



Caelus Foundation

LOST WITHOUT TRANSLATION

IDENTIFYING GAPS IN U.S. PERCEPTIONS OF
THE CHINESE COMMERCIAL SPACE SECTOR

FEBRUARY 2021

U.S. commercial space stakeholders firmly believe that competition from Chinese actors will be an inevitable part of their future decision making. However, beyond this surety there are significant gaps in understanding of how this competitive relationship will develop. For these stakeholders it remains unclear who their Chinese competition will be, what resources they will have, and what rules they will operate by. By comparing common U.S. stakeholder perspectives with discourse and analysis on China's commercial space sector, this paper highlights where more effort is required to better understand these emerging dynamics. This research challenges common narratives of a Chinese commercial space sector with unlimited financial support, direct government control, and long-term vision. It illuminates barriers to understanding the complexities and conflicts within China's commercial ecosystem, thus providing nuance for one of the most challenging and heated topics in the space industry: U.S.-Sino space relations. This paper raises more questions than it answers, but these questions will help U.S. researchers, analysts, practitioners, and policymakers better investigate and understand the complex dynamics emerging in China's nascent commercial space sector.

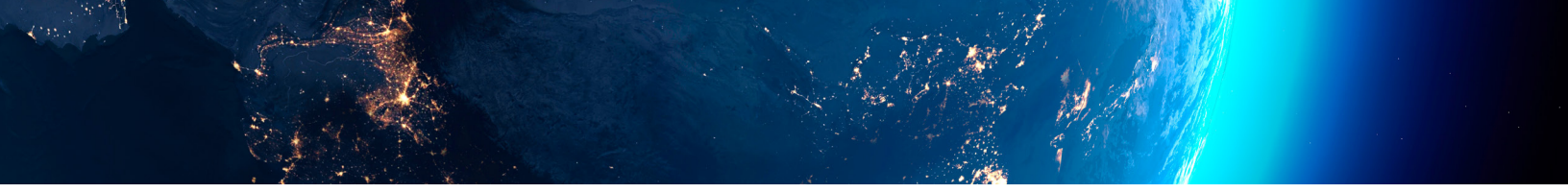
FEBRUARY 2021

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ACRONYM LIST

BRI	Belt and Road Initiative
CASC	China Aerospace Science and Technology Corporation
CASI	China Aerospace Studies Institute
CASIC	China Aerospace Science and Industry Corporation Limited
CCP	Chinese Communist Party / Communist Party of China
CEO	Chief Executive Officer
CF	Caelus Foundation
CMI	Civil-Military Integration
CTO	Chief Technology Officer
DoD	Department of Defense
FFRDC	Federally Funded Research and Development Center
IDA	Institute for Defense Analyses
IoT	Internet of Things
IP	Intellectual Property
LEO	Low Earth Orbit
MCF	Military-Civil Fusion
NDRC	National Development and Reform Commission
PLA	People's Liberation Army
STPI	Science and Technology Policy Institute
SOE	State Owned Enterprise
SWF	Secure World Foundation
TA	Thematic Analysis
UAV	Unmanned Aerial Vehicle
VC	Venture Capital



1.0 • INTRODUCTION

This whitepaper explores current perspectives that U.S. commercial space stakeholders have on the emerging Chinese commercial space sector and identifies significant questions and gaps in information that these stakeholders have. Via fifteen semi-structured interviews with private sector professionals across the space industry in the U.S., this study provides a glimpse into current perceptions, concerns, and questions about the potential impacts of China’s space activities on their business and investment realities. Common interviewee perspectives are compared to an investigation of Chinese commercial space dynamics in order to identify areas of alignment or misalignment. These findings illuminate significant areas where further research would improve understanding and better enable strategic decision-makers.

The utilization of space is increasingly recognized as a key emerging focus area for global military and economic development, and the United States and China are two of the world’s leading space powers. The U.S.-China relationship is one of the most important relationships in the world, and it is strained. Great power dynamics and domestic politics have created an environment of distance and mistrust. This is perhaps even more true when it comes to space activities, where there is a history of distrust between the two governments. Both countries are ambitiously seeking to position their space programs as drivers of economic growth, diplomatic leverage, and security advantage. As the global commercial space sector continues to rapidly develop, the decisions these two countries make, both together and separately, will have significant implications for the rest of the industry. Importantly, both countries consider the other in their strategic decision-making but there are significant gaps in understanding between stakeholders from both countries on their respective goals, positions, and approaches to commercial space development.

Gaps in understanding cover the structure of the aerospace sector, legal and business uncertainty regarding trade and competition, and whether a true separation between government and private sector entities is possible. These obscurities limit the abilities of commercial stakeholders in both countries to fully navigate and participate in the emerging global space economy. Furthermore, the prevalence of security-focused discourse between the two countries has led to an abundance of worst-case scenario posturing. As this occurs the potential for misunderstanding and misrepresentation increases as political and legal measures on both sides of the bilateral pose barriers for clear information exchange.

This whitepaper begins in Section 2 with a general review of the current state of U.S-Sino relations and of current developments in the Chinese commercial space sector. This review is intended to provide orientation and background for the body of the paper. Following this background, Section 3 of the paper outlines the methodology used for this research. Findings in this paper are presented in sections 4 and 5. Section 4 presents findings from U.S. space community interviews conducted for this study. Interviews focused on views, beliefs, and concerns of the Chinese commercial space sector and its interaction with the U.S. space sector. These discussions covered interviewees’ perspectives on a range of topics including whether China truly has a commercial space sector, expectations of competition, and strengths and weaknesses of the Chinese space industry.

This paper shows that 83% of interviewees do not perceive a current competitive business threat from China, but that 92% believe that it is inevitable in the long term. These stakeholders want to understand who their competition will be, what resources they will have, and what rules they will play by. However, it is apparent that there is a significant information disparity between both sides and that U.S. stakeholders have far less access to clear information on Chinese commercial activities than their Chinese counterparts have on the U.S. commercial sector. The implications of this information disparity are apparent when common U.S. stakeholder perceptions are compared with an analysis of U.S. and Chinese literature on the Chinese commercial space sector.



Section 5 of this whitepaper compares these common perceptions to significant narratives in both Chinese literature and U.S. and European analysis of China’s commercial space sector. Through this analysis multiple areas are identified where U.S. stakeholder perceptions did not align with these findings. For example, many in the U.S. believe they are at a disadvantage when it comes to government support, investment timelines, and effective national strategy. Their Chinese counterparts would likely beg to differ, as Chinese private space companies appear to struggle with unclear policies, internal friction with State Owned Enterprises, and identifying a customer base. The findings presented in this paper are significant in that they challenge common narratives and highlight the complexity of China’s commercial space sector.

This paper has a singular goal: to increase nuance in discussion of one of the most challenging and heated topics in the space industry: U.S.-Sino space relations. It raises more questions than it answers, but these questions will help U.S. researchers, analysts, practitioners, and policymakers better investigate and understand the complex dynamics emerging in China’s nascent commercial space sector.

2.0 • BACKGROUND

General Context

The relationship between the United States and China is characterized by a state of competition across strategic, diplomatic, military, and economic dimensions. Analysts have characterized the state of the U.S.-Sino relationship via a range of concepts including the risk of a Thucydides Trap; describing the current period as a new “Cold War;” or orienting around the rise of a potential competitor.¹ While the exact framing is debatable, most do orient in a context of tension. Since assuming the role of General Secretary (or paramount leader) in 2013, Xi Jinping has led China in pursuit of establishing itself as a leader on the international stage through a number of key policies and initiatives, including his shaping of the domestic narrative of the “China Dream” and his signature foreign policy initiative, China’s Belt and Road Initiative.² In recent years U.S. policy has shifted away from cooperation with China, towards competition.³ In 2015, President Obama indicated that the U.S. was “committed to expanding [U.S.-China] cooperation.”⁴ Whereas U.S. policy as of December 2017 regards the policy goals and initiatives of the Government of China as “antithetical to U.S. values and interests.”⁵ Economically, despite the agreement to a Phase I trade deal in early 2020, both countries continue to pursue policies of economic decoupling. The ongoing coronavirus pandemic – and efforts to assign blame – has contributed to this trend.⁶

While overall a small part of the U.S.-China dynamic, space has not been isolated from these trends. In the U.S., China’s space program is seen as a rising threat and challenge, while analysts in China (and elsewhere) see China’s

¹ See e.g.: Allison, Graham. “The Thucydides Trap: Are the U.S. and China Headed for War?,” *The Atlantic*. September 24, 2015, accessed October 12, 2020. <https://www.theatlantic.com/international/archive/2015/09/united-states-china-war-thucydides-trap/406756/>; Chen Weiss, Jessica, “A Word Safe for Autocracy? China’s Rise and the Future of Global Politics,” *Foreign Affairs*. July/August 2019, accessed October 12, 2020. <https://www.foreignaffairs.com/articles/china/2019-06-11/world-safe-autocracy>; Dupont, Alan, “The US-China Cold War Has Already Started,” *The Diplomat*. July 8, 2020, accessed October 12, 2020, <https://thediplomat.com/2020/07/the-us-china-cold-war-has-already-started/>; Gladstone, Rick, “How the Cold War Between China and U.S. Is Intensifying” *The New York Times*, July 24, 2020, accessed October 12, 2020, <https://www.nytimes.com/2020/07/22/world/asia/us-china-cold-war.html>

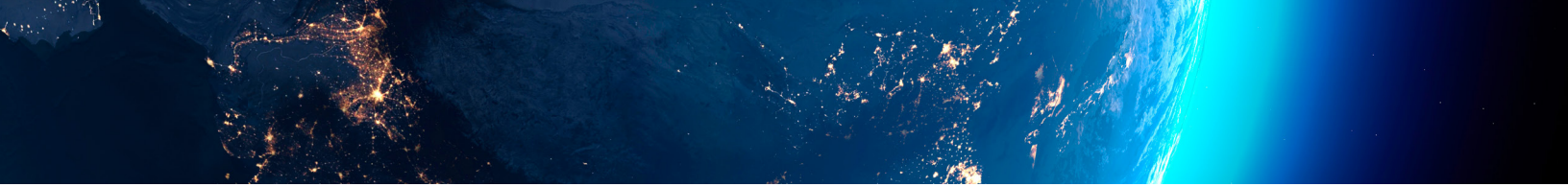
² Ferdinand, Peter, “Westward Ho - The China Dream and ‘One Belt, One Road’: Chinese Foreign Policy Under Xi Jinping,” *International Affairs*, 92:4 (2016): 941-957.

