa-what-the-worlds-biggest-telescope-means-for-africas-development/>.

⁹¹ "How Many Seeds Does It Really Take to Get 100,000 Plants per Acre at Harvest? | Integrated Crop Management." *Iowa State University*, 9 Apr. 2007, <https://crops.extension.iastate.edu/encyclopedia/how-many-seeds-does-it-really-take-get-100000-plants-acre-harvest.>; Qing-bo ZHOU, Qiang-yi YU, Jia LIU, Wen-bin WU, Hua-jun TANG. "Perspective of Chinese GF-1 High-Resolution Satellite Data in agricultural Remote Sensing Monitoring." *Journal of Integrative Agriculture*, vol. 16, no. 2, 2017, pp. 242–51, <https://www.sciencedirect.com/journal/journal-of-integrative-agriculture/vol/16/issue/2>.

constant monitoring by the satellite allows for harvesting at peak growth.⁹² This information is relevant and useful and has resulted in a drop in the agricultural land needed to produce crops while the population has increased.⁹³ This means more people can be fed using less land.

China's efforts to build goodwill are not limited to regional allies, it is also engaging in cooperation with private or public entities and is willing to fund and support organizations via official channels or the Chinese aerospace commercial entities. As per the official CASIC site, it "actively implements the concept of the "Belt and Road Initiative" and cooperates with international partners...to contribute our space intelligence and strength to promote the global economic development and the building of a community of common destiny for mankind."⁹⁴ China is willing to train respective partners on any of the technologies used in the aerospace industry as each of these trainees is a diplomat for the Chinese upon returning home. China confirms that it is a willing partner with the African countries and in 2018, committed to providing over 50,000 training opportunities to various leaders and technical experts, as well as over 50,000 scholarships and degree program opportunities in STEM fields, including in the aerospace industry.⁹⁵ According to one source, over 80,000 students from Africa

⁹² Qing-bo ZHOU, Qiang-yi YU, Jia LIU, Wen-bin WU, Hua-jun TANG. "Perspective of Chinese GF-1 High-Resolution Satellite Data in agricultural Remote Sensing Monitoring." *Journal of Integrative Agriculture*, vol. 16, no. 2, 2017, pp. 242–51, <https://www.sciencedirect.com/journal/journal-of-integrative-agriculture/vol/16/issue/2>.

⁹³ Ritchie, Hannah, and Max Roser. "Land Use." *Our World in Data*, Nov. 2013, <https://ourworldindata.org/land-use>. The dual capability to use this information as a method of warfare is as simple as denying any country the data, which would result in a dramatic loss of crop yield as they will no longer be able to produce the same number of crops as with the data. If crop yield is approximately 100% using this data technology, even a modest reduction of 20% to an 80% yield could have dramatic impacts on a country that relies on a full harvest. It would be equivalent to the old method of burning the crops and poisoning the wells to starve the population.

⁹⁴ See footnote 12, CASIC-English - ABOUT US - Introduction of CASIC.

⁹⁵ US-China Economic and Security Review Commission, *China's Strategic Aims in Africa*, May 8, 2020, https://www.uscc.gov/sites/default/files/2020-06/May_8_2020_Hearing_Transcript.pdf, 30

participate in international studies in China per year, including 57 Namibian students in 2019.⁹⁶

From the African partners' perspective, there is an understanding that this training is a necessary requirement for building generational advancement due to the immense labor pool, especially of the youth, which can help build greater technological development in the future. As per STISA:

Africa's greatest hope for continental development is its vibrant human resources. However, to accelerate Africa's transition to an Innovation-led, Knowledge-based Economy, our Human Resources must be empowered with the necessary skills and greater emphasis must be placed on innovation and appropriate adaptation of technology and existing research results. It is necessary to promote creativity and innovative technologies to locally process the continent's abundant natural resources and to create more wealth and jobs for the youth on the continent. This priority will develop internal capacities; spur the co-creation, development, and marketing of new or improved products and services through engagement with end-user communities. This will create new opportunities for value-added employment by adapting and commercializing the outputs of national and regional Innovation across Africa.⁹⁷

Other than the obvious potential displacement of the United States as the global hegemon, the question remains as to why China is engaged in multiple partnerships to build cooperation on projects such as mining the Moon or Mars. The answer is that China seeks, and is potentially on track, to dominate the market of alternative energy from minerals in outer space by 2050 and any country which is a full partner in the space/lunar programs will benefit from this resource. The Moon is rich in Helium 3 and Mars is rich in deuterium, both extensively used in nuclear fusion power generation.⁹⁸ A Chinese

⁹⁶ Klinger, "China, Africa, and the Rest: Recent Trends in Space Science, Technology, and Satellite Development.", 10, *Space In Africa*, "China-Namibia Relationship On Space Is One Of The Best In Africa - Chinese Ambassador To Namibia." *Space in Africa*, 3 Sept. 2019, <https://africanews.space/china-namibia-relationship-on-space-is-one-of-the-best-in-africa-chinese-ambassador-to-namibia/>.

⁹⁷ African Union, "Science, Technology and Innovation Strategy for Africa 2024."

https://au.int/sites/default/files/documents/38756-doc-stisa_science_tech_innovation_strategy.pdf, 2.

⁹⁸ Zubrin, Robert. "The Case for Colonizing Mars." *National Space Society*, Aug. 1996, <https://space.nss.org/the-case-for-colonizing-mars-by-robert-zubrin/>.

lunar base will enable and produce items for further space exploration, such as oxygen which can be used as a propellant in further missions to Mars.⁹⁹ As the Moon has been called the "Persian Gulf of the solar system," Mars has been named the New World as it is rich in resources and can maintain an atmosphere.¹⁰⁰ Mars is a much greater source than the Moon of almost every rare mineral, as well as deuterium, another element essential for nuclear fusion.¹⁰¹

Nuclear fusion generators are known as magnetic confinement fusion (MCF) reactors, and as seen by the enclosed illustration, these are already in development in China with a plan to start large-scale operations in 2030 and power plant power generation by 2050. This fusion research facility built in 2018 is located in Hefei, in Anhui Province.¹⁰²

⁹⁹ This is already being planned and will be tested in the Chang'E-7 mission in 2024. Zou, Yongliao, et al. *Overview of China's Upcoming Chang'E Series and the Scientific Objectives and Payloads for Chang'E-7 Mission*. National Space Science Center, Chinese Academy of Sciences, 2020, p. 2, <https://www.hou.usra.edu/meetings/lpsc2020/pdf/1755.pdf>.

¹⁰⁰ Id.

¹⁰¹ Zubrin, Robert. "The Case for Colonizing Mars." *National Space Society*, Aug. 1996, <https://space.nss.org/the-case-for-colonizing-mars-by-robert-zubrin/>. While Helium-3 has a value of \$40,000 per ounce, deuterium has a value of \$10,000 per kilogram (1 kilo= 35.274 oz) and can be directly used in nuclear fusion versus Helium-3, which must be processed to produce fuel. Launching facilities on the moon, which will occur in this century, will be able to take advantage of the abundant water and oxygen production for fuel, the massive amount of raw materials for on-site production, including a large amount of metal from the South Pole-Aitken basin, the limited gravitational pull of the moon, and the zero friction in space. In other words, it will be relatively easy to build and launch a vessel to Mars from the moon using materials largely developed on the moon. Travel velocity will only need to be reached using propellant minimal or it also could be obtained by a combination catapult and propellant system due to the low gravitational pull. Once reached, no propellant is necessary as the ship will continue to maintain speed in perpetuity.

¹⁰² Zhang, Nanna. "Chinese Academy of Sciences." *China to Start Large Scale R&D on Fusion Demo Test Facilities*, 14 Dec. 2018, http://english.cas.cn/newsroom/archive/news_archive/nu2018/201812/t20181214_202468.shtml.



Figure 3 - Roadmap for Chinese MCF Development¹⁰³magnetic confinement fusion (MCF)

If China can successfully establish a lunar base and return Helium 3 to Earth, it will potentially have access to an incredibly efficient and long-lasting alternative energy source as well as an abundance of rare earth minerals. This access will last until another country can reproduce this technology for fusion and reproduce the mining operations on either the lunar surface or the surface of Mars, along with transportation of the mined material back to Earth. If countries wish to have access to this alternative energy source, each will need to engage with China, which will give China immense power and leverage. Alternatively, the large-scale introduction of this power source and rare earth minerals could collapse both the oil and the rare earth minerals markets, causing economies based upon petroleum dollars to collapse and making China the leading

¹⁰³ Li, Jiangang, and Yuanxi Wan. "Present State of Chinese Magnetic Fusion Development and Future Plans." *Journal of Fusion Energy*, vol. 38, no. 1, 2019, pp. 113–24, doi:10.1007/s10894-018-0165-2.

country in space and energy production.¹⁰⁴ According to the former chief scientist for China's lunar program, there is enough Helium-3 on the moon to match the energy consumption of the Earth for the next 10,000 years.¹⁰⁵ Thus, there would be no need to produce carbon fuels any longer, especially if global warming/pollution escalates. Any country which is a full partner with China and utilizes its technologies or participates in these programs will directly benefit from the inexhaustible power supply. On a diplomatic level, China can offer - or even require - cooperation and partnerships with other countries which wish to utilize China's capabilities and services.¹⁰⁶

The U.S. response, especially in the aerospace sector, has been dilatory and episodic. The United States has been slow to recognize and react to the threats posed by the Chinese space program, especially in Africa and has instead focused on countering terrorism and violent extremist organizations as well as providing humanitarian relief to African countries.¹⁰⁷ The entire structure of the Combatant Commands (COCOMs) is designed to protect the United States from threats emanating from the regions under the COCOM's area of responsibility. The COCOMs engage in civil/military relations as per the military directives. However, these engagements relate directly to the military versus engaging the host countries on a holistic, coordinated response. Partner countries recognize that the COCOMs are unable to provide the capital, influence, and cooperation necessary, thus engagements are limited to maintaining close personal relationships with

¹⁰⁴ CASI China's Space Narrative, p. 73

¹⁰⁵ Pollpeter, Kevin, et al. *China Dream, Space Dream: China's Progress in Space Technologies and Implications for the United States | U.S. - CHINA | ECONOMIC and SECURITY REVIEW COMMISSION*. 2 Mar. 2015, <https://www.uscc.gov/research/china-dream-space-dream-chinas-progress-space-technologies-and-implications-united-states>.

¹⁰⁶ APA (American Psychological Assoc.) Montluc, B. de. (2011). *A New International Strategic Context for Space Policies*. Nova Science Publishers, Inc.

¹⁰⁷ https://www.state.gov/wp-content/uploads/2019/04/JRS_ASecretaryEsper'sRemarksattheNorthAfricaAmericanCemeteryinCarthageTunisia > U.S. DEPARTMENT OF DEFENSE > Transcript. 30 Nov. 2020, <https://www.defense.gov/Newsroom/Transcripts/Transcript/Article/2367437/secretary-esper-remarks-at-the-north-africa-american-cemetery-in-carthage-tuni/>.

the respective leadership and working on counter-terrorism training. These well-meaning attempts to ensure stability or defeat terrorism ignore the remaining avenues for multi-level assistance, including assisting African nations with their respective and varied emerging technology industries and tailoring a response to the individual countries' technology needs. As the United States is not engaging with these countries on joint ventures in space, these countries have no choice but to seek an alternative partner in pursuit of the desire to enter the space domain.

As of January 2020, fourteen African countries have launched forty-two satellites (including nine by Egypt alone) and U.S. private companies have assisted in only eight of these programs as a contractor versus as a mutual partner.¹⁰⁸ The United States has issued a clear line in the sand by limiting certain business technology transactions and ownership with Chinese corporations, especially in the area of technology devoted to the space industry and these prohibitions extend to partners.¹⁰⁹ The original order was in the Wolfe Amendment which prohibits agreements which would enhance China's missile or space program.¹¹⁰ This amendment has prohibited various companies from collaborating on technical projects with any entity which will also work with China to prevent the

¹⁰⁸ Klinger, *China and Africa Initiative*, p. 5-8, SpaceX launched Ghana's first satellite in 2017.

¹⁰⁹ Executive Order 13959 of November 12, 2020, Addressing the Threat From Securities Investments That Finance Communist Chinese Military Companies *Code of Federal Regulations, title 3(2020); 73185-73189*, <https://public-inspection.federalregister.gov/2020-25459.pdf?1605534335>.

¹¹⁰ 51 USC §30701. Competitiveness and international cooperation

(a) Limitation.—

(2) Agreements with People's Republic of China.—The Administrator shall certify to Congress at least 15 days in advance of any cooperative agreement with the People's Republic of China, or any company owned by the People's Republic of China or incorporated under the laws of the People's Republic of China, involving spacecraft, spacecraft systems, launch systems, or scientific or technical information, that—

(A) the agreement is not detrimental to the United States space launch industry; and

(B) the agreement, including any indirect technical benefit that could be derived from the agreement, will not improve the missile or space launch capabilities of the People's Republic of China.

technology being used to enhance China's space capabilities. This prohibition was further expanded by Executive Order 13959 issued on November 12, 2020, which blocks any American companies or individuals from owning shares of any companies that aid in the modernization of the Chinese military.¹¹¹ As the Chinese aerospace industry is expressly engaged in modernizing the military, potentially every Chinese company directly engaged in the aerospace industry, including companies working directly with African and American partners, are included in this order. While these orders were long-overdue and will help curtail the theft of U.S. technology, China can use these reports to illustrate that the U.S. is not interested in technology transfer or collaboration/teaching the next generation of upcoming scientists and aerospace engineers, including those in African countries. The U.S. is failing to counter this narrative.

On an international level, U.S. actions are being portrayed as attempting to militarize space and to use it for commercial purposes, feeding directly into the narrative that the U.S. is interested solely in profit. For example, the U.S. State Department's 2018 Joint Regional Strategy amplified the wrong message by stating, "We will also foster trade linkages to enable greater levels of two-way trade, boost economic diversification and sustainable growth, actively support U.S. private sector engagement in Africa, and create broader markets for U.S. goods and services."¹¹² This message feeds into the narrative by the Chinese that the U.S. is only interested in partnerships for profit. In contrast, China is strategically positioning itself as the legitimate leader in international

¹¹¹ Executive Order 13959 of November 12, 2020, "Addressing the Threat from Securities Investments That Finance Communist Chinese Military Companies," Code of Federal Regulations, (2020) 85 FR 73185, 73185-73189, <https://www.federalregister.gov/documents/2020/11/17/2020-25459/addressing-the-threat-from-securities-investments-that-finance-communist-chinese-military-companies>.

¹¹² State Department, Joint Regional Strategy, (Washington, DC, Department of State) August 23, 2018. 5. https://www.state.gov/wp-content/uploads/2019/04/JRS_AF-AFR_UNCLASS_508_CMC.pdf 5.

organizations based on humanitarian considerations. For example, China has positioned itself in support of the G77 group of emerging space powers in the UN Office for Outer Space Affairs (UNOOSA).¹¹³ This group seeks to reaffirm the 1967 Outer Space Treaty and the Moon Agreement.

The 1967 Outer Space Treaty was signed by the United States and the former Soviet Union and specifically forbids the militarization of space and further contains provisions that, 1) prohibit any country from claiming ownership of the moon, and 2) establishes that exploration of any celestial body cannot be for the exclusive use of one nation.¹¹⁴ A follow-up treaty, the Moon Agreement, which was negotiated but never signed by the United States, goes even further by forbidding ownership of any resources in space and maintains that all resources are for the benefit of humanity.¹¹⁵ The Chinese are using these treaties to ensure that U.S. hands are tied on ownership and exploitation of outer space resources and to limit the U.S. development and use of offensive/defensive space warfare capabilities.

To ensure the U.S. has freedom of movement to develop space warfare tactics, the U.S. is openly discussing withdrawing from the Outer Space Treaty. While potentially

¹¹³ G77 and China, “Draft resolution on the fiftieth anniversary of the first United Nations Conference on the Exploration and Peaceful Uses of Outer Space: Space as a driver of sustainable development” 12 April 2018., United Nations Conference on the Exploration and Peaceful Uses of Outer Space. https://www.unoosa.org/documents/doc/copuos/Proposal_by_G77_and_China_NEW_as_at_12_April.pdf; China also submitted a proposal in the Composition and Election of the Bureau of the Working Group on the Long-term Sustainability of Outer Space Activities (LTS2.0 Working Group) that there be one Chair and one-vice-Chair. It further proposes that if the Chair is from a developed country, the vice-Chair should come from an emerging space power. Under either scenario, China is poised to be either the Chair or the vice-Chair as it can simultaneously claim to be a developed country as well as an emerging space power. https://www.unoosa.org/documents/pdf/copuos/stsc/2021/LTS/Intersessional_non-paper_-_LTS_-_China.pdf

¹¹⁴ Mann, Adam. “The New Scramble for the Moon.” *Scientific American*, vol. 321, no. 1, 2019, pp. 39–41, DOI: 10.1038/scientificamerican0719-60 citing the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, Jan. 27, 1967, 18 U.S.T. 2410, 610 U.N.T.S. 205 [otherwise known as the Outer Space Treaty.

¹¹⁵ Agreement on the Activities of States on the Moon and Other Celestial Bodies (Dec. 5, 1979) otherwise known as the Moon Agreement.

strategically necessary, these actions feed directly into the narrative that the U.S. is attempting to militarize space. Further, to ensure it can match the Chinese exploitation of resources, in 2015 the U.S. passed the U.S. Commercial Space Launch Competitiveness Act which gives U.S. commercial firms the right to own and sell natural resources mined from celestial bodies.¹¹⁶ This law is arguably contrary to The Moon Agreement, which has been adopted by the UN General Assembly, although it is not against customary international law.¹¹⁷ These actions, while potentially necessary to ensure parity with China, again feed directly into the Chinese narrative that the U.S. is engaged in capitalistic exploitation and the militarization of the moon and space.

¹¹⁶ McCarthy, Kevin. *Text - H.R.2262 - 114th Congress (2015-2016): U.S. Commercial Space Launch Competitiveness Act*. 25 Nov. 2015, <https://www.congress.gov/bill/114th-congress/house-bill/2262/text>.

¹¹⁷ Hatton, Scott. "IISL Position Paper on Space Resource Mining." *International Institute of Space Law*, 28 Dec. 2015, <https://iislweb.org/iisl-position-paper-on-space-resource-mining/spaceresourceminig/>.

CHAPTER 3: **COUNTERPOINT**

There is a counter-argument that China is engaging in cooperation versus competition with the United States and is not engaged in an IW campaign in the space sector. Further, there is a counter-argument that Chinese influence in Africa is not for nefarious purposes but instead, “outer space cooperation between China and African partner states epitomizes the intersection of peaceful development and security interests of all parties involved.”¹¹⁸ International realism theory does not appear to support these counter-arguments. A liberalist view would be that China is seeking to benefit all of humankind with the increased satellite systems and the lunar exploration programs versus using it to build its global power and military strength. This is contradicted by the White Papers issued by China, with the latest being issued in 2016, which clearly states the purpose:

[T]o utilize outer space for peaceful purposes, promote human civilization and social progress, and benefit the whole of mankind; to meet the demands of economic, scientific and technological development, national security and social progress; and to improve the scientific and cultural levels of the Chinese people, protect China’s national rights and interest, and build up its overall strength.

In the next portion of the White Paper, under the paragraph entitled “Vision,” the paper indicates some of the intended effects of the space program “to promote strong and sustained economic and social development, to effectively and reliably guarantee national security...[and] to provide strong support for the realization of the Chinese Dream of the renewal of the Chinese nation.” Thus, it appears that the very statement issued by the

¹¹⁸ Klinger, Julie. *China, Africa, and the Rest: Recent Trends in Space Science, Technology, and Satellite Development*. 38, Johns Hopkins School of Advanced International Studies, p. 26, <https://static1.squarespace.com/static/5652847de4b033f56d2bdc29/t/5ecdb4ab6dad0e25fa0feb06/1590539437793/WP+38+-+Klinger+-+China+Africa+Space+Satellites.pdf>, p 4

Chinese contradicts that the sole motive is for the benefit of all of humankind.¹¹⁹ The landing of the first two Chang'E explorers appears to bolster the concept that China is engaged in lunar exploration other than for the pure benefit of humanity. Instead, they demonstrate the Chinese lunar program is a multi-level strategic and economic program that is advancing its interests and ensuring that China is the greatest beneficiary when the utilization of lunar resources is realized. Through its exploration programs and partnerships, China is “anticipating the challenges of the future and addressing them through a coherent strategy already today... [and] setting up the board so that the game will play out in its favor, no matter whether the future players will want it to or not.”¹²⁰

The lunar program began in earnest in 2004 when China “formulated a robotic lunar exploration program, consisting of three phases—orbiting, landing, and returning—and named the program the “Chang'E Project,” after the Chinese goddess of the Moon.”¹²¹ Figure 4 depicts the sites of the successful landings on the moon with the Chang'E-4 depicted on the right side of the diagram at the bottom and the Chang'E-5 landing site (the ongoing mission) is at the top left portion of the illustration.

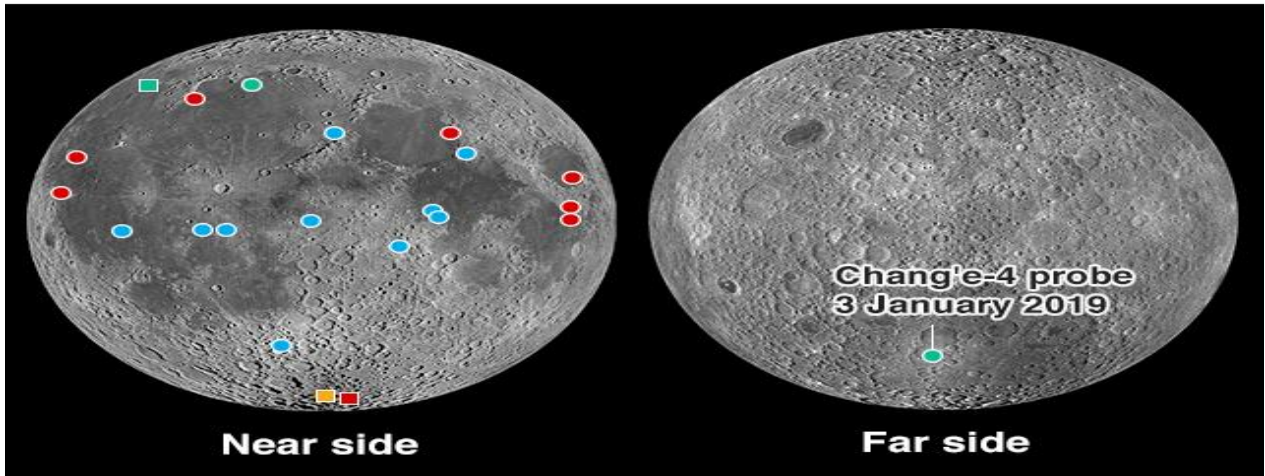
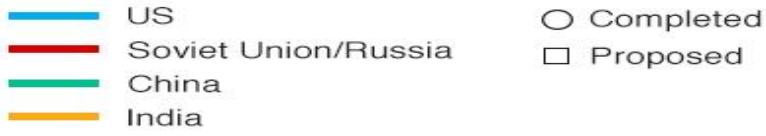
¹¹⁹ PRC State Council, Full Text of White Paper on China's Space Activities in 2016, December 28, 2016. http://english.gov.cn/archive/white_paper/2016/12/28/content_281475527159496.htm, and short paper prepared on the white paper, *China's Space Activities in 2016*, China National Space Administration, Page 1, Preamble.

¹²⁰Syk, Marcus. *If You Want to Get Rich, First Build a Road, A Study on Chinese Trade Network Building in Eurasia*. Lund University, May 2018,

<http://lup.lub.lu.se/luur/download?func=downloadFile&recordId=8947664&fileId=8947665>, page 9

¹²¹ Li, Chunlai; Wang, Chi, Wei; Yong; Lin Yangting, “China's Present and Future Lunar Exploration Program.” *American Association for the Advancement of Science*, vol. 365, no. 6450, July 2019, pp. 238–39, DOI: 10.1126/science.aax9908, [China's present and future lunar exploration program | Science \(sciencemag.org\)](https://doi.org/10.1126/science.aax9908)

Sites of successful Moon landings



Source: NASA

BBC

Figure 4 - Sites of Successful Moon Landings¹²²

China has aggressively been mapping the moon over the last several Chang'E lunar satellite missions. The following illustration depicts the Helium-3 dispersion:

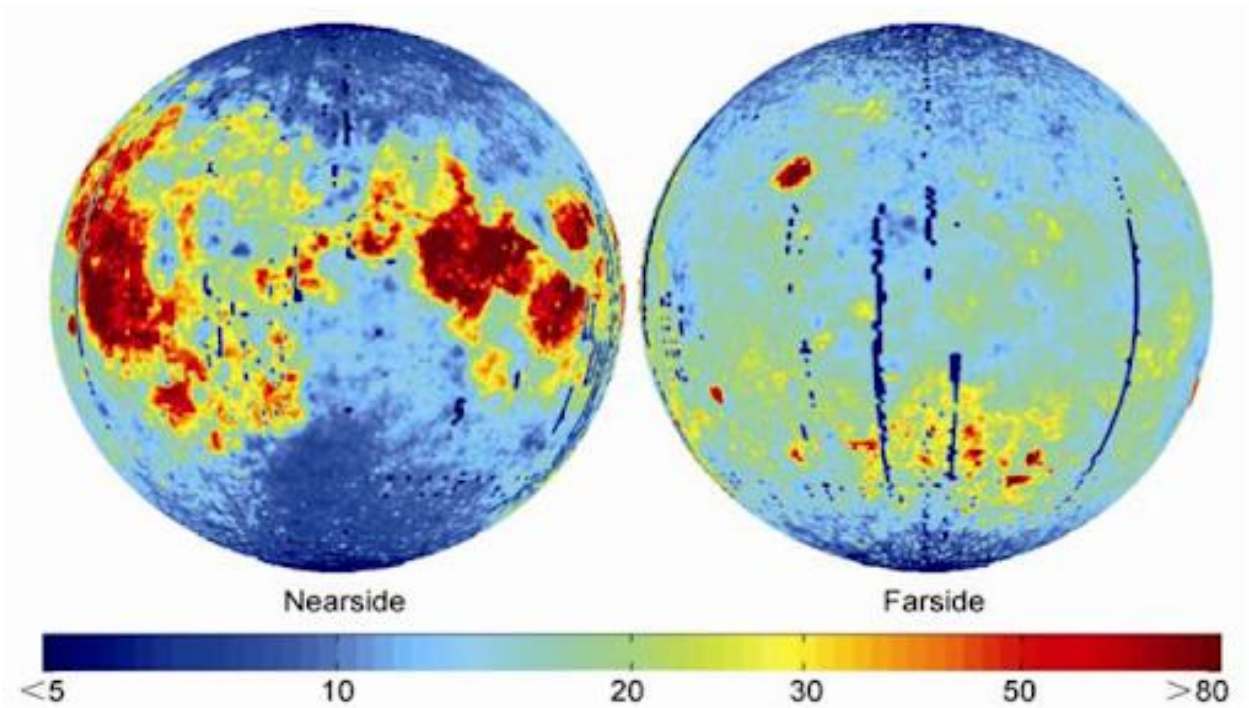


Figure 5 - Map of Helium-3 dispersion on the Moon¹²³

The location of the prior and future landing sites demonstrate China is conducting its lunar program with the ambition of developing the lunar base ideally located near potential lava tubes or near the South Pole as a primary location for mining.¹²⁴ The Chang'E-4 is operating on the far side of the moon at a location where it has been confirmed that an extraordinarily large deposit of metal and other minerals are located under the surface.¹²⁵ Presuming the Chang'E – 5 has similar instruments as the Chang'E-4, this will allow China to see in multiple tactically and strategic locations at least a hundred meters¹²⁶ below the surface to determine if any lava tunnel systems are present, and determine if any additional rare earth minerals are present and/or accessible.¹²⁷ Strategic mapping performed by the Chang'E-7 in 2024 of the Antarctic area (South Pole region)¹²⁸ will assist China in determining the prime spots on the moon which contain water, shade from radioactive waves, and sunlight for near-continuous solar power generation, needed for mining Helium-3 and rare earth minerals.^{129,130} It is anticipated that the site of the Chinese International Lunar Research Station (ILRS) will be at one of

¹²⁴ Jones, Andrew. "China Is Aiming to Attract Partners for an International Lunar Research Station." SpaceNews, 21 Aug. 2020, <https://dev.spacenews.com/china-is-aiming-to-attract-partners-for-an-international-lunar-research-station/>. To China's credit, they released data and a high-resolution Helium 3 dispersion map which was generated using data obtained in earlier Chang'E flights and modeled using AI techniques from the data collected. This map is contained and referenced herein.

¹²⁵ James, Peter B., et al. "Deep Structure of the Lunar South Pole-Aitken Basin." *Geophysical Research Letters*, vol. 46, no. 10, 2019, pp. 5100–06, doi:<https://doi.org/10.1029/2019GL082252>; Mosher, Dave. "Scientists Have Discovered a Mysterious Lump on the Moon's Far Side, and It's 5 Times Bigger than Hawaii's Big Island." *Business Insider*, 10 June 2019, <https://www.businessinsider.com/moon-crater-anomaly-south-pole-metal-asteroid-core-2019-6>.

¹²⁶ The Chang'E 4 rover, the Yutu 2 (named after the moon goddess's rabbit) had a radar that penetrated 100 meters. See Stuart, Colin. "Race to the Moon: Inside China's Plans to Build a Lunar Base." *Science Focus Magazine*, 15 Nov. 2019, <https://www.sciencefocus.com/space/inside-chinas-plans-to-build-a-lunar-base/>.

¹²⁷ Soderman/NLSI Staff. "Is Mining Rare Minerals on the Moon Vital to National Security?" *Solar System Exploration Research Virtual Institute*, <https://sservi.nasa.gov/articles/is-mining-rare-minerals-on-the-moon-vital-to-national-security/>. Accessed 15 Dec. 2020.

¹²⁸ Xinhua. "China Set to Build Lunar Base Prototype." *ShanghaiDaily.Com*, 27 Nov. 2020, <https://archive.shine.cn/nation/China-set-to-build-lunar-base-prototype/shdaily.shtml>.

¹²⁹ Mann, Adam. "The New Scramble for the Moon," *Scientific American*, Top Stories of 2019, 321, no. 1 (2019): 39–41. <https://doi.org/DOI:10.1038/scientificamerican0719-60>, 41.

¹³⁰ XU, Lin, and Yingzhuo Jia. "China's Planning for Deep Space Exploration and Lunar Exploration before 2030." *Chinese Journal of Space Science*, vol. 38, no. 5, 2018, pp. 591–92, doi:10.11728/cjss2018.05.59.

the “Peaks of Eternal Light” at the South Pole as the position of these peaks ensures they remain in the path of the sun due to the direction of the Moon’s tilt, it’s synchronous rotation, and the Earth’s orbit around the sun. They provide a limitless supply of light for generating solar power.¹³¹ Simultaneously, the craters below the peaks do not receive any sun, which potentially means there is a large supply of ice crystals for a virtually unlimited supply of water as well as shielding from radiation.¹³²

Further, equipment for future missions also appears to contradict that the missions are for purely scientific reasons as the Chang’E-7 instrument payload will contain instruments to test for water, oxygen production possibilities, the existence of Helium-3, and whether 3D printing/production is possible using the regolith.^{133,134} Russia recognizes the opportunities that cooperation with China will bring as evidenced by the agreement in February 2021 between China and Russia to cooperate on building a lunar base.¹³⁵ The Russians have traditionally cooperated with the United States on multiple missions and had expressed an interest in working with the United States on its lunar base, especially on the airlock systems.¹³⁶ China’s actions to circumvent that cooperation and to work

¹³¹ Xu, Lin, and Yingzhuo Jia. “China’s Planning for Deep Space Exploration and Lunar Exploration before 2030.” *Chinese Journal of Space Science*, vol. 38, no. 5, 2018, pp. 591–92, doi:10.11728/cjss2018.05.59; Mann, Adam. “The New Scramble for the Moon.” *Scientific American*, vol. 321, no. 1, 2019, pp. 39–41, DOI: 10.1038/scientificamerican0719-60, 41; Kruijff, Michiel. “2000ESASP.462..333K Page 333.” *Peaks of Eternal Light on the Lunar South Pole: How They Were Found and What They Look Like*, European Space Agency, 2000, pp. 333–336, http://articles.adsabs.harvard.edu/cgi-bin/nph-article_query?bibcode=2000ESASP.462..333K&db_key=AST&page_ind=0&plate_select=NO&data_type=GIF&type=SCREEN_GIF&classic=YES.

¹³² Ibid.

¹³³ Potter, Sean. “NASA’s SOFIA Discovers Water on Sunlit Surface of Moon.” *NASA*, 26 Oct. 2020, <http://www.nasa.gov/press-release/nasa-s-sofia-discovers-water-on-sunlit-surface-of-moon>. ; Zou, Yongliao, et al. *Overview of China’s Upcoming Chang’E Series and the Scientific Objectives and Payloads for Chang’E-7 Mission*. National Space Science Center, Chinese Academy of Sciences, 2020, p. 2, <https://www.hou.usra.edu/meetings/lpsc2020/pdf/1755.pdf>.

¹³⁴ Ibid.

¹³⁵ Myers, Steven Lee, *China and Russia Agree to Explore the Moon Together*, New York Times, March 10, 2021, updated May 14, 2021. [nytimes.com](https://www.nytimes.com)

¹³⁶ Office of Inspector General, NASA’s Management of the Gateway Program for Artemis Missions, IG-21-004, National Aeronautics and Space Administration, November 10, 2020, 7, <https://oig.nasa.gov/docs/IG-21-004.pdf>; Roulette, Joey. “Pivoting from NASA, Russia Partners with China for Lunar Space Station.” *The Verge*, 9 Mar. 2021, <https://www.theverge.com/2021/3/9/22321114/lunar-moon-space-station-russia-china-agreement-nasa>.

with Russia on a mutual base demonstrate it seeks to be the dominant space power, influence global populations, and dominate legitimacy in the space industry. In addition, the lunar exploration missions appear to follow China's plan for developing a lunar/space economy in three stages as part of the dramatic improvement of the Chinese economy.

¹³⁷These stages are: 1) "improving fundamental space capabilities"; 2) build the "infrastructure for a low-cost transport system between the Earth and the Moon"; 3) "establish a space economic zone by 2045."¹³⁸

Thus, China's prior actions, as well as the future planned missions, establish it is seeking the best locations for establishing a base where both power and water would be in abundant supply and mining would be worthwhile. As stated previously, the introduction of an abundant alternative energy source and rare earth minerals has the potential to provide China with the raw materials to propel it to be the dominant technological country in the world as most technology requires rare earth materials for construction and power to operate. China will have an abundance of both.

Simultaneously, should it serve its national interests or ensure economic superiority, it would have the ability to collapse the current energy sector and the rare earth metals market due to an excess in both sectors. This same abundance of resources will give China tremendous leverage.

Applying the strategic analysis of irregular warfare framework to China's actions in Africa clearly demonstrates that China is utilizing the space and lunar programs as a

¹³⁷ CASI, China's Space Narrative, p 47,48 citing Chinese Academy of Science's Bao Weimin, Zhao Lili, "Bao Weimin: Developing a New Format of Cislunar Economic Zone", (Bao Weimin: kaizhan di yue kongjian jingji qu xin yetai 包为民: 开发地月空间经济区新业态), Chinese Journal of Science and Technology (zhongguo kexue bao 中国科学报) (2018), http://www.cas.cn/zjs/201812/t20181213_4673769.shtml.

¹³⁸ Ibid.

method of irregular warfare. As the analysis demonstrates an irregular warfare campaign against the United States, the next step is to develop a strategic response which can be implemented by the United States. As indicated previously, the strategic response must include analysis starting with the concept of the response. After determination of the concept of response, the specifics of the response must be formulated, including the “assumptions inherent in the response, an implementation plan incorporating various lines of effort, and the risk assessment for each line of effort, and the mitigation plan to minimize the risks.”¹³⁹ The next section of this paper will develop the concept of response, but it is not limited to a response in Africa. Instead, it serves as a guideline for a broader strategic response which can be further tailored to individual countries or regions.

¹³⁹ Ucko, *Crafting Strategy for Irregular Warfare: A Framework for Analysis and Action*, Pgs. 36.

CHAPTER 4: **STRATEGIC RESPONSE**

For the first step in preparing a response, the United States must recognize China's effort for what it is, and craft an appropriate response based upon countering an irregular warfare strategy. After understanding and acknowledging that it is fighting an irregular warfare campaign, the United States must then take further steps to counter this campaign – specifically, it must engage.

As per a recent article from the original authors of the framework of irregular warfare, Drs. Marks and Ucko, any response to an irregular warfare threat requires a three-step approach:

First, if irregular strategies seek to exploit the economic, societal, and political vulnerabilities of target societies, it follows that those attacked must engage in effective and concerted political action and reform as a means of self-defense. ... Second, if narratives are central to irregular warfare, targeted states must amass the credibility and resonance to communicate clearly. ... Third, if irregular warfare blends disparate lines of effort, these must all be interrogated and countered as doggedly as the more high-profile use of violence.¹⁴⁰

If the United States is to match the IW strategy employed by China in space, it must engage “economic, societal, and political vulnerabilities” both domestically and internationally, build “credibility and resonance to communicate clearly,” and engage in multiple “disparate lines of effort.”¹⁴¹ It must do so by engaging in actions that invite other countries to become full partners in peer international cooperation, being transparent in its intentions and actions.¹⁴²

The critical vulnerability for China in the aerospace sector is control, and by

¹⁴⁰ Marks, Ucko. "Gray zone in red: China revisits the past." (2021). Pg 11

¹⁴¹ Id, 11-12

¹⁴² United States National Aeronautics and Space Administration, *Artemis Plan, NASA's Lunar Exploration Program Overview*, National Aeronautics and Space Administration (September 2020), 59, https://www.nasa.gov/sites/default/files/atoms/files/artemis_plan-20200921.pdf

extension, legitimacy. China seeks control so that it can surpass the United States and become a “strong space power (航天强国)”, by 2045, just in time for the 100th anniversary of the Communist Revolution in 2049.¹⁴³ The theory of victory for the United States is not the domination of space exploration in the foreseeable future and monopolistic exploitation of the resources in space. Instead, it should be to maintain legitimacy, and in turn, ensure long-term economic growth for the country and partners, ensure the physical security of the country, ensure proper governance via mutual collaborative policies on further exploration and utilization of resources, and establish long-term international collaboration and cohesion. In accomplishing this theory of victory, the United States should not engage in the standard response to irregular warfare, such as clear-hold-build, or find-fix-finish-exploit, as the strategic method. Instead, it should focus on engagement in an overall strategy of hold and build.