³ Cordesman, Anthony H., “From Competition to Confrontation with China: The Major Shift in U.S. Policy.” CSIS. August 3, 2020, accessed October 12, 2020, <https://www.csis.org/analysis/competition-confrontation-china-major-shift-us-policy>

⁴ “Remarks by President Obama and President Xi of the People’s Republic of China in Joint Press Conference,” The White House, September 25, 2015, accessed October 12, 2020. <https://obamawhitehouse.archives.gov/the-press-office/2015/09/25/remarks-president-obama-and-president-xi-peoples-re-public-china-joint>

⁵ National Security Strategy of the United States of America, White House, December 2017, accessed October 12, 2020, p. 25, <https://www.whitehouse.gov/wp-content/uploads/2017/12/NSS-Final-12-18-2017-0905.pdf>

⁶ Hanemann, Thilo et. Al., “Two-Way Street: 2020 Update US-China Investment Trends.” Rhodium Group and National Committee on U.S.-China Relations. May 8, 2020, accessed October 12, 2020, p.12, https://www.ncuscr.org/sites/default/files/TWS%202020_Report_8May2020_Final.pdf



“space program as catching up with the U.S. space program and surpassing it by mid-century.”⁷ A forthcoming working paper study of Chinese public opinion on space activities and the U.S. space program by R. Lincoln Hines finds that the U.S. is viewed as a competitor by the Chinese public.⁸ As a recent analysis of Chinese perspectives on the U.S. space program published by the China Aerospace Studies Institute (CASI) concludes:

“...the United States and China are in a long-term competition in space. Although advancing rapidly, China’s space program is viewed by Chinese officials and analysts as trailing the U.S. space program. Nevertheless, China’s space industry plans to surpass the United States in space by mid-century. To date, China’s success in space can be attributed in large part to top-level leaders’ recognition of the benefits of space power, consistent planning, and stable and ample funding. U.S. success in competing with China will need to rely on the same fundamentals.”⁹

While the U.S. remains the most space-capable country across all dimensions, China is rapidly investing and developing capabilities in all aspects of space activities. Initiatives under China’s “Belt and Road Spatial Information Corridor” create opportunities to increase diplomatic ties with other countries and develop China’s space capabilities. This occurs through a number of activities such as the active export and financing of satellites and planned participation opportunities in its planned LEO space station.¹⁰ In the national security domain China has developed a robust suite of space and counterspace capabilities.¹¹ In the economic domain there is concern that the “nascent commercial space industry may displace the U.S. commercial space industry through mercantilist trade policies.”¹² While this set of capabilities does not yet surpass those of the U.S., the rapid advancement and context of competition has led some, including former U.S. Vice President Mike Pence, to describe “a new space race” between the U.S. and China.¹³ Other analysts, however, argue that the “space race” formulation is inaccurate and overly simplistic.¹⁴

In the United States, although there is a general awareness of China’s rising space capabilities and an increasing amount of analysis of those capabilities, the majority of the literature focuses on China within the context of great power competition. It is uncommon to see differentiation in analysis between commercial, private, and national structures within China’s burgeoning space capabilities. Analysis of Chinese space activities in the U.S. focuses on the national security dimension, with economic aspects of competition often treated in a secondary nature. Yet, a better understanding of the nature of commercial space activities - and how they are perceived may yield both a more informed strategic picture for commercial competition and identify areas in which both countries may have shared interests in developing a domain conducive to commercial activity, despite the overall competitive relationship.

⁷ Pollpeter, Kevin et. Al.; “China’s Space Narrative.” China Aerospace Studies Institute (CASI). September 2020, . accessed October 12, 2020, p. 7, <https://www.airuniversity.af.edu/CASI/Article-Display/Article/2369900/chinas-space-narrative/>

⁸ Hines, R. Lincoln, “Heavenly Mandate: Public Opinion and China’s Space Activities,” 2021, working paper

⁹ Pollpeter, Kevin et. Al.; 2020. p.7-8

¹⁰ See e.g. Pekkanen, Saadia M., “China’s Ambitions Fly High: ‘One Belt, One Road’ to Extend into Space,” *Forbes*, May 26, 2017, accessed October 12, 2020 <https://www.forbes.com/sites/saadiampekkannen/2017/05/26/chinas-ambitions-fly-high-one-belt-one-road-to-extend-into-space/#776b68f44c0c>; Chase, Michael S., “The Space and Cyberspace Components of the Belt and Road Initiative,” NBR Special Report #80, September 2019, accessed November 12, 2020, <https://www.nbr.org/publication/the-space-and-cyberspace-components-of-the-belt-and-road-initiative/>

¹¹ Weeden, Brian and Samson, Victoria., eds., “Global Counterspace Capabilities: An Open Source Assessment,” April 2020, <https://swfound.org/counter-space/>

¹² Pollpeter, Kevin et. Al.; 2020, p.7

¹³ Autry, Greg and Kwast, Steve. “America Is Losing the Second Space Race to China,” *Foreign Policy*. August 22, 2019, accessed October 12, 2020,

<https://foreignpolicy.com/2019/08/22/america-is-losing-the-second-space-race-to-china/>; Wall, Mike. “US Is in a New Space Race with China and Russia, VP Pence Says.” *Space.com*. March 27, 2019, accessed October 12, 2020, <https://www.space.com/new-space-race-moon-mike-pence-says.html>

¹⁴ Day, Dwayne. “Racing to where/what/when/why?,” *The Space Review*, March 2, 2020, accessed October 12, 2020, <https://www.thespacereview.com/article/3893/1>



Emergence of Chinese Commercial Space

Chinese commercial space activity has increased in scope, scale, number of companies, and amount of investment capital in recent years. While quantification of this is difficult, a first-of-its kind analysis of China's commercial space sector published in September 2019 by the U.S. Institute for Defense Analyses (IDA) Science and Technology Policy Institute (STPI) - a federally funded research and development center (FFRDC) - identified 78 commercial space companies in China. These companies were active in the satellite manufacturing, launch, remote sensing, communications, data analytics and ground systems segments of the space industry.¹⁵ Other sources have reported a larger number of companies.¹⁶ China has also become the leading non-U.S. location and source for venture funding of space companies. U.S.-based space consulting firm Bryce Space and Technology reports that \$314.2 million was invested "into Chinese [space] ventures during 2019, up from \$288 million in 2018. These investment totals far exceeded those for other non-U.S. countries, with Japan placing second at \$130.6 million."¹⁷ The same report estimated that investment in U.S. companies totaled \$4.8B in 2019 - mostly represented through SpaceX, OneWeb, Blue Origin, and Virgin Galactic. Euroconsult reports that Chinese commercial launch companies raised a total of a total of approximately \$530 million across 8 funding rounds in 2020 and the last 2 months of 2019; while Chinese satellite manufacturers raised close to \$155 million in 2020.¹⁸

The definition of "commercial space" in the context of China's political and economic system is itself a subject of analysis. Chinese analysts and trade press sources often refer to "privately-held" or "private aerospace" companies. The Air University's China Aerospace Studies Institute notes in a report on "Private" Chinese Aerospace Defense Companies that those firms "are more agile than state-owned companies in pursuing new technologies, and are driven by profit incentives to push technological change to customers rather than take the traditional "sit and wait" approach of hidebound state-owned defense industries."¹⁹ Other U.S. analysts argue that many Chinese satellite companies that are described as commercial, retain close ties to both the state-owned enterprises (SOEs), and to the Communist Party of China (CCP).²⁰ STPI notes that the definition used in its analysis to identify a company as commercial focused on three aspects:

- "Does the company have some private parties taking risk (through ownership, investment or other means), even if the majority shareholder is an SOE?"
- "Do they sell their products to customers other than the Chinese government?"
- "Do they appear to demonstrate independence from their parent SOE or government agency?"²¹

In conducting the analysis in this whitepaper the authors do not attempt to define commercial space within the context of the Chinese ecosystem. Instead, noting the reporting elsewhere, we accept that there are a range of different company types and operating models within China's space sector, and that some of these companies may exhibit commercial characteristics. As the discussion in this paper will address, understanding the nuances in these company types is likely more instructive than a strict effort to define them.

¹⁵ Liu, Irina, Linck, Evan., et Al., "Evaluation of China's Commercial Space Sector," Institute for Defense Analyses, September 2019, accessed October 12, 2020, <https://www.ida.org/-/media/feature/publications/e/ev/evaluation-of-chinas-commercial-space-sector/d-10873.ashx>

¹⁶ Deville, Jean. "A Large Scale Update of the China Aerospace Blog NewSpace Mapping," *The China Aerospace Blog*, June 2019, accessed January 4, 2021, <https://china-aerospace.blog/2019/06/10/a-large-scale-update-of-the-china-newspace-mapping-06-2019/>

¹⁷ Bryce Space and Technology, "Start-up Space 2020." March 9, 2020, accessed October 12, 2020, https://brycetech.com/reports/report-documents/Bryce_Start_Up_Space_2020.pdf

¹⁸ Curcio, Blaine. "#SpaceWatchGL Opinion: Launching Into the New Decade," SpaceWatchGlobal, November 2020, accessed December 2, 2020.

<https://spacewatch.global/2020/11/spacewatchgl-opinion-launching-into-the-new-decade/>; Curcio, Blaine; "Constellation Watch: China's Incubating Answer to Starlink," *Satellite Markets and Research*, December 4, 2020, accessed December 7, 2020, <http://satellitemarkets.com/constellation-watch-china-incubating-answer-starlink>

¹⁹ Hull, Andrew W. and Markov, David R, "Private Chinese Aerospace Defense Companies," China Aerospace Studies Institute (CASI), June 2020, accessed October 12, 2020, p. 5, https://www.airuniversity.af.edu/Portals/10/CASI/Books/CASI_Chinese_Aerospace_Defense_Companies.pdf

²⁰ Stokes, Mark, et. Al., "China's Space and Counterspace Capabilities and Activities," Report prepared for the U.S.-China Economic and Security Review Commission, March 20, 2020, accessed November 21, 2020, https://www.uscc.gov/sites/default/files/2020-05/China_Space_and_Counterspace_Activities.pdf

²¹ Liu and Linck, et. Al., 2019, p. iv



U.S. analysts often trace the emergence of the Chinese commercial space sector to Chinese government policy changes initiated in 2014, with the release of what is known as “Document 60” (Official English Language Title: Guiding Opinions of the State Council on Innovating the Investment and Financing Mechanisms in Key Areas and Encouraging Social Investment). Document 60 specifically encourages “private investment in certain key industries, including the satellite industry” and is often credited by outside observers as “officially opening up the [Chinese] space industry to private investment and actively encouraging participation of private companies in a historically state-dominated industry.”²² The 2014 timing of Document 60 corresponds with policy changes within the People’s Liberation Army (PLA) “intended to reduce market access thresholds for private businesses, ensure fair market competition and encourage private enterprises to participate in the production, maintenance, and research and development of military equipment.”²³

Since 2014 the Chinese government has instituted a number of policies and documents aimed at encouraging growth within the space industry. These include:

- 2015: State Council *2015-2025 Medium- and Long-term Development Plan for National Civil Space Infrastructure* which “lays out the priorities for the civil space industry, including support for commercial applications of space goods and services.”²⁴
- 2016: State Council White Paper which was “the first space white paper to acknowledge private investment and private companies in the space industry.”²⁵
- 2016: Designation by the State Council of the space industry as a Strategic Emerging Industry
- 2016: Inclusion of a “Sky and Earth Integration Network” in the 13th Five-Year Plan. This calls for the creation of an integration networks of satellites and terrestrial communications capabilities.
- 2019: National Development and Reform Commission (NDRC) publication of the *Industry Catalogue Encouraging Foreign Investment* which promoted “foreign investment in a number of previously closed or semi-closed industries, including many related to satellite manufacturing and satellite communications.”²⁶
- 2020: Decision by the National Development and Reform Commission to add “satellite broadband, 5G, and the Internet of Things (IoT) to the Commission’s ‘New Infrastructures’ list” which has the effect of signaling importance of capital investment in these areas.²⁷

Beyond these targeted policies, broad policy initiatives such as Military-Civil Fusion (MCF) and the Belt and Road Initiative (BRI) do not focus on the space sector specifically but will likely impact the role and opportunities available to China’s developing commercial space sector. MCF refers to efforts to reduce barriers and increase integration between China’s defense industrial base and its commercial companies. Although the term civil-military integration (CMI) has been used by Chinese leaders since Mao Zedong, MCF effectively expands the scope and coordination of CMI.²⁸ Under the leadership of Xi Jinping, there has been a meaningful shift and prioritization of MCF and in March

²² Liu and Linck, et. Al., 2019, p. 14

²³ Hull and Markov, 2020, p. 5.