There are explicit assumptions that are made for the purposes of this strategic response and this response is drafted based on the laws and policies in effect at the time of writing. The first assumption is that China will continue to “wag[e] a protracted irregular warfare campaign to secure its core interests in Asia, grow its global power and influence, and challenge the legitimacy of the U.S.-led Western liberal order.”¹⁴⁴ Each side is fully aware of the potential strength, influence, and economic boon the aerospace industry can provide across the full spectrum of influence. Thus, dramatic capitulation by either side is unlikely. The second assumption is that space exploration will experience setbacks and losses, including losses to equipment and potentially, the tragic

¹⁴³ Pollpeter, Ditter, Miller, and Waidelich. "China's Space Narrative." 11

¹⁴⁴ Mittelmark, Cary. "Playing chess with the Dragon: Chinese-US competition in the era of irregular warfare." *Small Wars & Insurgencies* (2021): 1-24. 13 51 USC §20135. Property rights in inventions generally remain under the exclusive control and ownership of the United States Government.

loss of lives, such as the deaths of 23 American astronauts in three separate instances.¹⁴⁵ For the purposes of this paper, it is assumed that losses of life, if below an indeterminable threshold, will not result in the cessation of space exploration and it is also presumed the U.S. will continue to value a space exploration program. These assumptions are not guaranteed as changes in the perceived value of the space program could result in the curtailment of these programs, as is further explained later in this paper.

Broad assumptions and uncertainties exist but are beyond the scope of this response. For example, it is presumed that market fluctuations, including potential shocks, will occur and are anticipated. However, a sustained global economic generational collapse would similarly collapse societal structures, rendering this response strategy moot. Minor assumptions, such as presuming the continued advancement of technology and leaps in technology are inherent in this response. While technological advances cannot be certain, they can be predicted and anticipated.¹⁴⁶

China, especially in the aerospace industry, is seeking legitimacy and by extension, influence, and power. It seeks to increase its legitimacy by using a combination of credibility and propaganda across multiple lines of effort.¹⁴⁷ As illustrated by the inclusion of multiple space agencies on its Mars mission rockets, China's message is that it is only interested in being a full and equitable partner and it is willing to proceed in joint development of space exploration and technology.

¹⁴⁵ NASA Headquarters, Office of the Press Secretary. "President Bush Announces New Vision for Space Exploration Program." *The White House*, 14 Jan. 2004, <https://history.nasa.gov/Bush%20SEP.htm>.

¹⁴⁶ Bloch, Marcus. & Fenn, Jackie, (20 August 2018). Understanding Gartner's hype cycles. Gartner, Stamford, CT.(ID: G00370163).

¹⁴⁷ Marks and Ucko. "Gray zone in red: China revisits the past," 11-12.

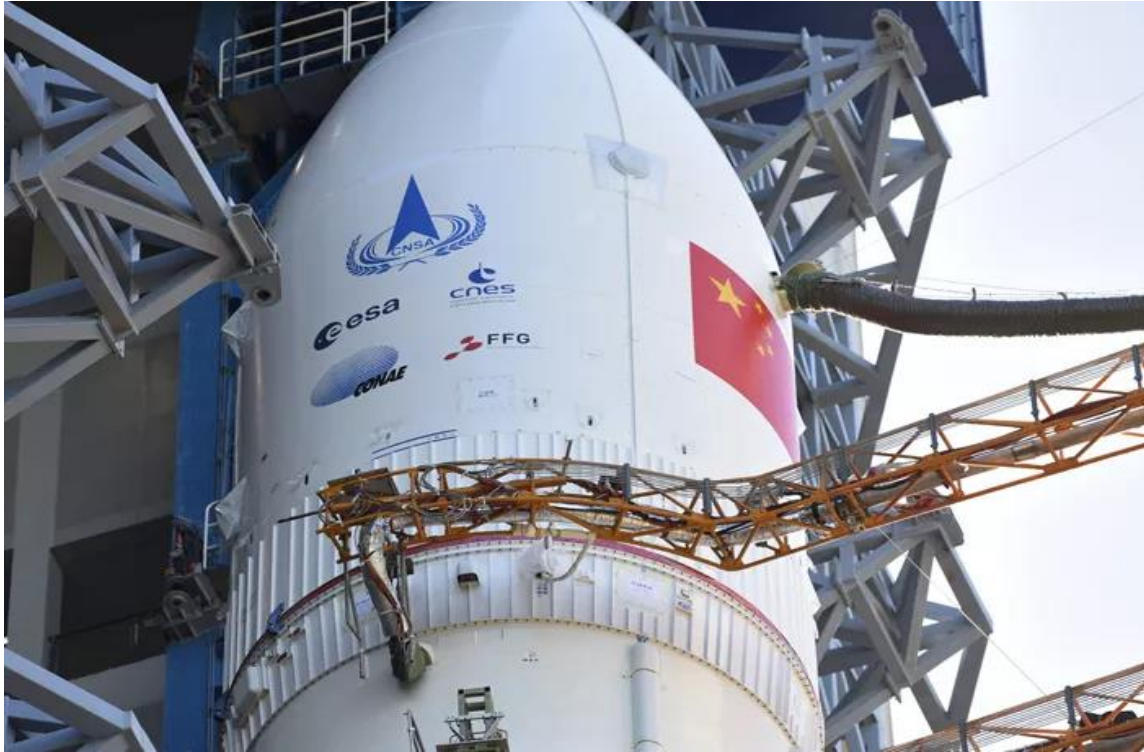


Figure 6 - Long March Booster System with Partner Agencies¹⁴⁸

As part of any response to an irregular warfare campaign, the U.S. must counter these narratives and properly “engage economic, societal, and political vulnerabilities” both domestically and internationally and this is critical in the space industry.¹⁴⁹ A recent paper indicates that irregular war with China must be “won from the inside out—built on a 21st-century foundation of social, environmental, and economic reforms, investments, and initiatives which revalidate the prevailing liberal-democratic approach to politics and economics, likely including steps to enhance the sharing of wealth and levels of economic justice inherent to the system.”¹⁵⁰ As part of winning from the “inside out,” the

¹⁴⁸ Tianwen-1— the Long March 5 booster system with multiple space agency logos. David, Leonard. “China’s Tianwen-1 Mars Rover Mission Gets a Boost from International Partners.” *Space.Com*, 22 July 2020, <https://www.space.com/china-mars-mission-tianwen-1-international-partners.html>. (Image credit: CNSA)

¹⁴⁹ Marks and Ucko. “Gray zone in red: China revisits the past.” 11-12.

¹⁵⁰ Mazarr, Michael. “The Essence of the Strategic Competition with China.” *PRISM*, vol. 9, no. 1, Oct. 2020, <https://nsa-demo.dod.afpims.mil/News-Features/Stories/Article-View/Article/2389522/the-essence->

author proposed recommitment by the United States in "international institutions, agreements, and processes."¹⁵¹ This approach is critical in the area of space exploration and the U.S. must recommit to being part of the international institutions and agreements governing this industry. For example, the U.S. must be an active participant on the UN Committee on the Peaceful Uses of Outer Space and engage on provisions of the Treaty of Outer Space.¹⁵²

By engaging with partners, U.S. legitimacy, both domestically and internationally, will increase, which will help address the “societal and political vulnerabilities” existing domestically in the United States and other countries.¹⁵³ Addressing these vulnerabilities can be part of winning from the “inside out” by framing the response in one word: unity.¹⁵⁴

Members of society, either on a micro or a macro level, have needs and when these needs are not being met, they will seek to have those needs fulfilled. Societal and political vulnerabilities arise from the government’s failure to meet those needs. In the United States, societal and political vulnerabilities are manifested by political discord and dissension. Although these manifestations may or may not be inflated, the fact that they manifest at all demonstrates that the vulnerabilities exist. The United States, and partner nations, can frame a response to quiet the internal discord by stressing unity and fulfilling the message and promise of unity with action. Focusing on space exploration, winning the space race, and benefiting from the outer space resources can help rally the residents

of-the-strategic-competition-with-china/. 17.

¹⁵¹ Ibid.

¹⁵² In Executive Order 13914, the US unilaterally declared that it did not find the Moon Agreement to be reflecting customary international law and that the US “does not consider [it] an effective or necessary instrument” See Executive Order 13914. White House. Executive Order on Encouraging International Support for the Recovery and Use of Space Resources, 6 April 2020.

¹⁵³ Marks and Ucko, “Grey zone in Red,” 9.

¹⁵⁴ Mazzar, Michael. “The Essence of the Strategic Competition with China”

of the country towards a common cause and goal.¹⁵⁵ This benefit to all of humanity will result in sustainable technological development and assist in global issues, including renewable alternative resources, green energy, and reduction of global waste. The narrative of unity to achieve these goals will be reinforced when the benefits of the industry are realized, economically, socially, and politically.

If the U.S. is successful at controlling the narrative, it will help ensure that domestic and international support is achieved, maintained, and advanced in any venture even if that venture serves both selfless and selfish purposes. Narratives are much more effective if the basis is a verifiable truth as “narratives are at the center of irregular warfare.”^{156,157} In the space sector, as well as in other sectors, China’s center of gravity/critical vulnerability is legitimacy - its credibility as the leader in the industry.¹⁵⁸ Credibility is causally related to legitimacy in this sector as China seeks to project the message that it has surpassed the United States in space technology and thus, as the legitimate leader, it should have the ability to shape the direction and application of both technology and laws in this arena. China seeks to promote its legitimacy in order to create a self-perpetuation cycle of compliance by potential partner nations as it is in these nation’s self-interest to accept the CCP’s narrative.¹⁵⁹

The United States already has immense credibility in the area of space exploration; however, it is losing the narrative information campaign against China, and,

¹⁵⁵ This was done when John F. Kennedy rallied the United States to allocate funds and resources to achieve a landing on the Moon during the September 12, 1962 speech at Rice University. See: Space Center Houston. “This Day in History: JFK Delivers Iconic ‘We Choose to Go to the Moon’ Speech,” September 9, 2019. <https://spacecenter.org/this-day-in-history-jfk-delivers-iconic-we-choose-to-go-to-the-moon-speech>.

¹⁵⁶ Marks and Ucko. "Gray zone in red." Pgs 8-9

¹⁵⁷ Mazarr, *The Essence of Strategic Competition*.

¹⁵⁸ Mittelmark, Cary. "Playing chess with the Dragon." 10.

¹⁵⁹ Mazarr, *The Essence of Strategic Competition*.

in turn, it is losing credibility and legitimacy. The U.S. must create and demonstrate more resonance that it is the legitimate, credible leader in the aerospace sector. This is part of the hold and build campaign which will be effective in countering China's disinformation campaign.¹⁶⁰ The release of NASA's Artemis Plan is an effort to build on that credibility and clearly communicate the United States' intentions. The Artemis Plan, released in September 2020, is NASA's outline of the U.S. lunar and Mars program over the next several decades, including the technology which will be developed to achieve the next phases.¹⁶¹ One of the most critical portions of the Artemis Plan is an appendix that contains a proposed international framework for space exploration, the Artemis Accords.¹⁶²

These accords demonstrate that the U.S. is seeking to engage international partners, provided each is willing to comply with the requirements of transparency, interoperability, and registration.¹⁶³ The U.S. must now implement those accords through deeds and actions by seeking partners as equals and offering these partners equal or better terms than China, especially to counter the large-scale Belt and Road initiative, the Space Silk Road initiative, and the Digital Silk Road initiatives.¹⁶⁴ There are now over 80 countries with a space program operating or in development.¹⁶⁵ Each of these countries has different levels of technology, resources, and needs and the U.S. can demonstrate its commitment to the international community and individual countries by extending

¹⁶⁰ Curtis, Jesse S. "Springing the 'Tacitus Trap': countering Chinese state-sponsored disinformation." *Small Wars & Insurgencies* (2021): 1-37., 10

¹⁶¹ NASA, *The Artemis Plan*, NASA's Lunar Exploration Program Overview, September 2020, https://www.nasa.gov/sites/default/files/atoms/files/artemis_plan-20200921.pdf

¹⁶² NASA, *The Artemis Plan*, Appendix 7, The Artemis Accords. 70.

¹⁶³ Id.; Joint Doctrine II-7

¹⁶⁴ Moran, Jerry. "Op-Ed | The next Space Race." *SpaceNews*, 23 Mar. 2021, <https://spacenews.com/op-ed-the-next-space-race/>.

¹⁶⁵ Sheetz, Michael. "The Space Economy Has Grown to over \$420 Billion and Is 'weathering' the Current Crisis, Report Says." *CNBC*, 30 July 2020, <https://www.cnbc.com/2020/07/30/space-economy-worth-over-420-billion-weathering-covid-crisis-report.html>.

tailored incentives to match an individual country's needs that also benefit all of humanity.¹⁶⁶

It has been suggested the United States could cooperate versus competing with China, especially in Africa, and the new policy by the Biden administration includes an approach "based largely on competition - economic and diplomatic - but it is also prepared to alternately cooperate or confront Beijing when necessary."¹⁶⁷ This approach has merit in the space industry, however, there are pitfalls. If the U.S. engages in a joint venture, it could provide greater legitimacy by unintentionally signaling that the U.S. sees China as an equal in this sector.¹⁶⁸ Further, there is a significant risk when cooperating on space exploration technology as any advances made would be at risk of intellectual property theft.

As a final approach to countering the irregular warfare being engaged by China in the arena of outer space, the United States must engage in multiple "disparate lines of effort."¹⁶⁹ on a global scale with existing and new allies.¹⁷⁰ The response by the United States must include the lines of effort necessary in any IW strategic response – it must include political, strategic violence, non-violence, allies, and international support lines

¹⁶⁶ For example, it has been suggested that "Pooling development resources of foreign partners is essential to challenge BRI and economic disinformation. U.S. government foreign assistance request for FY2021 is nearly USD 29 billion.¹²³ The newly reorganized U.S. International Development Finance Corporation (DFC) adds an additional USD 60 billion in investment resources to the campaign and seeks to attract additional private-sector investment to international assistance.¹²⁴ The United States and its partners should selectively compete with China for development projects while continuing to insist that foreign assistance contract financing and terms meet international transparency norms." See, *Springing the Tacitus Trap*; p. 17. An example of such a program would be to develop a satellite program in Sudan to monitor and predict drought conditions. This would allow farmers to cultivate before extreme drought conditions and allow international food organizations to coordinate relief in hard-hit areas before the needs become critical.

¹⁶⁷ Jakes, Lara. "In First Talks, Dueling Accusations Set Testy Tone for U.S.-China Diplomacy." *The New York Times*, 19 Mar. 2021, <https://www.nytimes.com/2021/03/18/us/politics/china-blinken-sullivan.html>.

¹⁶⁸ Curtis, Jesse S. "Springing the 'Tacitus Trap.'" 17.

¹⁶⁹ Marks and Ucko. "Gray zone in red: China revisits the past." 1-24.11-12

¹⁷⁰ Mittelmark, Cary. "Playing chess with the Dragon." 12.

of effort.¹⁷¹

A political response is necessary as China is already attempting to establish a counter-state by engaging in efforts to build a “space society,” increasing “space accessibility” and engaging in “space diplomacy.”¹⁷² Violence, through the theft of US-developed technology, although not military in nature, is already occurring and it is equally as damaging as military action as the theft can result in the displacement of a U.S. company or allowing China to gain military superiority on a weapon.¹⁷³ The U.S. Department of Justice estimates that “80% of its economic espionage cases” and “60% of trade secret cases involve China.”¹⁷⁴ As there is a significant amount of overlap between the private sector and the Chinese military, every theft of intellectual property will increase Chinese military might. The U.S. must aggressively counter this action by all means necessary, or risk being made militarily obsolete. China continues to conduct military actions in space, which illustrates it can engage in violence, if necessary. Violence could include direct actions against U.S. satellites, including a jamming or a dazzle attack which would blind U.S. systems, or the obliteration of a satellite, which China demonstrated it could do in 2007.¹⁷⁵ The U.S. must anticipate and counter these technologies and be prepared to engage in escalated and targeted violence if necessary.

¹⁷¹ <https://ndupress.ndu.edu/Portals/68/Documents/strat-monograph/crafting-strategy-for-iw.pdf?ver=2020-07-02-111410-093>

¹⁷² Xinjun, Li. “Realizing SPACE 2030 Through Multi-Lateral Cooperation,” 1–46. Dubai, UAE: UN/UAE0HLF, 2017. https://www.unoosa.org/documents/pdf/hlf/HLF2017/presentations/Day3/High_Level_Panel/1st/Presentation4.pdf.

¹⁷³ Laufman, David, et al. “The Department of Justice’s National Security Division Chief Addresses China’s Campaign to Steal U.S. Intellectual Property.” *The National Law Review*, vol. X, no. 237, Aug. 2020, <https://www.natlawreview.com/article/departments-justice-s-national-security-division-chief-addresses-china-s-campaign-to>.

¹⁷⁴ Laufman, David, “China’s Campaign to Steal U.S. Intellectual Property.”

¹⁷⁵ Wood, Peter, et. al. “China’s Ground Segment”, 11, 12 discussing Shanahan: China Is Deploying Directed Energy Weapons,” <https://breakingdefense.com/2019/04/Shanahan-China-Is-Deploying-Directed-Energy-Weapons/>.

The economic line of effort is perhaps the most important and a line of effort which could be considered violent or non-violent, depending on how it is employed, and crosses several of the other lines of effort. The United States is and should continue to engage in efforts to build upon and expand the economic benefits associated with the aerospace industry both domestically and internationally. Globally, investment in the space industry is estimated to be \$423.8 billion, increasing more than 70 percent in the last 10 years, and the space industry alone employs more than 200,000 Americans.¹⁷⁶ It is conservatively estimated that annual revenue from the global aerospace industry will increase to between \$1 trillion and \$2.4 trillion by 2040.¹⁷⁷ Economic lines of effort should include international cooperation such as:

- Developing global technology partnerships where each country can freely transfer and transport technology (Such as a free trade zone for technology)
- Countering or engaging with competing international organizations, such as the Asia Pacific Space Cooperation Organization or the Russian controlled organization, Intersputnik¹⁷⁸
- Using more ground stations and launch from different locations using multiple launch platforms¹⁷⁹
- Sharing space facilities with other nations - especially on research with applications of this research to be used by participating countries
- Developing shared telemetry facilities and sharing use of these facilities
- Sharing data
- Freely providing technology transfers of “building blocks” of space development programs and data for partner countries
- Enhancing “humanitarian” uses for technology applications and provide this

¹⁷⁶ “Key Topics – Office of Space Affairs.” *United States Department of State*, <https://www.state.gov/key-topics-office-of-space-affairs/>. Accessed 31 Mar. 2021.; Sheetz, Michael. “The Space Economy Has Grown to over \$420 Billion and Is ‘weathering’ the Current Crisis, Report Says.” *CNBC*, 30 July 2020, <https://www.cnbc.com/2020/07/30/space-economy-worth-over-420-billion-weathering-covid-crisis-report.html>.

¹⁷⁷ “Space: Investing in the Final Frontier.” *Morgan Stanley*, <https://www.morganstanley.com/ideas/investing-in-space>. Accessed 31 Mar. 2021.; Sheetz, Michael. “The Space Industry Will Be Worth Nearly \$3 Trillion in 30 Years, Bank of America Predicts.” *CNBC*, 31 Oct. 2017, <https://www.cnbc.com/2017/10/31/the-space-industry-will-be-worth-nearly-3-trillion-in-30-years-bank-of-america-predicts.html>.

¹⁷⁸ Intersputnik currently has 29 member countries - none in Africa or the Americas.

¹⁷⁹ This would be in direct counter to China’s development of ground stations. Wood, Peter; Stone, Alex; Lee, Taylor A., *China’s Ground Segment, Building the Pillars of a Great Space Power*, ISBN 9798719347652, China Aerospace Studies Institute, March 1, 2021. https://www.airuniversity.af.edu/Portals/10/CASI/documents/Research/Space/2021-03-01%20Chinas%20Ground%20Segment.pdf?ver=z4ogY_MrxaDurwVt-R9J6w%3d%3d

information to economically partnered countries (such as environmental disaster warnings, water location technology, weather conditions affecting agriculture)

The multiple disparate lines of effort must utilize the entire spectrum of influence including the “military, informational, diplomatic, financial, intelligence, economic, law, and development (MIDFIELD)”¹⁸⁰ methods of influence. While each of these lines of effort can be developed in the future by greater analysis, the means to engage will include:¹⁸¹

- Increased budgets for governmental entities to develop space technology
- Advanced Technology Acquisition and Development Processes
- Technological and Flight personnel
- Data Development/Collection
- Telemetry Ground Stations and Launch pads
- International Partners and International Organizations
- Domestic and International Media Access/Shaping Campaign
- International Organizational control¹⁸²

Implementation of each of the lines of effort cannot be conducted in a dilatory or episodic manner. Some of the reasons for the initial success of China’s space program is "top-level leaders' recognition of the benefits of space power, consistent planning, and stable and ample funding." ¹⁸³ The U.S. must match this with long-term consistent planning across multiple agencies and partners.

All three branches of government must support these lines of effort and the Executive Branch must take an active role in leading and guiding these lines of effort. The Executive Branch leadership, with robust bipartisan support, will be critical as the

¹⁸⁰ Joint Chiefs of Staff. (2018). *Strategy* (JDN 1-18), II-8, 1-17.

¹⁸¹ This list could be much more comprehensive if developed with the prominent countries the US would like to engage. The list could then be implemented bilaterally.

¹⁸² This is not to say that sharing should be done in areas that could result in a significant detriment to the United States. For example, we may prefer not to share the information which could be used militarily.

¹⁸³ Pollpeter, Kevin, Timothy Ditter, Anthony Miller, and Brian Waidelich. "China’s Space Narrative." China Aerospace Studies Institute, (2020). <https://www.airuniversity.af.edu/Portals/10/CASI/Conference-2020/CASI%20Conference%20China%20Space%20Narrative.pdf?ver=FGoQ8Wm2DypB4FaZDWuNTQ%3d%3d,7>

IW strategic response must not become mired in legislative partisan politics but must instead cut across party lines, engaging with multiple government agencies such as: NASA, Department of Defense, Department of Commerce, including the National Oceanic and Atmospheric Administration, Department of State (especially the Office of Space Affairs), the Department of Energy, the Environmental Protection Agency, the Department of Transportation. Most importantly, the Executive Branch must lead the initiatives with broad bipartisan support from Congress.^{184,185} Further, U.S. governmental agencies cannot carry the entire burden of development. Instead, private companies, both large and small, must be involved in developing different aspects of the space program, including companies in non-traditional space industries, such as the mining and agriculture industries, as these areas will be applicable when the lunar and Mars gateway sites are developed.

Once the proper branches of government and organizations are engaged, there must be a system of metrics to capture if these organizations efforts are effective. There are three ways to capture the metrics of the United States' influence in the Space program: valuation, value, and values. Tracking the metrics of value, valuation and values will help the U.S. determine the effectiveness of the lines of effort, reshape the framing narrative, and promote a better understanding of the strategies of the ends, ways, and means of implementing the program.

Calculating the valuation of the impact of the aerospace industry to the United

¹⁸⁴ The Dept. of Energy provided the power system for the Perseverance. See [mars.nasa.gov](https://mars.nasa.gov/news/8865/touchdown-nasas-mars-perseverance-rover-safely-lands-on-red-planet). “Touchdown! NASA’s Mars Perseverance Rover Safely Lands on Red Planet.” *NASA’s Mars Exploration Program*, <https://mars.nasa.gov/news/8865/touchdown-nasas-mars-perseverance-rover-safely-lands-on-red-planet>. Accessed 31 Mar. 2021.

¹⁸⁵ Bjork, Charles. *Guides: Space Law: The Law of Outer Space: Other U.S. Government Agencies Involved in Space Policy & Regulation*. <https://guides.ll.georgetown.edu/c.php?g=1037047&p=7762102>. Accessed 31 Mar. 2021.

States and its partners is quantifiable, easily captured, and involves every aspect of this industry, from investment to impact, are already calculated by a series of companies. For example, one of the leaders in technology analytics reports and solutions, the Bryce Firm, tracks publicly reported seed, venture, and private equity investment in start-up space ventures and estimates that \$5.7 billion was invested in 2019 and an additional \$1.6 trillion funds remain available.¹⁸⁶ Its methodology captures publicly reported information, qualitative data, and insider/industry disclosures.¹⁸⁷ The relatively public nature of these transactions enables metrics to be captured and calculated on an ongoing basis. By capturing the valuation of the aerospace industry, the U.S. can ensure spending parity with similarly situated countries, determine the cost-effectiveness of each line of effort, and most importantly, quantifiably and credibly illustrate the impact of the industry for partners, bolstering the narrative and increasing legitimacy.

Calculating the value of international cooperation is more difficult to determine. However, it can be captured by looking at the level of cooperation with partners, the number of formal bilateral agreements, as well as capturing the metrics of the U.S. influence in “global rules and norms as established in international law, conventions, and practice.”¹⁸⁸ China routinely releases its success in collaboration with partners by noting the number and nature of agreements, the number of collaborative research projects and the number of personnel engaged in mutual exchanges. For example, as part of its White Paper released in 2016, China indicated that from 2011 to the time of the release in

¹⁸⁶ Bryce Space and Technology. "Start-Up Space: Update on Investment in Commercial Space Ventures." (2020).

¹⁸⁷ Ibid, 1, 2 Note, according to Bryce, its investment data includes: seed, venture, private equity, acquisition, debt financing, and initial public offering but generally DOES NOT include government funding.

¹⁸⁸ Mazarr, Michael. "The Essence of the Strategic Competition with China." *PRISM*, vol. 9, no. 1, Oct. 2020, <https://nsa-demo.dod.afpims.mil/News-Features/Stories/Article-View/Article/2389522/the-essence-of-the-strategic-competition-with-china/>.

February 2017, it had signed 43 space cooperation agreements or memoranda of understanding with 29 countries, space agencies, and international organizations.¹⁸⁹ The U.S. can utilize the same metrics and capture the diversity of its partnership agreements.¹⁹⁰ Further, it can capture the value of mutual exchanges of personnel with partner countries, which can also serve to provide a forum for cultural exchange and understanding of and propagation of American values.

The success of exporting American values is difficult to track but arguably even this metric can be quantifiably measured. The values of the United States, include “global political and economic values such as democracy, liberal economic policies, free trade, and human rights. These could be measured by such yardsticks as the total number of regimes reflecting certain values, indices of political and economic freedom, and public opinion polling on favored values.”¹⁹¹ The tracking of these metrics would demonstrate the global advancement of the shared values of the United States between partner countries. In addition, tracking these metrics will help to ensure these values were adopted by willing partners based upon the internalized understanding that these values can promote innovation, economic success, and ultimately, legitimacy.¹⁹²

The metrics on influence in the legal sector, both domestically and internationally, must be tracked to ensure the U.S. does not lose the non-violent “lawfare” line of effort

¹⁸⁹ People’s Republic of China Information Office of the State Council, “China’s Military Strategy,” Xinhua, May 26, 2015, National Security Situation, http://eng.mod.gov.cn/DefenseNews/2015-05/26/content_4586748.htm.