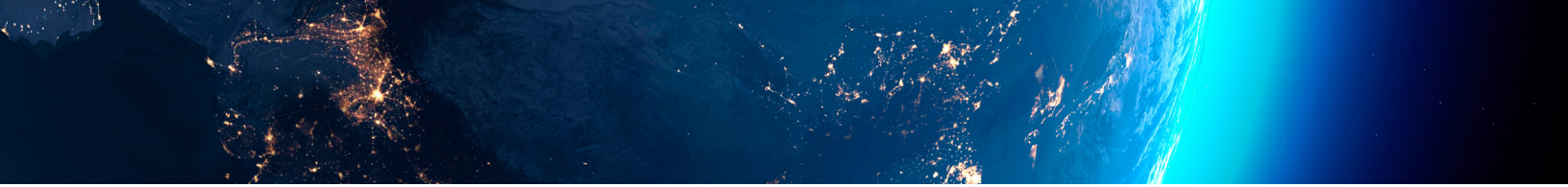
²⁴ Liu and Linck, et. Al., 2019, p. 19

²⁵ *Ibid.*

²⁶ *Ibid.*

²⁷ Curcio, Blaine, “China’s Satellite Internet Ambitions,” *WestEastSpace*, May 28, 2020, accessed October 12 2020, <https://westeastspace.com/2020/05/28/chinas-satellite-internet-ambitions/>

²⁸ For more information regarding the usage of MCF and CMI in China see: Alex Stone and Peter Wood, “China’s Military-Civil Fusion Strategy A View from Chinese Strategists”, China Aerospace Studies Institute, accessed January 4, 2021. https://www.airuniversity.af.edu/Portals/10/CASI/documents/Research/Other-Topics/CASI_China_Military_Civil_Fusion_Strategy.pdf; Audrey Fritz, “China’s Evolving Conception of Civil-Military Collaboration,” CSIS, August 2, 2019, accessed January 4, 2021, <https://www.csis.org/blogs/trustee-china-hand/chinas-evolving-conception-civil-military-collaboration>; Hull, and Markov, 2020, p. 4



2016 it was raised by the Central Politburo to the status of “national strategy.”²⁹ The Belt and Road Initiative is a multi-sector trade and investment program of the Chinese government and there are indications that developing countries participating in BRI may be more amenable to business with commercial Chinese space companies.³⁰ The Belt and Road Spatial Information Corridor expands the scope of BRI to include projects supporting communication, remote sensing, and navigation satellites.³¹ Some Chinese space companies are marketing some of their projects within the BRI umbrella, portraying business with Chinese space companies as an extension of Chinese infrastructure encouraged under the BRI.³² Neither the BRI or MCF specifically focuses on space; yet the Chinese space sector can be expected to benefit from these national level strategic activities.³³

This paper does not contain a detailed analysis of these policies; such analysis can be found in sources such as the 2019 STPI Evaluation of China’s Commercial Space Sector study and the 2020 CASI China’s Space Narrative report. While overall it is clear that “Space activities serve national strategy in that national space policies comply with the development plans of China;”³⁴ the relationship of this policy context to China’s commercial space sector is less clear. STPI notes that interviews with Chinese space sector stakeholders indicate that “the actual impact of Document 60 may not be particularly large.”³⁵ Furthermore as will be discussed later in this paper there are indications that the commercial players within China’s space industry desire more clear laws and policies outlining their role in China’s space industry.

Information Sources, Barriers, and Asymmetry

Efforts to develop a more nuanced understanding of the space ecosystem in China, and the roles of actors within it, are hampered by both barriers to accessing information sources and by an inherent frame of reference that focuses on national security. A situation of information asymmetry exists: in general, more information is easily accessible on U.S. commercial space activities than on Chinese commercial space activities. Primary source information on Chinese commercial space activities does exist in Chinese-language sources, Chinese databases, and Chinese social media, with a limited amount of English-language blogs providing some access to Chinese source material. Yet at the same time verification of information in Chinese-sourced publications can be challenging. In the United States, a general lack of Mandarin language ability and access to Chinese networks results in information being predominantly being accessed through a relatively small number of sources who do have those language and contact resources. This can result in a filtering or bottlenecking of sources, due to limitations of resources.³⁶

Academic, government, and analyst resources in the U.S. often focus on the strategic implications of Chinese space exploration and national security activities. While recent reports that focus on or provide specific discussion of the Chinese commercial space sector – such as the 2019 STPI Evaluation of China’s Commercial Space Sector; the 2020 CASI report on China’s Space Narrative; and Euroconsult’s 2020 China Space Industry Report – begin to reduce this challenge; the existence of these information barriers itself influences perceptions. The following is a brief review of information sources and barriers from the authors’ perspective.

²⁹ Lasakai, Lorand, “Building China’s SpaceX: Military-Civil Fusion and the Future of China’s Space Industry,” Testimony before the US-China Economic and Security Review Commission Hearing on China in Space: A Strategic Competition?, April 25, 2019, accessed September 3, 2020.

³⁰ Liu and Linck, et. Al., 2019, p. 83.

³¹ Hui Jiang, “Programme and Development of the “Belt and Road” Space Information Corridor”, CNSA, April 2019, accessed January 4, 2021, https://www.unoosa.org/documents/pdf/psa/activities/2019/UNChinaSymSDGs/Presentations/Programme_and_Development_of_the_Belt_and_Road_Space_Information_Corridor_V5.1.pdf

³² Huang, Echo, “China is Building Its New Silk Road In Space, Too,” *Quartz*, June 18, 2018, accessed November 8, 2020, <https://qz.com/1276934/chinas-belt-and-road-initiative-bri-extends-to-space-too/>

³³ Liu and Linck, et. Al., 2019, p. 19-20; Stone and Wood, 2020

³⁴ Yuan Yuan & Peeters, W. “Research Viewpoint: Rapid Growth of the Chinese Commercial Space Sector,” *Astropolitics*, 17:3 (2019): p. 195.

³⁵ Liu and Linck, et. Al., 2019, p. 14

³⁶ See e.g.: Cheng, Dean, “China, Open-Source Information, and Transparency,” *The Heritage Foundation*, August 12, 2020, accessed January 4, 2021, <https://www.heritage.org/asia/report/china-open-source-information-and-transparency>



Types of Sources

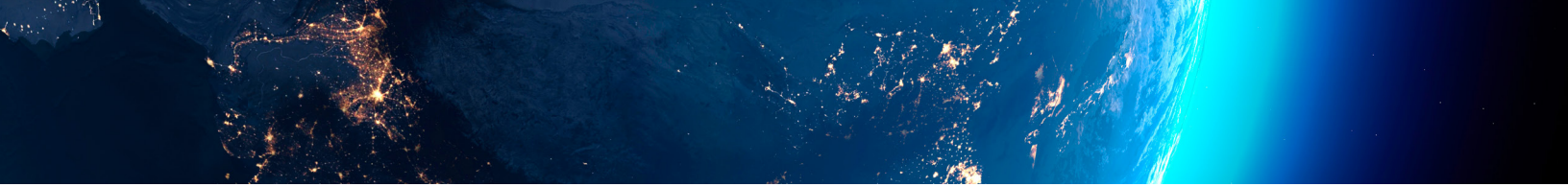
- Academic Literature, Think Tank, and Research Institute Publications: Academic literature provides historical context to the current U.S.-China commercial space environment, and insight into the political-economic systems of the space industry.³⁷ The lag time of peer reviewed pieces between the initial writing period and publication creates time delay and limits the ability to react to recent and quickly changing events relevant to those in the commercial space industry. Notable themes have included the role of export controls, military-civil fusion, and the role of space capabilities in national security.³⁸ Sources exist in both Western and Chinese publications.
- Official Sources: The Government of China publishes official statistics on various aspects of its economy, releases official policy statements, and maintains official websites for certain space organizations and projects. SOEs also maintain official websites and publications. However,, these official publications do not cover some basic information concerning Chinese space activities, such as information on the space program’s budget. There are also questions concerning the reliability of official statistical information sources and data. Similarly, regional level statistics are also published by provincial governments.
- Media and Trade Press: Aerospace trade publications (e.g. *SpaceNews*); international relations and policy focused magazines (e.g. *the Hill*, *Foreign Policy*); and general news publications all publish stories and op-eds related to developments in both the U.S and Chinese space sectors. Review of these types of sources can be useful to identify both factual developments and perspectives. Chinese state media, such as the People’s Daily, provides official information on Chinese commercial space activities, however news reported through these outlets are subject to government review. Hong Kong based news outlets such as the South China Morning Post, an English publication, have historically been more independent than their mainland counterparts, but that has been called into question in recent years. While these sources have their limitations, they remain useful sources of information.
- Chinese Social Media and Websites: In addition to Western and U.S. publications there is a wide range of Chinese trade and popular media that covers the space sector. Some articles are published in English, though of course most are solely published in Mandarin. Many of these sources are accessible outside of China, but vastly different layouts and website functionalities from western websites can make them difficult to navigate for users unfamiliar with them. These sources can provide a useful view on Chinese perspectives. In particular WeChat is often referenced in conversations and publications as a source of information for Chinese space companies, and in fact many Chinese companies do not have formal websites, using WeChat handles instead.³⁹ Although WeChat is accessible internationally much of the activity of China’s private space companies requires some knowledge of Mandarin, creating a language barrier for non-Mandarin speakers.
- Specialized Blogs/Newsletters Focused on Commercial Space in China: There are a small number of newsletters and videoblogs available in English that focus on China’s commercial space activities. Notable examples of these include: Taikonautica, Go Taikonauts, and the DongFang Hour.⁴⁰ These types of sources,

³⁷ Zhang, Zhihui and Seely, Bruce, “A Historical Review of China-US Cooperation in Space: Launching Commercial Satellites and Technology Transfer, 1978-2000,” *Space Policy*, 50 (2019), <https://doi.org/10.1016/j.spacepol.2019.08.003>; Erickson, Andrew, “China’s Space Development History: A Comparison of the Rocket and Satellite Sectors,” *Acta Astronautica*, 103 (2014): p. 142-167, <https://doi.org/10.1016/j.actaastro.2014.06.023>

³⁸ Lasakai, 2019; Nie, Mingyan, “Space Privatization in China’s National Strategy of Military-Civilian Integration: An Appraisal of Critical Legal Challenges,” *Space Policy*, 52 (2020), <https://doi.org/10.1016/j.spacepol.2020.101372>; Quintana, Elizabeth, “The New Space Age,” *RUSI Journal*, 162:3 (2017): p. 88-109, <https://doi.org/10.1080/03071847.2017.1352377>

³⁹ Liu and Linck, et. Al., 2019, p. 8

⁴⁰ Fitz, Cory, “Taikonautica.” <https://taikonautica.substack.com/>; Lan, Chen et. Al., “Go Taikonauts” <https://www.go-taikonauts.com/en/>; Curcio, Blaine and Deville, Jean, “Dongfang Hour” <https://www.youtube.com/channel/UC3UXwB0UbUlg4z4vssUHPBw/featured>



with are published by a mix of American, European, and Chinese nationals living in either Hong Kong or mainland China are often able to bridge English-Mandarin language gaps. They are also more easily able to keep abreast of rapidly changing news in commercial space than are research institute and academic publications; although they lack the depth of those type of sources.