¹⁹⁰ Currently, there are only 8 countries that have signed these accords. “Eight Countries Sign Artemis Accords.” *SpaceNews*, 13 Oct. 2020, <https://spacenews.com/eight-countries-sign-artemis-accords/>.

¹⁹¹ Mazarr, Michael. “The Essence of the Strategic Competition with China.” *PRISM*, vol. 9, no. 1, Oct. 2020, <https://nsa-demo.dod.afpims.mil/News-Features/Stories/Article-View/Article/2389522/the-essence-of-the-strategic-competition-with-china/>.

¹⁹² *Ibid.*

where international laws are shaped in opposition to U.S. interests.¹⁹³ Internationally, metrics include tracking the number of Chinese officials in key positions in international agencies, such as the UN Committee on Space Exploration, policies promulgated by these agencies, and cases or disputes heard on these policies. International law will typically turn to the “norms” and “customary international law” as precedent when deciding issues of first impression. If cases, treaties, policies, and briefs contain only China’s viewpoint or were decided by Chinese officials, it creates precedent and “norms” counter to U.S. positions. Thus, the personnel, policies, cases, treaties, and briefs across international organizations must be tracked and countered.

Domestically, the U.S. must track, develop, and pass laws that will promote the use of standards in the industry, including production and data sharing. The laws/policies regarding the application of technology must keep pace with technology development.¹⁹⁴ If technologies are invented but an antiquated law prevents application, it will stifle further technical innovation and use. Currently, despite the incredibly fast-paced technological change, most federal regulations are seldom updated and there is a significant amount of time lag between technological change and meaningful regulation.¹⁹⁵ Given the scope and speed of technological changes, the United States cannot passively react and change laws when a societal issue is brought to the forefront of public perception but must instead track the current legislation and incentives to ensure

¹⁹³ In this context, the term lawfare is not used to connote actions by one government or entity attempting to paralyze target governments by forcing them to respond to a myriad of real or imaginary actions such as human rights violations. Instead, it refers to the attempts to influence the controlling legal authorities or entities to adopt laws most favorable to accomplishing the goals of a nation. For example, having an international body determine that any country can increase its borders by creating islands would immediately legitimize China’s actions in the South China Sea.

¹⁹⁴Ennis, Henry, Alan Estevez, Joe Mariani, Jessica Moran, and Joe Pauloski. “National Security and Technology Regulation.” Deloitte. July 12, 2019. <https://www2.deloitte.com/us/en/insights/industry/public-sector/national-security-technology-regulation.html>. 9.

¹⁹⁵ Ibid, 7.

each facilitates the desired outcomes in the multiple lines of effort.¹⁹⁶

After the proper metrics are determined to ensure an effective response, the timing of when to begin each phase and line of effort must be established. In the present case, the timing of each phase of the line of effort is already established by both China and by the United States. China's's timeline for space domination is detailed in various sources and the U.S. must match or exceed this timeline in order to maintain legitimacy. As per the report discussed earlier [f]rom 2020 to 2035, the CCP plans to significantly increase China's economic, scientific, and technological strength and plans for it to be one of the most technologically innovative countries and with greatly enhanced soft power."¹⁹⁷ By 2050, China seeks to "occupy the high end of the global space economy industrial chain" and be the dominant country in the space race "with a space program that supports the country's full range of scientific, technological, economic, and military development needs."¹⁹⁸

China's phases for development can be countered by NASA's Artemis Program, which already strategically matches China's timelines for technological developments and space exploration. According to the Artemis Plan, the first phase is returning astronauts to the moon in 2024 as the moon is the "cornerstone for continued building up of space exploration."¹⁹⁹ The country which successfully returns a crew to the moon will

¹⁹⁶ *Values and the Fourth Revolution the Dots Between Value, Values, Profit and Purpose*, World Economic Forum, 2016, pp. 1–36.http://www3.weforum.org/docs/WEF_Values_and_the_Fourth_Industrial_Revolution_WHITEPAPER.pdf.

¹⁹⁷ "Space Narrative," 9 quoting "Xi Jinping's Speech at the 19th Congress of the Chinese Communist Party."

¹⁹⁸ *Ibidd*, 6, quoting "Strong Space Power: "Our journey is the Sea of Stars"."; Hu Wei, "CASC: To Strive to Push China to Forward Ranks of Strong Space Powers by 2030," (Zhongguo hangtian keji jituan: jiang lizheng dao 2030 nian tuidong woguo jishen shijie hangtian qiangguo xinglie; 中国航天科技集团: 将力争到2030年推动我国跻身世界航天强国行列), Xinhua, (Xinhua; 新华), June 27, 2019, http://www.xinhuanet.com/science/2019-06/27/c_138177326.htm According to the report, The goal is "60 percent of the economy will be based upon technology, including the aerospace industry."

¹⁹⁹ NASA *Artemis Plan*, 32, Appendix 1

immediately establish legitimacy in both the aerospace field and as a leader in space exploration. The Artemis plan will ensure the United States will be the first country to do so since 1972.²⁰⁰ A strategically placed lunar base, such as at the South Pole, near the Shackleton Crater, near the massive deposits of Helium 3, or in the Von Kaman crater where a large deposit of iron and rare earth minerals are contained, will be critical to further exploration and potential utilization of the lunar resources.²⁰¹ Continued phases are outlined in Appendix 3 of the Artemis plan and include building upon the current technology for exploration, monitoring, and operating in space.

The United States must seek additional partners in each of these phases, including establishing a lunar base. As discussed earlier, originally, it was presumed that Russia would be a strategic partner, especially in sharing airlock technology²⁰² However, as of February 2021, Russia and China have established a partnership to establish a lunar base.²⁰³ Instead of seeing this as a defeat, the U.S. could use this as an opportunity to engage with other strategic partners in Europe, such as the European Space Agency, or to further cement relationships with the British or any of the five intelligence sharing allied countries, collectively known as the “5 Eyes” or the “6 Eyes” if Japan joins the collective.²⁰⁴ In addition, a better approach would be to also seek other partners in Africa, such as Kenya or Ethiopia, to counter China's influence in both countries through the

²⁰⁰ Ibid, 22.

²⁰¹ Ibid, 27.

²⁰² Office of Inspector General, NASA's Management of the Gateway Program for Artemis Missions, IG-21-004, National Aeronautics and Space Administration, November 10, 2020, 7, <https://oig.nasa.gov/docs/IG-21-004.pdf>; Roulette, Joey. “Pivoting from NASA, Russia Partners with China for Lunar Space Station.” *The Verge*, 9 Mar. 2021, <https://www.theverge.com/2021/3/9/22321114/lunar-moon-space-station-russia-china-agreement-nasa>.

²⁰³ Roulette, Joey, “Pivoting from NASA.”

²⁰⁴ Panda, Jagannath, and Ankit Panda. “RESOLVED: Japan Is Ready to Become a Formal Member of Five Eyes.” *Center for Strategic and International Studies: Debating Japan* (blog), December 8, 2020. <https://www.csis.org/analysis/resolved-japan-ready-become-formal-member-five-eyes>.

Malindi Test and Control Station in Kenya and the ground stations/launching facilities in Addis Abba, Ethiopia.

If the U.S. engages multiple countries in Africa, it must treat them as legitimate, equal partners at the inception and continue to build these relationships during the next phases of space exploration: a lunar station and gateway followed by a crewed mission to Mars by the 2030s.²⁰⁵ By engaging with partnerships with African Union nations, the technology developed in the multiple phases of the Artemis plan – such as improved communication, habitat development, autonomous operations, navigation improvements, sustainable power generation, robotics, and in-situ resource generation - can be equally shared.²⁰⁶ As the partners will have a vested interest in continued exploration, it would be anticipated each partner would continue to help shape international policy favoring the values shared with the U.S. Furthermore, the additional relationships will credibly demonstrate that the U.S. is not interested in global domination and conquest over smaller countries. This will further build the legitimacy of the U.S. as a valued partner.

Building and maintaining the legitimacy of the U.S. as a global partner is not without risks and each risk must have a mitigation plan. There is a risk as to the suitability, feasibility, and acceptability of each line of effort as well as the timing for implementation.²⁰⁷ It must be assumed that the strategies will be suitable and effective, subject to continued monitoring and changes to ensure success. Focus must then turn to the other areas of evaluation of risks and mitigation - specifically, feasibility and acceptability.²⁰⁸

²⁰⁵ NASA, *Artemis Plan*, 59.

²⁰⁶ See NASA, *Artemis Plan* – Appendix 3: Core Mission Elements.

²⁰⁷ JDN 1-18, IV-3.

²⁰⁸ JDN 1-18, IV-3

The first feasibility risk is if the United States does not have the appetite to implement these strategies before 2050 to effectively counter China's timeline. This feasibility risk is high due to the shifting priorities of the American people. The current NASA Artemis Project is a reinvigoration of the Constellation Program which was developed under the George W. Bush administration in 2004, and which had a goal of landing a crew on the moon by 2020, followed by a crewed Mars landing.²⁰⁹ The Constellation Program was effectively terminated under the Obama Administration in 2010 and the focus was changed to the pay as you go approach, asteroid exploration, and eventual exploration of Mars.²¹⁰ The current domestic situation of the United States or a shift away from globalization may cause a shift of political will, resulting in the space program being gutted budgetarily, killing each line of effort.

The next risk in feasibility is if the United States can afford, both monetarily and socially, to engage in these lines of effort. Each line of effort and each phase will bring an increase in costs of treasure and blood. The Artemis Plan estimates that Phase 1, the return of humans to the moon, will cost the United States almost \$2.8 billion from FY 21 to FY25.²¹¹ In addition, as discussed previously, there will possibly be a loss of life in embarking on these perilous journeys. The third risk is associated with acceptability - does the strategic plan align with the goals of the country as well as with the values of the

²⁰⁹ NASA Headquarters, Office of the Press Secretary. "President Bush Announces New Vision for Space Exploration Program."

²¹⁰ Morgan, Daniel. "NASA: Issues for Authorization, Appropriations, and Oversight in the 113th Congress." Retrieved September 11 (2013): 2014. Moring, Frank. "Constellation Is Dead, But Pieces Live On." *Aviation Week*, 26 Oct. 2010, [http://www.aviationweek.com/aw/generic/story_channel.jsp?channel=space&id=news%2Fawx%2F2010%2F10%2F22%2Fawx_10_22_2010_p0-264465.xml&headline=Constellation%20Is%20Dead%2C%20But%20Pieces%20Live%20On.](http://www.aviationweek.com/aw/generic/story_channel.jsp?channel=space&id=news%2Fawx%2F2010%2F10%2F22%2Fawx_10_22_2010_p0-264465.xml&headline=Constellation%20Is%20Dead%2C%20But%20Pieces%20Live%20On.;); Notably, the appropriations bill requires a "pay as you go" approach with launch and crew systems to be "scaled to the minimum necessary to meet the core national mission capability needed to conduct cislunar missions." This approach may have deliberately or inadvertently led to a greater development of the private commercial space programs.

²¹¹ https://www.nasa.gov/sites/default/files/atoms/files/artemis_plan-20200921.pdf, pg 53

country? Domestic concerns and increased activism on social issues may be signaling a change in the values of the United States away from being a leader in space programs.

The risks associated with feasibility and acceptability can be mitigated by full transparency on all the lines of effort, including the monetary costs, the actions taken when/if there are accidents, and matching the program to American values. Transparency as to the costs can help ensure credibility, especially when considering the return on investment and the considerable economic and technological benefits. The costs of the return to the moon are high, however, this is a nominal amount when compared to the \$28 billion (\$283 billion in today's dollars) which was spent on the space program between 1960 and 1973, and the return on this investment has yielded the current \$423.8 billion space economy with the potential for growth to \$2.4 trillion by 2040.^{212,213} As to the potential for a loss of life, the safety of all astronauts and other participants is, and will always remain, paramount. Any loss of life will be tragic and must be mitigated. However, simultaneously, the space programs must prepare for this eventuality, be transparent if there are mistakes that could have been avoided, be transparent in accountability for these mistakes, and be transparent in steps taken to correct deficiencies. Regarding the goals of the program matching American values and interests, the U.S. has traditionally held a fundamental desire to be the leader in space and it is a source of national pride that it was the first country to land a person on the moon. This national

²¹² "Space: Investing in the Final Frontier." *Morgan Stanley*, <https://www.morganstanley.com/ideas/investing-in-space>. Accessed 31 Mar. 2021.; Sheetz, Michael. "The Space Industry Will Be Worth Nearly \$3 Trillion in 30 Years, Bank of America Predicts." 1 Mosher, David Anderson, Bob Hunt, Dave. "NASA's \$30 Billion Artemis Missions Will Attempt to Set up a Moon Base." *Business Insider*. Accessed April 5, 2021. <https://www.businessinsider.com/nasa-artemis-moon-base-apollo-space-rocket-sls-2019-9>.

²¹³ Dreier, Casey. "How Much Did the Apollo Program Cost?" *The Planetary Society*, June 16, 2019. <https://www.planetary.org/space-policy/cost-of-apollo>. CASI report, 15, citing Space Foundation, *The Space Report 2018*, p. 8. and "SCIO briefing on China's 1st National Day of Space Flight," [china.org.cn](http://www.china.org.cn/china/2016-04/23/content_38309726.htm), April 23, 2016, http://www.china.org.cn/china/2016-04/23/content_38309726.htm.

pride has seen a resurgence throughout the last few years and strategic messaging should be tailored to demonstrate how the program is an extension of this pride. This will further mitigate the risk the U.S. will turn away from the space program to focus on domestic/social issues. Further, a narrative must be widely disseminated both internationally and domestically which credibly illustrates that the United States is a respectful global partner as opposed to a dominating hegemonic predator. This can be most easily accomplished by being fully transparent on the sharing of technology and applications which will apply to multiple humanitarian issues. Thus, transparency in each area will ensure public support and cement U.S. leadership in space exploration.

There is a significant risk that partner nations will not choose to work with the United States, or, if forced into a binary choice of choosing the U.S. over China, would choose China. This area should be explored further as there are areas in which the U.S. could potentially collaborate with China, mitigating the risk that China will be the sole partner of choice for other nations. Mitigation can also occur by engaging in selective collaboration. For example, just because one country chooses China for one aspect of a project does not mean that it will choose China for the whole project. The U.S. could engage in introductory projects, such as assisting with launching platforms, which would continue the collaboration. Further, if successful in the various lines of effort, the U.S. should not need to engage in the rhetoric of a forced binary choice but instead will have regained legitimacy which will provide multiple reasons why one country would prefer to work with the United States as the partner of choice.

CHAPTER 5: CONCLUSION

China is using the space and lunar programs as instruments of irregular warfare (IW) to gain legitimacy. These programs further have the dual capability to build a strong base of power and influence with multiple partners as part of China's soft power projection. China is engaging in multiple lines of effort across multiple instruments of national influence in the space industry to challenge the U.S. in this sector, and thereby is seeking to displace the U.S. through implementation of this portion of its overall campaign. If it wins in this campaign effort, China will be the leader in the next generation of military technology, the leader in the international aerospace and space industry, and the country with the strongest and most influential economy in the world. In short, if it wins the space race, it gains the legitimacy, power, and influence it desires.

The United States must recognize the campaign for what it is and craft an appropriate response based upon countering an irregular warfare strategy. It must hold the legitimacy it already has in the space sector by engaging in multiple lines of effort including political action and reform.²¹⁴ It must build its space program over a sustained period with multiple partners as this will provide credibility to the narrative that the United States is interested in seeking respectful partnerships which provide mutual benefits. By engaging, the U.S. will hold and build legitimacy and continue to lead the world in its journey to the stars.²¹⁵

²¹⁴ Marks, Thomas A., and David H. Ucko. "Gray zone in red: China revisits the past." (2021): 1-24. Pg 11

²¹⁵ Id.

BIBLIOGRAPHY:

- 5 Big Ideas for Making Fusion Power a Reality - IEEE Spectrum.” IEEE Spectrum: Technology, Engineering, and Science News. Accessed December 8, 2020.
<https://spectrum.ieee.org/energy/nuclear/5-big-ideas-for-making-fusion-power-a-reality>
- BBC, China Moon Mission Lands Chang’E-4 Spacecraft on Far Side.” *BBC News*, January 3, 2019, China Moon Mission edition, sec. Science & Environment.
<https://www.bbc.com/news/science-environment-46724727>
- Borowitz, Mariel. “Earth Observing Satellites and Open Data Sharing in China.” *China Research Center* (blog), February 5, 2020.
- Bowe, Alexander.”*China’s Pursuit of Space Power Status and Implications for the United States.*” US-China Economic and Security Review Commission, 2019.
- Brown, Michael, and Pavneet Singh. "China’s technology transfer strategy." *Silicon Valley, CA: Defense Innovation Unit Experimental Report* (2018).
- Bjork, Charles. “Guides: Space Law: The Law of Outer Space: Other U.S. Government Agencies Involved in Space Policy & Regulation.” Accessed March 31, 2021.
<https://guides.ll.georgetown.edu/c.php?g=1037047&p=7762102>
- Cheng, Dean. “China’s Military Role in Space.” *Strategic Studies Quarterly* 6, no. 1 (Spring 2012): 55-77 (23 pages).
https://www.jstor.org/stable/26270790?seq=1#metadata_info_tab_contents.
- CNSA.gov.cn/english. “China National Space Administration,” May 24, 2018.
<http://www.cnsa.gov.cn/english/n6465645/n6465650/c6768437/content.html>.
- ChinaPower Project. “What’s Driving China’s Race to Build a Space Station?,” December 7, 2016. <http://chinapower.csis.org/chinese-space-station/>.
- China Public Private Partnerships Center. “Guiding Opinions of the State Council on Innovating the Investment and Financing Mechanisms in Key Areas and Encouraging Social Investment.” China Public Private Partnership Council, November 16, 2014.
<http://www.cpppc.org/en/zy/994006.jhtml>.
- Clark, Stephen. “China Successfully Launches Earth-Imaging Satellite for Venezuela – Spaceflight Now,” October 9, 2017. <https://spaceflightnow.com/2017/10/09/china-successfully-launches-earth-imaging-satellite-for-venezuela/>.
- Clark, Stephen. “NASA Lays out \$28 Billion Plan to Return Astronauts to the Moon in 2024 – Spaceflight Now.” Spaceflightnow.com, September 21, 2020.
<https://spaceflightnow.com/2020/09/21/nasa-lays-out-28-billion-plan-to-return-astronauts-to-the-moon-in-2024/>. english.spacechina.com. “Company Profile.” Accessed April 11, 2021. <http://english.spacechina.com/n16421/n17138/n17229/index.html>.
- Curtis, Jesse S. “Springing the ‘Tacitus Trap’: Countering Chinese State-Sponsored Disinformation.” *Small Wars & Insurgencies*, February 21, 2021, 1–37.
<https://doi.org/10.1080/09592318.2021.1870429>.

- David, Leonard. "China's Tianwen-1 Mars Rover Mission Gets a Boost from International Partners." *Space.com*, July 22, 2020. <https://www.space.com/china-mars-mission-tianwen-1-international-partners.html>.
- David, Leonard. "China Wraps Up 1-Year Mock Moon Mission to Lunar Palace 1." *Space.Com*, 17 May 2018, <https://www.space.com/40612-china-lunar-palace-1-mock-moon-mission.html>.
- Deeks, Russell. "The Digital Silk Road - China's \$200 Billion Project." *BBC Science Focus Magazine*, 12 Aug. 2020, <https://www.sciencefocus.com/future-technology/the-digital-silk-road-chinas-200-billion-project/>;
- Dilmegani, Cem. "AI in Government: Applications, Challenges & Best Practices [2021]." *AIMultiple.com*, December 6, 2020. <https://research.aimultiple.com/ai-government/>.
- Dreier, Casey. "How Much Did the Apollo Program Cost?" *The Planetary Society*, June 16, 2019. <https://www.planetary.org/space-policy/cost-of-apollo>.
- SpaceNews. "Eight Countries Sign Artemis Accords," October 13, 2020. <https://spacenews.com/eight-countries-sign-artemis-accords/>.
- Emewu, Ikenna. "China Plans to Carry out 40 Space Launches in 2020." *AFRICA CHINA ECONOMY* (blog), January 21, 2020. <https://africachinapresscentre.org/2020/01/21/china-plans-to-carry-out-40-space-launches-in-2020/>.
- Ennis, Henry, Alan Estevez, Joe Mariani, Jessica Moran, and Joe Pauloski. "National Security and Technology Regulation." *Deloitte*, July 12, 2019. <https://www2.deloitte.com/us/en/insights/industry/public-sector/national-security-technology-regulation.html>.
- ESA. "Bricks from Moon Dust." *The European Space Agency*, 20 Aug. 2018, https://www.esa.int/Science_Exploration/Human_and_Robotic_Exploration/Exploration/Bricks_from_Moon_dust.
- Fravel, M. Taylor. *Active Defense: China's Military Strategy Since 1949*. Princeton University Press, 2019.
- Gabriel Alvarado, Mark Stokes, Emily Weinstein, and Ian Easton. "China's Space and Counterspace Capabilities and Activities." *The U.S.-China Economic and Security Review Commission*, March 30, 2020. https://www.uscc.gov/sites/default/files/2020-05/China_Space_and_Counterspace_Activities.pdf.
- Global Agenda Council on Values. "Values and the Fourth Revolution the Dots Between Value, Values, Profit and Purpose." In *Values and the Fourth Revolution the Dots Between Value, Values, Profit and Purpose*, 1–36. Switzerland: World Economic Forum, 2016. http://www3.weforum.org/docs/WEF_Values_and_the_Fourth_Industrial_Revolution_WHITEPAPER.pdf.
- GMT, Posted 28 Jan 2020 | 16:00. "5 Big Ideas for Making Fusion Power a Reality - IEEE Spectrum." *IEEE Spectrum: Technology, Engineering, and Science News*. Accessed December 8, 2020. <https://spectrum.ieee.org/energy/nuclear/5-big-ideas-for-making-fusion-power-a-reality>.

- Grush, Loren. “At His Last Space Council Meeting, Mike Pence Announces New Cadre of Lunar Astronauts.” *The Verge*, December 9, 2020. <https://www.theverge.com/2020/12/9/22166077/nasa-artemis-astronauts-18-first-woman-moon-mike-pence-space-council>.
- John Hickman (2019) *Research Viewpoint: International Relations and the Second Space Race Between the United States and China*, *Astropolitics*, 17:3, 178-190, DOI: 10.1080/14777622.2019.1672507.
- Hua, Xin. “China Reveals Space Plan for 2020- China.Org.Cn.” *China.Org.CN*, January 18, 2020. http://www.china.org.cn/china/2020-01/18/content_75626065.htm;
- Huadong, Guo. “Steps to the Digital Silk Road.” *Nature* 554, no. 7690 (February 2018): 25–27. <https://doi.org/10.1038/d41586-018-01303-y>.
- Ibold, Sebastian. “Belt and Road Initiative - China’s Space Silk Road.” *Belt and Road Initiative* (blog), May 14, 2018. <https://www.beltroad-initiative.com/space-silk-road/>.
- Jakes, Lara. “In First Talks, Dueling Accusations Set Testy Tone for U.S.-China Diplomacy.” *The New York Times*, March 19, 2021, sec. U.S. <https://www.nytimes.com/2021/03/18/us/politics/china-blinken-sullivan.html>.
- James, Peter B., David E. Smith, Paul K. Byrne, Jordan D. Kendall, H. Jay Melosh, and Maria T. Zuber. “Deep Structure of the Lunar South Pole-Aitken Basin.” *Geophysical Research Letters* 46, no. 10 (2019): 5100–5106. <https://doi.org/https://doi.org/10.1029/2019GL082252>.
- Jet Propulsion Laboratory, California Institute of Technology. “Mars 2020 Perseverance Launch Press Kit | Science.” NASA/JPL. Accessed March 31, 2021. http://www.jpl.nasa.gov/news/press_kits/mars_2020/launch/mission/science/.
- United States Department of State. “Key Topics – Office of Space Affairs.” Accessed March 31, 2021. <https://www.state.gov/key-topics-office-of-space-affairs/>.
- Jones, Andrew. “China Is Aiming to Attract Partners for an International Lunar Research Station.” *SpaceNews*, 21 Aug. 2020, <https://dev.spacenews.com/china-is-aiming-to-attract-partners-for-an-international-lunar-research-station/>.
- Klinger, Julie. *China, Africa, and the Rest: Recent Trends in Space Science, Technology, and Satellite Development*. 38, Johns Hopkins School of Advanced International Studies, p. 26, <https://static1.squarespace.com/static/5652847de4b033f56d2bdc29/t/5ecdb4ab6dad0e25fa0feb06/1590539437793/WP+38+-+Klinger+-+China+Africa+Space+Satellites.pdf>.
- Kruijff, Michiel. “2000ESASP.462..333K Page 333.” In *Peaks of Eternal Light on the Lunar South Pole: How They Were Found and What They Look Like*, 333–36. ESTEC, Noordwijk, The Netherlands: European Space Agency, 2000. http://articles.adsabs.harvard.edu/cgi-bin/nph-iarticle_query?bibcode=2000ESASP.462..333K&db_key=AST&page_ind=0&plate_select=NO&data_type=GIF&type=SCREEN_GIF&classic=YES.
- Laufman, David, Joseph Casino, and Michael Kasdan. “The Department of Justice’s National Security Division Chief Addresses China’s Campaign to Steal U.S. Intellectual

Property.” *The National Law Review*, August 24, 2020.
<https://www.natlawreview.com/article/departments-national-security-division-chief-addresses-chinas-campaign-to>.

Li, Chunlai, et al. “China’s Present and Future Lunar Exploration Program.” *Science*, vol. 365, no. 6450, July 2019, pp. 238–39, doi:10.1126/science.aax9908

Liu, Irina, Evan Linck, Bhavya Lai, Keith Crane, Xueying Han, and Thomas Colvin. “Evaluation of China’s Commercial Sector.” Institute for Defense Analyses, Science and Technology Policy Institute, September 2019. <https://www.ida.org/-/media/feature/publications/e/ev/evaluation-of-chinas-commercial-space-sector/d-10873.ashx>,.