- **Commercial or Proprietary Sources:** A small but growing number of high-quality but private publications focus on Chinese commercial space, which are not widely available for a number of reasons which can include but are not limited to paywalls, proprietary relationships, or commercial nature. Some examples of these sources include reports by leading consulting firms (such as Euroconsult’s China Space Industry Report), reports by investment firms or brokerage houses, and various company specific analyst reporting.

In short, while information on China’s commercial space sector is limited compared to information on the U.S. sector, there is still a wide range of information sources available to U.S. stakeholders. There are various reasons why it is challenging to access them, with the lack of Chinese language skills being the most substantial and obvious hurdle. Publicly accessible translations of Mandarin-language material are sparse in the U.S., which limits access to information circulating the Mandarin speaking community to those that can access quality translation services or must otherwise rely on free automated translation software (such as Google translate) which has accuracy shortcomings. This leads to many stakeholders having to rely on the perspectives of the few space sector analysts who can access the materials. Furthermore, the geopolitical sensitivities and perceived risks of interacting with Chinese counterparts within the space industry limit the opportunities to develop personal relationships with Chinese nationals that may be able to field questions or provide a Chinese perspective to their American counterparts. Barriers also exist for Chinese nationals to engage with American counterparts, as STPI noted in their study of Chinese commercial space: “Many commercial space companies were unable to speak with a U.S. research organization, especially the state-owned subsidiaries, because they could not attain official approval.”⁴¹

Further complicating matters, there are sometimes mismatches between English-language and Mandarin-language material from the same source. For example, Chinese space companies often have several names in both English and Mandarin. STPI notes that company information published in Chinese-language was typically both more detailed and more frequently updated than English material - a situation that could possibly lead to incorrect information via English-only publications.⁴² The implication of this is that the challenge of accessing quality information sources contributes to considerable uncertainty and gaps in understanding. With a lack of information, individuals typically make “worst case” assumptions, leading to patterns of mistrust and suspicion. This problem is particularly acute on the U.S. side of the bilateral relationship, since there is less easily accessible information about the Chinese side.

Dominant Narratives

The space industry is inextricably linked to national security issues, and so the geopolitical context surrounding China and the United States is heavily present in discussions about the U.S.-China space relationship, and industry’s role in it. Often, in U.S. literature the future of China’s space industry is framed through a lens of great power competition, and national ambitions to increase space capabilities and independence are considered in relation to impact on U.S. national security.

⁴¹ Liu and Linck, et. Al., 2019, p. 8

⁴² Liu and Linck, et. Al., 2019, p. 8



There is a narrative that the Chinese space sector is rapidly growing and will soon catch up to the U.S. space industry.⁴³ This narrative is present in both U.S. and Chinese media, but appears to be more prevalent in U.S. sources. Sometimes China's rapid growth and ambitions in space are seen as an impressive feat from a rapidly advancing country and a beacon of advancements in international space capabilities; at other times China's burgeoning space capabilities are seen as a strategic threat to America's hold as the preeminent power in an industry critical to its national security interests. U.S. literature often describes all Chinese space industry activity as part of China's national space program; yet at the same time portrays uncertainty around the structure and nature of commercial or private activities in China's space sector.

Chinese sources - including academic, trade, and popular press - generally portray the U.S. as leaders in space commercialization, sharing in the narrative that the Chinese space sector is progressing rapidly, albeit with a more hopeful and ambitious tone than one of strategic competition.⁴⁴ The success of SpaceX, both for its commercial endeavors and partnerships with U.S. government entities, is watched closely by the Chinese space industry. SpaceX milestones are referenced in interviews with leaders of Chinese space companies and reported by general media outlets.⁴⁵ Some sources suggest that China can both learn from the experience of the United States and gain confidence from the success of privately owned space enterprises.⁴⁶ For example, it is not uncommon for Chinese companies, and their founders, to be compared to SpaceX and Elon Musk, and for comparisons of the timeline and trajectory of SpaceX's milestones to be made with the accomplishments of their Chinese counterparts.⁴⁷

The common suggestion that Chinese companies might learn from or emulate the success of U.S. companies, might be an example of a concept known as secondary innovation. Secondary innovation is a process, common in developing countries, in which technology acquired from developed countries is used as a basis for further development, and which has historically been prevalent in Chinese innovations systems.⁴⁸ The Chinese technology start-up sector has long had a "copy-cat" reputation in Western analysis. This dynamic exists in the space sector as well. Representation of Chinese innovation styles can have an important influence on perception on a country often seen as a competitor.⁴⁹

These narratives point towards an environment of competition and awareness throughout the Chinese space sector of what is happening in the United States commercial space sector. As CASI points out "it is important to understand with whom we are competing and the manner in which they are competing with us. Too often, we view things only through our own 'lens' and forget to look at how our competitors see the world and organize within

⁴³ See e.g.: Beames, Charles, "The Dragon Is Breathing Down Our Neck: Action Is America's Best Weapon." *Forbes*, October 14, 2020, accessed November 20, 2020, <https://www.forbes.com/sites/charlesbeames/2020/10/14/the-dragon-is-breathing-down-our-neck-action-is-americas-best-weapon/?sh=2dd7113a4cb5>; Weichert, Brandon J, "Op-ed | China is Beating the United States in the New Space Race," *SpaceNews*, February 1, 2019, accessed November 20, 2020, <https://spacenews.com/op-ed-china-is-beating-the-united-states-in-the-new-space-race/>; "China Rising as Major Space Power," *People's Daily*, June 22, 2018, accessed November 20, 2020, <http://en.people.cn/n3/2018/0622/c90000-9474103.html>; Zhen, Liu, "China's BeiDou Set to Show the Way as Xi Jinping Commissions Rival to America's GPS," *South China Morning Post*, July 31, 2020, accessed November 20, 2020, <https://www.scmp.com/news/china/science/article/3095593/chinas-beidou-set-show-way-xi-jinping-commissions-rival-americas>; Schulte, Paul, "Race to be the 5G Winner," *China Daily*, June 10, 2020, accessed November 20, 2020, <https://www.chinadaily.com.cn/a/202006/10/WS5ee01c93a310834817251f0a.html>

⁴⁴ Yusha ,Zhao, "China's Space Tech Has a Lot to Catch Up With US: experts," *Global Times*, February 7, 2018, accessed December 2, 2020, <https://www.globaltimes.cn/content/1088610.shtml>; Zhijia, Lin, "中国版SpaceX为何还没有诞生 ["Why Hasn't The Chinese Version of SpaceX Been Born Yet?]," *TMTPost*, June 2020, accessed December 2, 2020, <https://www.tmtpost.com/4429628.html>

⁴⁵ Xiang, Nina, "Chinese Rocket Startup Wants to Achieve SpaceX Success in 50% Less Time Than Elon Musk," *China Money Network*, February 28, 2019, accessed December 2, 2020, <https://www.chinamoneynetwork.com/2019/02/28/chinese-rocket-startup-wants-to-achieve-spacex-success-in-50-less-time-than-elon-musk/>; Lei, Zhao, "Rocket Fires up Chinese Scientists' Interest," *China Daily*, February 8, 2018, accessed December 2, 2020, <http://www.chinadaily.com.cn/a/201802/08/WS5a7b8602a3106e7dcc13b65f.html>; Zhijia, 2020

⁴⁶ Goh, Deyana, "Interview: One Space CEO on Its Progress, Plans, and China's Space Industry," *Space Tech Asia*, November 7, 2018, accessed December 2, 2020, <https://www.spacetechnasia.com/interview-one-space-ceo-on-its-progress-plans-and-chinas-space-industry/>

⁴⁷ Xiang, 2019.

⁴⁸ Xiaobo Wu, Rufe Ma, Guannan Xu., "Secondary Innovation: the Experience of Chinese Enterprises in Learning, Innovation and Capability Building," Georgia Institute of Technology, 2006, accessed November 21, 2020, <https://smartech.gatech.edu/bitstream/handle/1853/36267/SECONDARY%20INNOVATION%28Prof.%20WU%20Xiaobo%29.pdf?sequence=1&isAllowed=y>

⁴⁹ Lee, Kevin, "China's Copycat Startup Problem," *Forbes*, July 6, 2010, accessed November 21, 2020; <https://www.forbes.com/sites/china/2010/07/06/chinas-copycat-startup-problem/?sh=3c3cdb6612ff>; Bello Perez, Yessi, "China's No Copycat on Tech and May Overtake the West," *The Evening Standard*, December 6, 2018, accessed November 21, 2020 <https://www.standard.co.uk/business/yessi-bello-perez-china-s-no-copycat-on-tech-and-may-overtake-the-west-a4010626.html>



it.”⁵⁰ With this background in mind this paper sets out to identify how American commercial space practitioners and industry professionals view Chinese competition, and what concerns and questions they have. From there we seek to identify information gaps to address through further research and dialogue.

3.0 • METHODOLOGY

In order to identify meaningful gaps in U.S. awareness of Chinese commercial space activities, this research was conducted by comparing perspectives of U.S. stakeholders to an investigation of current dynamics within the Chinese commercial space sector. The data in this research comes from two types of sources. Perspectives of U.S. stakeholders were primarily gathered by a series of qualitative interviews. These interviews were designed to explore U.S. stakeholders’ views, experiences, beliefs, and questions on the Chinese space sector’s commercial capabilities and how these capabilities impact the U.S. commercial space sector. The second source of data was a review of available research, discourse, trade press analysis, and public policy statements to illuminate current dynamics in the Chinese commercial space sector. This review was broad ranging, included both U.S. and Chinese sources, and was done with the purpose of creating a baseline of understanding to compare with significant themes that emerged from the interview process.

The findings presented in this paper are a collection of discordant narrative themes (themes that contradicted each other between datasets) that emerged from comparing significant themes from U.S. stakeholder interviews with available literature. Identification of these discordant narratives themes illuminates the meaningful gaps in understanding and topics for which future research can be targeted to improve competitive positioning and reduce tensions resulting from misunderstanding. In order to obtain in-depth insights on U.S. stakeholder perceptions, this research utilized semi-structured interviews. An interview guide with open ended discussion questions helped direct each interview, but interviewees were encouraged to share personal insights and discuss subjects not specifically asked for in the guide (see Appendix 1 for interview guide). These interviews were held long-distance over video conferencing platforms June through August 2020. Each interview lasted between 30 minutes and 1.5 hours in duration, allowing for in-depth conversation. Most interviews were recorded with permission from interviewees for accurate internal transcriptions. However, some interviewees requested that their interviews not be recorded due to perceived sensitivity of the subject matter. All interviews were conducted on condition of anonymity.

In total, 15 interviews were conducted with 16 participants. Prospective interviewees were selected to represent stakeholders most likely to be affected by a competitive Chinese commercial space sector. Interviewees were all private sector or academic stakeholders in the U.S. commercial space industry. These individuals included entrepreneurs, investors, business development professionals, and legal advisors. They represent a range of space industry subsegments including launch providers, geospatial companies, venture capital (VC) firms, and in-space logistics and operations. This was not an exhaustive representation of the space sector, and there were certain key industry segments not represented (e.g. satellite telecommunications providers) that would have undoubtedly added to the insights presented here. A summary of the interview subjects can be seen in Table 1 below.

⁵⁰ Hull, and Markov, 2020, p. 2

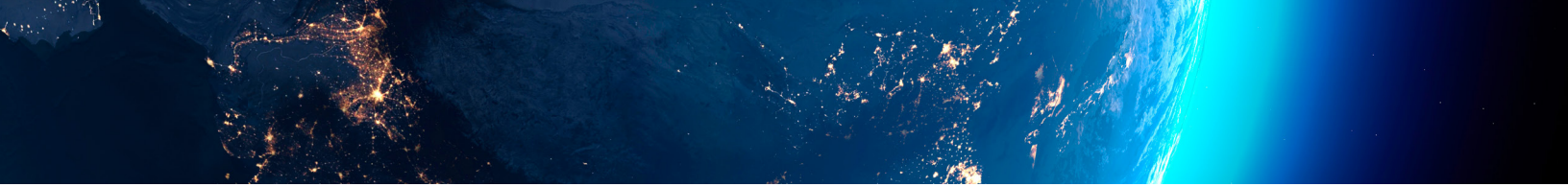


Table 1: Summary of Interview Subjects

Expertise	Segment	<i>Remote Sensing / Geospatial</i>	<i>Space Exploration</i>	<i>Launch</i>	<i>In-Space Logistics / Infrastructure</i>	<i>Academia</i>	<i>Finance / Venture</i>
<i>Corporate Executive / Strategy</i>		2			3		
<i>Business Development</i>			1	1	1		
<i>Legal or Government Affairs</i>		1	1	1			
<i>Investor</i>							2
<i>Analyst</i>							2
<i>Business Education</i>						2	
Totals: 15 interviews/16 interview subjects							


Note: total number of subjects exceeds total number of interviews for two reasons:

- A) some interviews included two individuals from a single company and*
- B) some interviewees had job functions that represented multiple segments*

A key limitation of such an interview methodology is that the number of participants is limited compared to a less labor-intensive approach such as a simple survey. However, a semi-structured qualitative interview process allows for the discovery of unexpected themes and a wider range of insights. As the purpose of this research was to uncover gaps in understanding, rather than determine the prevalence of certain perspectives, the sacrifice of less interview subjects was deemed appropriate. Additionally, during the interview phase of the study, a number of potential U.S. interviewees declined invitations to participate in the study. Many of these declines referenced the sensitivity of the U.S.-China relationship and their lack of specific knowledge on this topic as reasons for declination participation. This hesitancy further contributed to limiting the number of interview participants.

In conjunction with the interviews the authors also researched perceptions of the U.S. and Chinese commercial space industry found throughout trade press articles, academic literature, and research studies. This investigation of available literature was conducted in two phases. The initial phase was a wide-ranging gathering of information across available U.S. and Chinese literature in order to inform early development of the interview guide. This phase included informal consultations with a variety of U.S. and Hong Kong based experts to identify harder to find resources and to confirm meaningful research questions. The second phase began during the final interviews and continued to the completion of this paper. In this phase, significant interview narratives were applied to the literature from phase one to identify areas where narratives appeared to be discordant. Our use of Chinese source material incorporated free automated translations of Mandarin text and English-language text released/published from China based sources.

The goal of using China-based sources is to increase awareness of existing conversations and narratives about commercial space that are taking place within China and being presented to English speakers abroad. Awareness of existing narratives among publicly available U.S. and Chinese voices in the space sector provides context for perceptions of both the U.S. and Chinese commercial space sector. In addition to the U.S. interviews presented in this paper, a very limited number of interviews were conducted with space sector stakeholders in China. These interviews were used to validate literature review findings and help guide the research team, but are not reported in the interview table above.



The analysis of these findings was conducted by utilizing reflexive thematic analysis (TA). TA, a qualitative methodology initially described by Braun and Clarke, utilizes coding processes to generate and categorize emergent elements within a given data set.⁵¹ For this research, each of the authors independently reviewed and coded each interview transcript for a set of thematic labels predetermined before the coding phase. The three authors then compared codes and began generating analysis themes. Those themes were then iteratively compared to the literature which had been identified during the literature review stage. It is important to note that while TA is commonly utilized and respected within social sciences disciplines, it is not without its limitations.⁵² Using this method it is impossible to completely remove researcher bias and findings will be inductive by nature. However, despite its limitations this methodology was deemed a practical, appropriate, and effective approach to achieve the goals of this research.

4.0 FINDINGS • HOW DO U.S. STAKEHOLDERS VIEW THE CHINESE COMMERCIAL SPACE SECTOR?

Interviews with U.S. stakeholders for this study included a number of questions intended to assess the current viewpoints interviewees held on the state of the Chinese commercial space sector, and its interaction with the U.S. space sector. These questions covered definitions of commercial space, whether interviewees believed China has a commercial space sector, interviewees' information sources for Chinese space activities, and perceptions around competition and strengths and weaknesses of Chinese space industry, as compared to their U.S. counterparts. While the interview questions and discussions covered a range of topics, concerns about competition emerged as the core theme. Overall interviewees were concerned about Chinese competition as a future threat, but few saw much active competition in their current business.

The results of this interview process indicate a range of viewpoints within the U.S. on whether commercial space activities and companies exist in China. As shown in Table 2, of the 15 interviews conducted in the U.S. during this project - four were sure that there are commercial space companies in China; while four were sure that there are not commercial space companies in China. The remaining respondents described Chinese companies as “acting in commercial ways” or “giving the veneer/appearance of being commercial” or as “entrepreneurial” but remained uncertain about the role of the Chinese government in ownership and control of these companies. These results indicate that there is both openness and skepticism within the U.S. space sector to the idea that Chinese companies may be commercial in character.

Interviewees were also asked about their perceptions of - and experience with - competition with Chinese companies. 83% of U.S. interviewees did not see Chinese companies as current competition; but 92% of interviewees believed that competition with Chinese space companies is inevitable, and coming sooner rather than later. Only two of the U.S. private sector interviews described current direct competition with what they described as Chinese commercial firms, and both of those interviewees represented companies in the remote sensing and geospatial analysis segment.⁵³ This is particularly notable as outside of the geospatial interviewees, launch was consistently recognized as the segment where competition was expected. A venture capitalist explained *“I don't see [the U.S. startups and early phase companies I work with] actively worried about competition from China...[but] most of the companies I'm working with are not launch companies.”*⁵⁴ A business development executive at a U.S. in-space logistics company said *“from what I've seen and based on what's been publicly reported, it does seem like they're pushing really hard to compete with us on launch...”* However, neither launch company interviewee recognized China as a current or near-term commercial competitor. As a business development executive at a U.S. launch

⁵¹ Braun V., and Clarke. V., “Using Thematic Analysis in Psychology,” *Qual Res Psychol*, 887 (2006): p. 77-101, DOI: [10.1191/1478088706qp063oa](https://doi.org/10.1191/1478088706qp063oa); Braun V., and Clarke. V., “Reflecting on Reflexive Thematic Analysis,” *Qual Res Sport Exercise Health*, 11:4 (2019): p. 589–597. DOI: [10.1080/2159676X.2019.1628806](https://doi.org/10.1080/2159676X.2019.1628806)

⁵² Braun V., and Clarke. V., 2019

⁵³ The interviews conducted did not include any satellite telecommunications operators or any satellite manufacturers. These are notable gaps, and the project team would expect that competition also exists in these segments currently.

⁵⁴ Throughout this whitepaper quotes are italicized when they are directly from interview transcripts.



provider explained: *“none of our customers take [Chinese commercial launch] seriously, but as soon as customers bring it up, we would take it seriously.”*

Interviewees were generally unsure of the nature of that future competition, though they expect it in terms of interactions in third-country markets and largely based on price. At the same time interviewees were uncertain of the rules or norms through which Chinese companies will interact in international markets, and were uncertain about the role the Chinese government might play in supporting and enabling Chinese companies as competitors. In general U.S. interviewees saw Chinese commercial space competition as a future threat - in fact all U.S. private sector representatives interviewed described an expectation of future direct competition with China, regardless of their business segment or role.

While there was near universal agreement that competition would be coming from China, there was a surprising amount of uncertainty of who the actors behind this competition would be. This uncertainty was best captured in the lack of consensus over whether there actually are commercial space actors in China. However, while there was little agreement over whether there are Chinese commercial space actors, this largely could be reduced to differences in how interviewees defined “commercial space”. Most interviewees had similar questions and concerns over specific aspects of how space companies in China operate.

Table 2: Are There Commercial Space Companies in China?

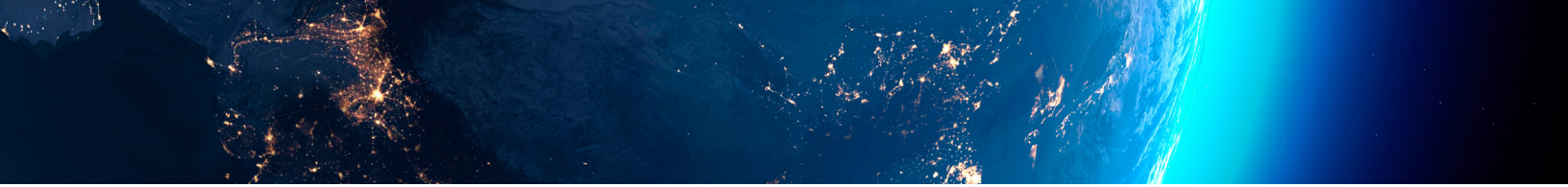
Yes	Uncertain/Unclear	No
4	7	4

Most interviewees described themselves as “not expert” or “not particularly knowledgeable” in matters related to China’s space activities, and many acknowledged that their perspectives of Chinese commercial space are heavily influenced by larger perceptions and expectations of China based on the geopolitical relationship between the U.S. and China; rather than on experience or knowledge specific to the Chinese space industry. The lack of certainty around whether or not China has commercial space activities perhaps reflects this lack of specific knowledge. Most interviewees were not specifically engaged in tracking Chinese space activities - with few exceptions it was not seen as relevant to business - and described their information sources on Chinese space activities as limited to a small set of industry trade publications and analysts. Some interviewees described this as a situation of information been accessed primarily through a small set of ‘gatekeepers.’