Mahoney, Erin. “NextSTEP H: Human Landing System.” Text. NASA, April 4, 2019.
<http://www.nasa.gov/nextstep/humanlander2>.

Mann, Adam. “The New Scramble for the Moon.” *Scientific American*, Top Stories of 2019, 321, no. 1 (2019): 39–41. <https://doi.org/DOI:10.1038/scientificamerican0719-60>.

Marks, Thomas A., and David H. Ucko. “Gray Zone in Red: China Revisits the Past.” *Small Wars & Insurgencies*, March 11, 2021, 1–24.
<https://doi.org/10.1080/09592318.2021.1870422>.

[mars.nasa.gov](https://mars.nasa.gov/news/8865/touchdown-nasas-mars-perseverance-rover-safely-lands-on-red-planet). “Touchdown! NASA’s Mars Perseverance Rover Safely Lands on Red Planet.” NASA’s Mars Exploration Program. Accessed March 31, 2021.
<https://mars.nasa.gov/news/8865/touchdown-nasas-mars-perseverance-rover-safely-lands-on-red-planet>.

Mazarr, Michael. “The Essence of the Strategic Competition with China.” *PRISM* 9, no. 1 (2020) (2020): 1-21 (20 pages). <https://www.16af.af.mil/News/Article/2389108/the-essence-of-the-strategic-competition-with-china/>.

McLeary, Paul. “China Set To Beat US, Russia Again In Space Launch Race.” *Breaking Defense* (blog). Accessed December 15, 2020.
<https://breakingdefense.com/2020/10/china-set-to-beat-us-russia-again-in-space-launch-race/>.

Mittelmark, Cary. “Playing Chess with the Dragon: Chinese-U.S. Competition in the Era of Irregular Warfare.” *Small Wars & Insurgencies*, January 11, 2021, 1–24.
<https://doi.org/10.1080/09592318.2021.1870423>.

Mohon, Lee. “NASA Looks to Advance Large-Scale 3D Printing for the Moon and Mars.” *NASA*, 30 Sept. 2020, <http://www.nasa.gov/centers/marshall/news/releases/2020/nasa-looks-to-advance-3d-printing-construction-systems-for-the-moon.html>.

Moran, Jerry. “Op-Ed | The next Space Race.” *SpaceNews*, March 23, 2021.
<https://spacenews.com/op-ed-the-next-space-race/>.

Morgan Stanley. “Space: Investing in the Final Frontier.” Accessed March 31, 2021.
<https://www.morganstanley.com/ideas/investing-in-space>.

Morring, Frank. “Constellation Is Dead, But Pieces Live On.” *Aviation Week*, October 26, 2010.
http://www.aviationweek.com/aw/generic/story_channel.jsp?channel=space&id=news%2

Fawx%2F2010%2F10%2F22%2Fawx_10_22_2010_p0-264465.xml&headline=Constellation%20Is%20Dead%2C%20But%20Pieces%20Live%20On.

Mosher, Dave. "Scientists Have Discovered a Mysterious Lump on the Moon's Far Side, and It's 5 Times Bigger than Hawaii's Big Island." *Business Insider*, June 10, 2019. <https://www.businessinsider.com/moon-crater-anomaly-south-pole-metal-asteroid-core-2019-6>.

Mosher, David Anderson, Bob Hunt, Dave. "NASA's \$30 Billion Artemis Missions Will Attempt to Set up a Moon Base." *Business Insider*, September 24, 2019. <https://www.businessinsider.com/nasa-artemis-moon-base-apollo-space-rocket-sls-2019-9>.

Myers, Steven Lee, *China and Russia Agree to Explore the Moon Together*, *New York Times*, March 10, 2021, updated May 14, 2021. [nytimes.com](https://www.nytimes.com)

NASA: Artemis Accords." Accessed March 31, 2021. <https://www.nasa.gov/specials/artemis-accords/index.html>.

NASA Headquarters, Office of the Press Secretary. "President Bush Announces New Vision for Space Exploration Program." *The White House*, January 14, 2004. <https://history.nasa.gov/Bush%20SEP.htm>.

NASA Solar System Exploration. "Basics of Space Flight - Solar System Exploration: NASA Science." Accessed April 9, 2021. <https://solarsystem.nasa.gov/basics/chapter14-1/>.

Panda, Jagannath, and Ankit Panda. "RESOLVED: Japan Is Ready to Become a Formal Member of Five Eyes." *Center for Strategic and International Studies: Debating Japan* (blog), December 8, 2020. <https://www.csis.org/analysis/resolved-japan-ready-become-formal-member-five-eyes>. Peoples Republic of China State Counsel. "White Paper on China's Space Activities Published." ENGLISH.GOV.CN. Full Text of White Paper on China's Space Activities in 2016, December 28, 2016. http://english.www.gov.cn/archive/white_paper/2016/12/28/content_281475527159496.htm.

Pollpeter, Kevin, Timothy Ditter, Anthony Miller, and Brian Waidelich. "China's Space Narrative, Examining the Portrayal of the U.S.-China Space Relationship in Chinese Sources and Its Implications for the United States," n.d.

Potter, Sean. "NASA's SOFIA Discovers Water on Sunlit Surface of Moon." *NASA*, 26 Oct. 2020, <http://www.nasa.gov/press-release/nasa-s-sofia-discovers-water-on-sunlit-surface-of-moon>

PRC State Council, Full Text of White Paper on China's Space Activities in 2016, December 28, 2016. http://english.gov.cn/archive/white_paper/2016/12/28/content_281475527159496.htm, and short paper prepared on the white paper, *China's Space Activities in 2016*, China National Space Administration, p. 12.

Rajeswari Rajagopalan. "China's Growing Military Space Prowess: Institutions and Capabilities." *Chinese Aerospace Studies Institute*, September 2020. <https://www.airuniversity.af.edu/Portals/10/CASI/Conference-2020/CASI%20Conference%20China%20Military%20Space->

Institutions%20and%20Capabilities-%20Raji.pdf?ver=2PhK-19TwUQIIZScikGxgw%3D%3D.

- Roulette, Joey. "Pivoting from NASA, Russia Partners with China for Lunar Space Station." *The Verge*, March 9, 2021. <https://www.theverge.com/2021/3/9/22321114/lunar-moon-space-station-russia-china-agreement-nasa>.
- Sankaran, Jaganath. "Limits of the Chinese Anti-satellite Threat to the United States." *Strategic Studies Quarterly* 8, no. 4 (2014): 19–46.
- Schmitt, Clayton. "The Future Is Today: Preparing the Legal Ground for the United States Space Force." *University of Miami Law Review* 74, no. 2 (February 20, 2020): 563. <https://repository.law.miami.edu/umlr/vol74/iss2/7>.
- Schmitt, Harrison H. "Mining Rare Mineral From The Moon." *Popular Mechanics*, 7 Dec. 2004, <https://www.popularmechanics.com/science/space/moon-mars/1283056>.
- Sheetz, Michael. "The Space Economy Has Grown to over \$420 Billion and Is 'weathering' the Current Crisis, Report Says." CNBC, July 30, 2020. <https://www.cnbc.com/2020/07/30/space-economy-worth-over-420-billion-weathering-covid-crisis-report.html>.
- Sheetz, Michael. "The Space Industry Will Be Worth Nearly \$3 Trillion in 30 Years, Bank of America Predicts." CNBC, October 31, 2017. <https://www.cnbc.com/2017/10/31/the-space-industry-will-be-worth-nearly-3-trillion-in-30-years-bank-of-america-predicts.html>.
- Silk, Molly. "China Is Evolving a Distinct Space Culture." *TheDiplomat.com*, 21 2021. <https://thediplomat.com/2021/03/china-is-evolving-a-distinct-space-culture/>.
- Soderman/NLSI Staff. "Is Mining Rare Minerals on the Moon Vital to National Security?" *Solar System Exploration Research Virtual Institute*, <https://sservi.nasa.gov/articles/is-mining-rare-minerals-on-the-moon-vital-to-national-security/>. Accessed 15 Dec. 2020
- Stuart, Colin. "Race to the Moon: Inside China's Plans to Build a Lunar Base." *Science Focus Magazine*, 15 Nov. 2019, <https://www.sciencefocus.com/space/inside-chinas-plans-to-build-a-lunar-base/>.
- Syk, Marcus. *If You Want to Get Rich, First Build a Road, A Study on Chinese Trade Network Building in Eurasia*. Lund University, May 2018, <http://lup.lub.lu.se/luur/download?func=downloadFile&recordOId=8947664&fileOId=8947665>., page 9
- Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, Jan. 27, 1967, 18 U.S.T. 2410, 610 U.N.T.S. 205 [otherwise known as the Outer Space Treaty
- US-China Economic and Security Review Commission, *China's Strategic Aims in Africa*, May 8, 2020. <https://www.uscc.gov/hearings/chinas-strategic-aims-africa>.
- U.S. Army DEVCOM Army Research Laboratory Public Affairs. "Army Gets Boost from World's Largest, Fastest Metal Powder 3D Printer." *www.army.mil*, March 9, 2021.

https://www.army.mil/article/244079/army_gets_boost_from_worlds_largest_fastest_metal_powder_3d_printer.

Wood, Peter, Alex Stone, and Taylor Lee. "China's Ground Segment, Building the Pillars of a Great Space Power." China Aerospace Studies Institute, March 1, 2021. https://www.airuniversity.af.edu/Portals/10/CASI/documents/Research/Space/2021-03-01%20Chinas%20Ground%20Segment.pdf?ver=z4ogY_MrxaDurwVt-R9J6w%3d%3d.

World Economic Forum. "Values and the Fourth Revolution the Dots Between Value, Values, Profit and Purpose." <http://www3.weforum.org/>, September 2016. <http://www3.weforum.org/maintenance/public.htm>.

Xin, Guan, and Jin Yang. "New Money: China's Private Space Start-Ups Lift Off." CGTN, July 10, 2020. <https://news.cgtn.com/news/2020-07-10/New-Money-China-s-private-space-start-ups-lift-off-S0jCrO1Yzu/index.html>.

Xinhua. "China Set to Build Lunar Base Prototype." *ShainghaiDaily.Com*, 27 Nov. 2020, <https://archive.shine.cn/nation/China-set-to-build-lunar-base-prototype/shdaily.shtml>.

Xinjun, Li. "Realizing SPACE 2030 Through Multi-Lateral Cooperation," 1–46. Dubai, UAE: UN/UAE0HLF, 2017. https://www.unoosa.org/documents/pdf/hlf/HLF2017/presentations/Day3/High_Level_Panel/1st/Presentation4.pdf.

Xu, Lin, and Yingzhuo Jia. "China's Planning for Deep Space Exploration and Lunar Exploration before 2030." *Chinese Journal of Space Science*, vol. 38, no. 5, 2018, pp. 591–92, doi:10.11728/cjss2018.05.59.

Xu, Lin, and Ziyuan Ouyang. *Scientific Progress in China's Lunar Exploration Program*. Key Laboratory of Lunar and Deep Space Exploration, National Astronomical Observatories, Chinese Academy of Sciences, <http://english.cssar.cas.cn/ic/CNCOsPAR/201410/W020141016603613596668.pdf>.

Zakarin. "China's Moon Base and Secret Spacecraft Heat Up The New Space Race | Observer." Observer. Accessed December 7, 2020. <https://observer.com/2020/09/chinas-moon-base-advances-and-secret-spacecraft-heat-up-the-new-space-race/>.

Zhang, Nanna. "Chinese Academy of Sciences." *China to Start Large Scale R&D on Fusion Demo Test Facilities*, 14 Dec. 2018, http://english.cas.cn/newsroom/archive/news_archive/nu2018/201812/t20181214_202468.shtml.

Zhe, Gong. "China Is Planning a Moon Research Base That May Reshape the Space Race." *CGTN*, 26 Nov. 2020, <https://news.cgtn.com/news/2020-11-26/China-is-planning-a-moon-research-base-that-may-reshape-the-space-race-VJgJ2eElxe/index.html>.

Zou, Yongliao, et al. *Overview of China's Upcoming Chang'E Series and the Scientific Objectives and Payloads for Chang'E-7 Mission*. National Space Science Center, Chinese Academy of Sciences, 2020, p. 2, <https://www.hou.usra.edu/meetings/lpsc2020/pdf/1755.pdf>.

Zubrin, Robert. "The Case for Colonizing Mars." *National Space Society*, Aug. 1996, <https://space.nss.org/the-case-for-colonizing-mars-by-robert-zubrin/>.

SpaceChina.com. “党史学习教育专题.” News, April 7, 2021.
<http://zhuanti.spacechina.com/n3151488/n3151628/c3174638/content.html>.
CNSA.gov.cn. “机构简介.” Accessed April 11, 2021.
<http://www.cnsa.gov.cn/n6758821/index.html>.

SpaceChina.com. “航天三大精神_中国航天科技集团有限公司.” News. Accessed April 11, 2021. <http://www.spacechina.com/n25/n142/n154/n178/index.html>.
“航天三大精神_中国航天科技集团有限公司.” Accessed April 8, 2021.
<http://www.spacechina.com/n25/n142/n154/n178/index.html>. N.d.