Those in U.S. industry that we interviewed that were actively engaged in following Chinese space activities were largely doing so out of personal interest, rather than out of professional imperative, with a notable exception of interviewees in the geospatial segment who noted that there was current direct competition. Most U.S. interviews agreed with the statement that more information is available in China on U.S. space activities than there is in the United States on Chinese space activities. Very few interviewees could name a specific Chinese space company, and most who could named large state-owned aerospace enterprises (e.g. CASIC, China Great Wall Industry Corporation). The few interviewees that did describe some confidence in having information sources on Chinese space industry activities described relationship-based access to information. These interviewees - in the geospatial and financial segments - described a higher confidence level in accessing information on activities in China, based on contact networks in China and elsewhere in the region (e.g. resellers, suppliers, or brokerage firms) which provided access to information not easily accessible in the United States.

Perceptions Inextricably Linked to Overall Geopolitical Context

It clearly emerged that U.S. perceptions of the Chinese commercial space sector are inextricably linked to broader perceptions of the overall U.S-China relationship. As a member of the legal staff at a U.S. space exploration company



says, “we’ve got our collective opinion about China, right? And that collective opinion I would say is outside the industry, is skewed and influenced by political winds and by different parties and a numerous amount of other influencers anywhere between social media, to the news media, to politics. And then we’ve got the collective opinion within the industry, within the commercial space industry about what is going on with China.” A CEO of a U.S. in-space logistics company put it even more directly, “Space is closely tied to a nation’s strategic objectives, so we have to see in terms of great power competition, which can then simplify dynamics between the U.S. and China: good guy / bad guy camp.”

The point interviewees are raising is that perceptions of Chinese commercial space activities in the U.S. community cannot be separated from perceptions of the overall competitive and strained relationship between the two countries and from overall perception of a values competition between the U.S. and China. This is reinforced by articles in the U.S. space trade press which often discuss Chinese space activities in the context of larger geopolitical issues.⁵⁵ Necessarily, U.S. perceptions of Chinese commercial space activities cannot be entirely or even partially separated from perceptions of the overall competition between the two countries. It is important to note that this dynamic is likely mirrored on the Chinese side as well. A 2020 analysis by Kevin Pollpeter finds “that Chinese perceptions of the U.S.-China space relationship are a reflection of the overall U.S.-China relationship.”⁵⁶

In this context China – and its space activities – are viewed as geopolitical (as distinct from market) competition to the United States, and seen as a stimulus to motivate strategy and resources on the U.S. side. Interestingly some U.S. interviews expressed an expectation that a similar dynamic would exist on the Chinese side of the bilateral. As a CEO of a U.S. in-space logistics company said: “[China is a competitive]...threat that motivates technology spending, [and one] would assume the same on the Chinese side...the U.S. as a stalking horse for China.”

The geopolitical context also clearly influenced U.S. interviewees’ willingness to engage in conversations about Chinese commercial space. During the interviews a clear theme of reticence and concern about even talking about Chinese space activities emerged. Interviewees expressed concern that being seen as engaging with China could pose a risk to their relationship with U.S. government customers. As a business development executive at a U.S. space exploration company said: “a big part of that is because of our sensitivity to wanting to do business with NASA and the restrictions that NASA has. And I think there’s a general concern that we have even just the perception of interaction could draw significant controversy, even if there’s no wrongdoing per se. And we try to steer clear of that completely. And I’m guessing that many of our colleague companies do the same.” This sentiment was echoed by a business development executive at a U.S. in-space logistics company: “because of the work that we do for NASA and the work that we do for DoD, [engagement with China] is a ‘do not pass go, go straight to jail, do not collect \$200’ thing. And so we very much have shied away from that because of the sensitivities that our most steadfast customers have on that front.”

⁵⁵ See e.g.: Cheng, Dean, “Op-ed | China Must Be Held Accountable for Its Actions on Earth and In Space.” *SpaceNews*, August 19, 2020, accessed November 20, 2020, <https://spacenews.com/op-ed-china-must-be-held-accountable-for-its-actions-on-earth-and-in-space/>; Beames, 2020; Weichert, 2020

⁵⁶ Pollpeter, Kevin et. Al.; 2020. p.2.



Example: The Issue of Intellectual Property Theft

The threat of intellectual property (IP) theft is an example of one particular issue area where U.S. commercial space stakeholders' perceptions of Chinese commercial space is inextricably linked to the larger context of the dynamic between the two-countries.

Most U.S. interviewees – regardless of background or specific role in the space sector – raised concerns about Chinese theft of intellectual property (including both technology and business/finance IP). Several were able to relate specific anecdotes of IP theft or lack of respect for IP protection by Chinese actors. This topic – which has been written about extensively in U.S. trade publications – is of almost uniform concern within the U.S. commercial space sector as it pertains to interactions with Chinese actors.⁵⁷ As a CEO of an U.S. in-space logistics start-up says *“I fully expect that there’s somebody taking everything off my computer and replicating all of the best bits in China and one day they’ll come along and come meet with me commercially and possibly wipe me out. That’s a real threat to my business, but right now there’s absolutely nothing I can do about it.”*

However, many interviewees also noted that industrial espionage is a fact of life in a technology driven market. As a business development executive at a U.S. space exploration company said: *“We had another company that wasn’t Chinese at all, from another part of the world that has tried to very closely emulate what we’re doing, and did some things that were not really above board in terms of how they were trying to get information with how we did business. So I’m just in general just very cautious and wary of that.”* A business development executive at a U.S. in-space logistics company notes that IP protection and anti-theft provisions are just *“something that we’re aware of and as we’ve grown as a company, we’ve done a lot of work to make sure that we have an IP protection strategy.”*

The distinction that interviewees seemed to be making between IP protection threat perceived from Chinese actors and the general business imperative to protect IP, was a perception of pervasiveness and state-sanction of IP theft in China. As a U.S. space focused venture capitalist said: *“this perception that I have, that I know others share, that these [Chinese commercial space companies] are really state-owned actors that are probably just trying to partner with us to steal our data and our IP. I think there’s a lot of reticence to get into those types of relationships because there are some serious trust issues.”* Concern on this issue is not limited to the space sector. The CEO of the U.S. in-space logistics start-up told us: *“China’s reputation for taking IP and replicating it. And because of the perceived assistance from the government to do that, that does make American companies more worried about that. And Australian and Canadian companies as well and there’s nothing that’s particular to the space industry.”* This sentiment is echoed by another American space-focused venture capitalist, who told us that even if she were advising *“a toy company, I would caution them that their IP would get taken in China.”*

⁵⁷ See e.g.: Rohrlach, Justin and Fernholz, Tim, “China is Trying to Steal Military Space Tech. The US is Running Stings to Stop It,” *Quartz*, September 16, 2019, accessed October 20, 2020, <https://qz.com/1702414/inside-the-fight-to-keep-us-military-space-tech-out-of-china/>; Autry, Greg, “Beijing’s Fight for the Final Frontier,” *Foreign Policy*, April 2, 2019, accessed October 20, 2020, <https://foreignpolicy.com/2019/04/02/beijing-is-taking-the-final-frontier-space-china/>



Perceived Strengths and Weaknesses of Chinese Commercial Space Sector


U.S. interviewees were also asked to discuss what they perceived to be the key strengths and weaknesses of the Chinese commercial space sector. Interviewees' responses to this open-ended question were generally focused through a lens of potential competition. The responses represent U.S. stakeholders' perception of the strengths and weaknesses of the Chinese private or commercial space sector in comparison to the U.S. commercial space sector. Discussion of strengths largely focused on the perceived attributes of the Chinese space sector that might place U.S. organizations at a disadvantage in international competition.

Commonly mentioned perceived Chinese strengths and advantages included:

- Government Support: In a perspective that was shared by multiple interviewees, the CTO at a large U.S. remote sensing company explained that *"I certainly believe that there is a lot of government support behind those businesses. They've been very open and overt about it."* Interviewees gave several perceived examples of the types of this support, including transfer of technology from SOEs to commercial companies; aid from the government in completing foreign acquisitions; government subsidies; an ability to offer packaged inclusions (launch, insurance, financing, etc.) as part of international sales; and linking of the space industry to foreign policy initiatives.
- Long-term Outlooks: Interviewees described a perception that China's space sector benefits from a long-term strategic approach to space program development and objectives, including both government and private sector activities. This perception includes funding sources, where interviewees described a perception that Chinese funders (public and private) take a more patient approach to expectation of outcomes than do their U.S. counterparts. In these comments there is an implied weakness in the American system to take a long-term or strategic approach; as the CEO of a U.S. space logistics start-up stated: *"a big advantage in China is that they appear to have a long-term strategy that doesn't get interrupted every four years. And so they're able to execute on programs in ways that Americans are not able to execute."*
- Less Restrictive Business Ethics Requirements: Some interviewees described a perception that Chinese companies operate under a less restrictive business ethics and reporting compliance regime than do U.S. companies. This led to concerns about corruption and unfair business practices that might advantage Chinese entities in less developed markets. As the CEO of a U.S. in-space logistics company stated: *"it tilts business in an unfair way. [I] would like to see China get on board, and get on a level playing field in terms of corruption to create an even market."*
- Cost Advantage: Interviewees described both expectation and experience that Chinese firms are able to offer both lower costs and pricing compared to U.S. firms. These cost advantages were as both based on "legitimate" market factors (lower labor and supply input costs), and non-market factors (e.g. subsidies, government support). The CEO at an U.S. in-space operations company described the Chinese commercial space sector as *"a threat to us because they're legitimately lower priced;"* while a space focused venture capitalist described a concern that *"if a competitor is funded by the Chinese government and can offer product or service at much lower costs, because they have that government subsidy, that could knock one of my portfolio companies out of the ring."*

Discussion of weakness generally focused on factors the interviewees suggested might limit the competitive relevance of Chinese firms in international space markets. Commonly mentioned perceived weaknesses of Chinese space industry activities included:

- Opaqueness of Structure and Business Practices: Several interviewees expressed a view that the opaque nature of the structure and function of the Chinese space sector (including lack of clarity around business norms; and concerns about information flows from companies back to the Chinese government and



military) might limit the competitiveness of Chinese firms at the international level. A finance sector executive stated that “there aren’t the same disclosure levels, especially when you’re looking at a private company in China” and that this might limit willingness of foreign firms to invest in Chinese entities. The CTO at a large U.S. remote sensing company described legal concerns over engaging in potential sales to Chinese entities, because of lack of clarity around end-use and ownership, saying that in *“a few instances, some of those companies have come to us wanting to buy spacecraft with sort of an unclear end use and unclear financial backing. So we’ve had to dig in pretty hard to those opportunities to understand who the end customer was and whether it was legal for us to export to.”*

- Negative Brand Association: Interviewees suggested that overall perceptions of China as a bad actor on the global stage, including lack of respect for intellectual property protection, might act to limit commercial success of Chinese space companies. A space focused venture capitalist described that China does *“themselves a disservice by continuing to be bad actors in the worldwide ecosystem. I think that they could be much more successful commercially if we didn’t all hold these views about the state of China.”* Interviewees also expressed an association with Chinese space companies and lower quality parts and services than U.S. or European suppliers.

In considering the outlook for a fair or defined competitive landscape with the Chinese space sector, the role of the Chinese government in influencing the terms of that competition and in how Chinese space companies conduct international business was a central issue for U.S. interviews. Interviewees often described outlook for competition with “China” rather than an outlook for competition with Chinese companies – expressing skepticism that competition would evolve free of a government role. For example, one business development executive with a U.S. space launch provider explained that they viewed China as a potential source of competition for commercial sales but that they expect that any Chinese competitor will be a government entity and not commercial.

U.S. interviewees expressed questions over the degree to which Chinese companies could operate independently of state control or goals. A government affairs executive at a large U.S. remote sensing company told us their firm competes with Chinese actors *“with capabilities that in some way, compare to ours with growing capabilities that perhaps will even more so compare to ours in coming months and years. [However]... they do not mirror us in the sense of true independence in terms of funding and such.”* A business development executive at a U.S. space exploration company reflected: *“I’d be very interested to understand exactly what kind of relationship exists with these quote unquote independent companies, and the government itself.”* Several interviewees in the space launch and space exploration segments described anecdotal examples of Chinese actors being able to offer solutions packaged with government services or support that the U.S. commercial entities did not have similar abilities to offer.

A key concern expressed during the interviews was an expectation that Chinese competition would result in downward pricing pressure - perhaps not entirely based on market factors on the Chinese side. Many U.S. interviewees described either expectation or experience with price competition with Chinese space services or products. As a CEO of a U.S. in-space logistics company told us, Chinese companies have a *“cost advantage, the Chinese come in with lower costs for reasonable quality. But better quality and reliability is an advantage on the U.S. side; nonetheless many decisions largely are driven by cost.”* Some interviewees were concerned that, even in a theoretical environment of fair and open competition, this cost factor would have deleterious effects on the overall development of the space economy. In the words of a Chief Strategy Officer at a large U.S. remote sensing company: *“I’m concerned that there’s going to be a bit of a race to the bottom, and it’s not going to be a very attractive market to get into for companies that are truly building a commercial business, which then is less attractive for entrepreneurs, less attractive for Western investors.”*

This concern was echoed by other U.S. interviewees who looked to history of Chinese commercial activities, and competition, in other technology sectors, and saw cause for concern for U.S. competitiveness. One interviewee



pointed to the UAV / drone industry, where the production base has shifted from the U.S. to China. Another, a Chief Technology Officer at a U.S. remote sensing company, in speaking about the evolution of Huawei and other large Chinese information technology companies described how he *“saw how very slowly through price pressure and these kinds of international strategies and partnerships, they were able to expand that capability and really dominate the sector and kick out stalwart U.S. firms that you would have never thought would be disrupted. And I very much worry about that same pattern repeating itself in space.”* These concerns highlight the need to understand the nature of competition between the U.S. and Chinese space industry sectors including factors such as: source of cost and price advantage, roles of government in providing subsidy and packaged inclusions, and the degree to which Chinese companies look to compete in international markets.

U.S. Stakeholders Welcome Competition – Under Fair and Defined Rules

Most interviewees expressed a general attitude of being open to, or even welcoming Chinese competition, but looked for it to be under fair or at least defined terms. As a Chief Strategy Officer at a large U.S. remote sensing company told us *“I welcome dialogue with anybody, I welcome true competition with anybody. It makes us better. And I generally think that that actually supports more of a competitive free market society, such as those that we enjoy in liberal democratic governments.”* Some interviewees expressed viewpoints that better understanding the terms or rules of competition and the structure of the commercial ecosystems could help businesses in both countries develop success.

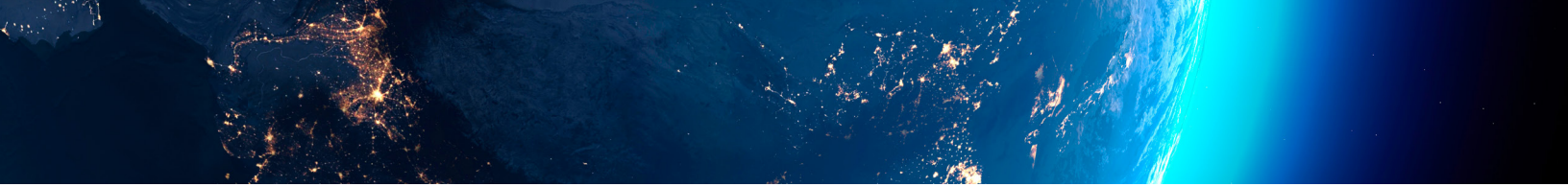
Referring to a better understanding of the rules and norms to which Chinese companies operate, the CEO of a U.S. space logistics start-up explained *“I can come up with a strategy if I know the rules. Without knowing the rules, I’m just pushing forward in the dark.”* A U.S. space-focused venture capitalist suggested *“that [Chinese commercial space actors] are doing themselves a disservice by continuing to be bad actors in the world ecosystem. I think that they could be much more successful commercially if we didn’t hold all these views about the state of China.”* The suggestion here is that by making more information available on the nature and structure of activities, private space companies in China might be able to become more relevant globally.

5.0 ANALYSIS • DISCORDANT NARRATIVES

In the previous section, this paper presented the most common perspectives that emerged from interviews with U.S. commercial space stakeholders. Very few interviewees recognize China as a current competitive threat, and literature generally supports this assessment.⁵⁸ However, an overwhelming majority believe it is coming. Every interviewee expressed that more information is necessary and that it would be beneficial for strategic decision making, yet another common theme was that few are trying to better understand current dynamics and generally do not know how to get information on what is happening. Unsurprisingly, in this context these interviews revealed significant gaps in U.S. stakeholder awareness of commercial space activities in China.

As commercial stakeholders, the individuals interviewed for this research saw the Chinese commercial space sector predominantly as a future competitor. Therefore, interviewees were most concerned with wanting a better understanding of what that competition will look like. At the most basic level, interviewees primarily wanted to know: who will their competition be, what resources will they have, and by what rules will they operate? The answers to these questions will directly impact the development of business and policy strategy in the U.S. commercial space sector.

⁵⁸ Laskai, 2019.



In the following section, we will not try to answer these questions. Instead, this paper will demonstrate that the answers to these questions are far more complex than commonly available information suggests. What follows is a collection of narrative threads from available literature and Chinese discourse that significantly diverge from common themes expressed in the interviews. These findings will not be an exhaustive presentation of U.S. and Chinese literature on the topic of Chinese commercial space, and they will create more questions than they answer. However, the questions that emerge from this analysis will provide U.S. researchers, business professionals, policymakers, and investors with a path to better understanding and preparing for this emerging competitor.

Who Will the Chinese Competition Be?

Is There Commercial Space in China?

Perhaps the most basic yet substantial gap in understanding was over whether there actually is a commercial space sector in China. Interviews and literature describing China's future role in the space industry (whether as a threat to U.S. national security or as a competitor on the global stage) spend little time differentiating between commercial and national Chinese space actors.⁵⁹ Part of this is due to the fact that the term "commercial space" is without a clear definition and means different things to different people.⁶⁰ Another challenge is that information on Chinese companies' finances and government ties is not easily accessible, making it difficult to determine what companies would be determined 'commercial', even if there was an industry consensus of what that definition is, and how it would apply to Chinese companies.

For this research, what is most important about this challenge is that there is a lack of clarity over which actors will be competitive with U.S. companies in the future. China is recognized as pursuing commercial activities in space, but U.S. stakeholders commonly view China as monolithic with the Chinese government and its extensions as the sole driving force of Chinese commercial space. Therefore, there is skepticism to the idea that there are private or semi-private entities with purely capitalistic drivers behind their actions. As per a CEO of a U.S. in-space logistics company, the *"political and economic ideologies in China are diametrically opposed to the U.S., and industry (although it may function as commercial in some aspects) is largely driven by and responding to needs of the state."* A space focused venture capitalist more directly expressed their skepticism: *"A commercial space sector, without state owned industry backing or government tentacles, I don't know... I'm pretty sure there's probably some linkage to the government somehow."*

While this perspective is fairly common, and may have its own merits, it is important to recognize that the Chinese commercial space ecosystem is far more complex than is widely recognized and is rapidly evolving. An investigative review of Chinese space media and introductory conversations with Chinese stakeholders reveals several interesting narratives that are not well understood within the United States. Determining the existence or absence of a private commercial space sector in China is a very difficult task due to challenges previously mentioned in this paper. However, there are clear and meaningful reasons to believe that some version either currently exists or is coming into existence. One particularly interesting conversation on the topic of commercial space in China, highlighted below, refers to four different categories of Chinese commercial space companies. A more commonly occurring and compelling narrative discovered in this research is an emerging dichotomy between some Chinese space industry stakeholders and what is referred to as the "National Team" (国家队).

⁵⁹ See e.g.: Butow, Steven J., Cooley, Thomas., Felt, Eric., and Mozer, Joel B., "State of the Space Industrial Base 2020 Report," Air Force Research Laboratory, July 28, 2020, accessed November 20, 2020, <https://afresearchlab.com/news/state-of-the-space-industrial-base-2020-report/>; Cooley, Thomas, Felt, Eric, and Butow, Steven J., "State of the Space Industrial Base: Threats, Challenges and Actions," Air Force Research Laboratory and the Defense Innovation Unit, May 30, 2019, accessed November 20, 2020, https://assets.ctfassets.net/3nanhbfr0pc/3eNw9rNggBYeEYN3RRfupu/41a42d5fad34743caeb24b-9f3eb09998/AFRL_DIU_Report_State_of_Space_Ind_Base_30May2019_Final.pdf; Stokes, et. Al. 2020

⁶⁰ Ronci, Rob, Christensen, Ian, et. Al., "Communicating Value: Investigating Terminology Challenges in "Newspace" and "Commercial Space"" *New Space*, 8:3 (2020): p. 153-163, <http://doi.org/10.1089/space.2020.0023>



One Example of Categories of Chinese Space Companies

During one conversation with a Chinese national interview subject who is a consultant in China's space sector, the interviewee described a characterization of the four types of commercial space companies in China. It is not clear how widely recognized this categorization of companies is within Chinese space circles, however, it was a vivid example of the potential variations of commercial space companies within China so we believe it is worth describing in detail here. It is worth noting that according to this interviewee, commercial referred to companies that were not explicitly run by the government. State-owned enterprises were considered to be 'traditional space', and in their definition the United States does not have a traditional space sector, but a strictly commercial one.

Type 1: Companies that Emerge from Government-Run Space Programs: For example, companies that stem from The China Aerospace Science & Industry Corporation (CASIC), such as ExPace, were considered a part of this category. These companies have commercial business models and seek private rather than government funding. However, the majority of shareholders are probably within government. They also focus on very large projects.

Type 2: Companies That Are Spin-offs from the Traditional Space Industry: This interviewee considers the spin-off category to mean that *"maybe the traditional space industry only provides some technology, or only provides some people, only provides some initial money. The traditional space industry only takes maybe 20 percentage, or 30 percentage of the shares. They are not the biggest shareholders of this kind of company."* Companies that emerge from The China Academy of Sciences (CAS), such as Spacety, were cited as examples. In this category, significant personnel and resources come from institutes such as the CAS, and the institute itself becomes a significant shareholder.

Type 3: Companies That Are Strictly Private: In this category the interviewee described the common start-up model: *"The private sector means maybe there's only three or four people, they say: 'Well we want to do something exciting and we want to do the space industry thing'. So maybe they will create a new company and they are all of the shareholders of this company, only personal."* All the shareholders in this company type are private and the companies are venture funded. From this definition it is not clear whether these companies are funded exclusively through private capital or if they also take state investment capital as well.

Type 4: Publicly Listed Companies: This category refers to publicly traded companies (on Chinese or international exchanges) who raise capital and shareholders through the public markets. This category may include existing companies for whom space is a new area of activity.⁶¹

⁶¹ Note: this interview took place prior to the September 2020 announcement by Xi Jinping of efforts to increase the role of the Chinese Communist Party in private companies in all sectors of the Chinese economy.



The “National Team”⁶² is a commonly used term in Chinese sources referencing companies and actors, such as the major State-Owned Enterprises, that are run directly for or by the Chinese government. Significantly, the term is commonly used in a manner that distinguishes a company as an “other” or separate from the National Team.⁶³ In China, the comparison of companies that are or are not a part of the National Team is perhaps most similar to the Newspace-Oldspace dynamic in the United States. The term Newspace doesn’t have a consistently used definition in the U.S., but largely refers to the entrance of commercial startups that are fully private, entrepreneurial, and utilize open market business models.⁶⁴ This is intended as a juxtaposition to the traditional Oldspace cost-plus government contractors such as Lockheed Martin and Boeing. Effectively, the term denotes a transition in focus from government to private sector. The term Newspace is also used in China, and is largely portrayed as having a similar meaning. However, as some Chinese stakeholders described to us, in China the term Newspace is mostly used to refer to companies that are simply “new”. Therefore, while most emerging startups are described as Newspace companies, some are still considered part of the National Team. In this context, these companies are seen as government offshoots with direct Communist Party influence. This is significant because there is a clear distinction in identity where “they” are part of the National Team and “we” are not. The existence of this specific “othering” categorization, suggests that there are entities in China that consider themselves as independent from the Chinese government.

Interestingly, while companies can be labeled as part of the National Team, there does not appear to be a clear counter term to describe companies that are not a part of it. There are some instances where they are referred to as “private” or “privately owned” companies, however it does not appear to be a universally accepted label. There are two likely reasons for this. First that these companies are in the early stages of identity formation and have not come up with a term to gather around. Second, that this group is currently less incentivized to clearly identify themselves as separate. In the U.S., Newspace, a clear and semi-confrontational identity, was developed to distinguish smaller privately funded companies as different and more commercially viable than more traditional space contractors. While not without its own challenges or controversies, this identity formation came with positive incentives and was generally acceptable in the U.S. context. For various reasons a similar identity formation appears to have its own unique challenges in the Chinese context.

In a 2019 interview with *ChinaMoneyNetwork* Huo Liang, the founder of Deep Blue Aerospace (a Chinese space launch start-up), stated that “as much as startups can ‘stand on the shoulders of a giant,’ they are equally beholden and constrained by it.”⁶⁵ This statement serves as a succinct introduction to the complex but intertwined relationship between China’s growing commercial space sector and the traditional government run space companies. One illuminating question that emerged during our U.S. interviews was why do Chinese commercial launch companies pursue small launch vehicles when larger rockets would provide an easier business model? The answer to that appears to be because larger launch vehicles belong to the SOEs, and smaller commercial companies avoid competing with their National Team counterparts. The CEO of OneSpace, for example, clearly distinguishes his company’s offerings as separate from what the government providers offer.⁶⁶ This is significant because there also appears to be a clear understanding that private companies could significantly reduce costs compared to their SOE counterparts, and that doing so would provide a lucrative business opportunity.⁶⁷ Qi Shiyang of Chun Xiao Capital, an investor in OneSpace explains “in the short-term the launch cost can be reduced to 50 per cent of the ‘national team’, and just one-tenth in the long run – very competitive.”⁶⁸ Yet despite the potential financial benefits of entering

⁶² For examples of the phrase “national team” directly mentioned in a Mandarin-language source as “国家队”, see Zhijia, 2020.

⁶³ For example see: “张小平跳槽背后：航天国企人才流失严重 两三年换一波” [‘Behind Zhang Xiaoping’s Job-hopping: A Serious Loss of Talents in Aerospace State-Owned Enterprises’], *Interface News*, September 27, 2018, accessed December 2, 2020, https://www.sohu.com/a/256575591_313745;

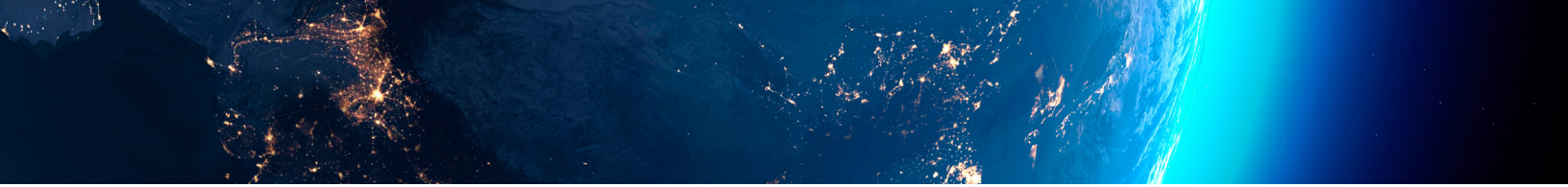
⁶⁴ Ronci and Christensen, et. Al. 2020

⁶⁵ Xiang, 2019.

⁶⁶ Goh, 2018

⁶⁷ “蓝箭航天创始人张昌武：运载火箭研制不是一件特别烧钱的事” [Zhang Changwu, Founder of Blue Arrow Aerospace: Launch Vehicle Development Is Not a Particularly Money-Consuming Thing’], July 10, 2018, accessed December 2, 2020, <https://m.jiemian.com/article/2282243.html>

⁶⁸ Chen, Stephen. “Space the Final Frontier for Chinese Start-ups and Venture Capitalists.” *South China Morning Post*, May 20, 2016, accessed October 22, 2020. <https://www.scmp.com/news/china/article/1947369/space-final-frontier-chinese-start-ups-and-venture-capitalists>



into competition with the more traditional SOEs, it appears that Chinese commercial companies are still avoiding competing directly. Currently, the status quo is for Chinese start-ups to work in support of the National Team and to promote “win-win” relationships.⁶⁹ Some Chinese analysts believe that this will change over time and that private companies will increase their presence in the market, but currently there seem to be strong disincentives in place to avoid competing with the SOEs.⁷⁰ It is difficult to see direct evidence for friction between commercial companies and SOEs, as it is clearly a sensitive subject Chinese stakeholders would prefer to avoid discussing publicly, but in some instances it bubbles to the surface.

One such example is in the movement of employees between SOEs and Chinese commercial companies. A significant number of employees working within China’s private sector have had previous work experience in China’s traditional space industry, and having prior experience in SOEs or government institutions is seen as an asset during the hiring process at private companies.⁷¹ In 2016, over 80% of OneSpace staff reportedly “had more than five years of work experience in China’s top space companies and research institutes including China Aerospace Science and Technology Corporation, China Aerospace Science and Industry Corporation, China Aviation Industry and the Chinese Academy of Sciences.”⁷² Despite the Chinese commercial sector being in its very early stages, there are already significant incentives for Chinese professionals to transition from SOEs to more commercial entities. Reportedly, moving to or starting privately owned companies can result in doubling or tripling one’s salary, as well as allowing for more innovative freedom and limiting painful bureaucracy.⁷³

The resulting outflow of talent from the national team to the private companies, which in recent years has been increasing annually, has created tension and resulted in public debate.⁷⁴ In 2018, a senior employee at Xian Aerospace Propulsion Research Institute, a China Aerospace Science and Technology Corporation (CASC) subsidiary, faced obstruction when he tried to resign and move to Landspace Technologies Company Limited, a private launch company in China. The SOE tried to utilize administrative measures to delay and prevent Zhang Xiaoping from taking a position with LandSpace, and their efforts attracted public attention when related documents were leaked online.⁷⁵ This resulted in a seemingly rare public debate over “inadequate talent compensation within the Chinese state-led systems,” demonstrating that these feelings may be more widespread than is publicly displayed.⁷⁶

Xiaoping’s departure from the Research Institute, and the subsequent leaking of documents from the Xian Labor Dispute Arbitration Committee process following his departure resulted in a public conversation that reveals several points of the tension and competition between the SOE and the private company segments. Xiaoping was subject to a two-year “declassification period” prior to departure from the Institute, due to his access to national security sensitive information, a period he did not observe. In a public statement following the Arbitration Committee document leak, the Institute admitted to exaggerating Xiaoping’s significance in the initial document that was leaked in an attempt to leverage his return to the Institute for the declassification period. Xiaoping himself publicly

⁶⁹ Sikun, Li, “Will China’s Private Aerospace Firms Fall Into Quagmire Like EV Makers?,” *Global Times*, October 29, 2018, accessed December 2, 2020, <http://www.globaltimes.cn/content/1124932.shtml>; “未来宇航 | “2018中国商业航天产业投资报告”发布 [Future Aerospace | “2018 China Commercial Aerospace Industry Investment Report” Released], Future Aerospace Research Institute, May 14, 2019, accessed December 2, 2020, <https://mp.weixin.qq.com/s/ulO66pxt4R3K2Cw46c5KjA>; “张小平跳槽背后：航天国企人才流失严重 两三年换一波” [‘Behind Zhang Xiaoping’s Job-hopping: A Serious Loss of Talents in Aerospace State-Owned Enterprises’], *Interface News*, September 27, 2018, accessed December 2, 2020, https://www.sohu.com/a/256575591_313745; “蓝箭航天创始人张昌武：运载火箭研制不是一件特别烧钱的事 [Zhang Changwu, Founder of Blue Arrow Aerospace: Launch Vehicle Development Is Not a Particularly Money-Consuming Thing]”, July 10, 2018, accessed December 2, 2020, <https://m.jiemian.com/article/2282243.html>; “Xiaomi’s Lei Jun: China will soon catch up with U.S. in satellite Internet,” *cnTechPost*, May 3, 2020, accessed December 2, 2020, <https://cnetechpost.com/2020/05/23/xiaomis-lei-jun-china-will-soon-catch-up-with-u-s-in-satellite-internet/>

⁷⁰ Xiang, 2019

⁷¹ Liu and Linck, et. Al., 2019, p. 42

⁷² Chen, 2016.

⁷³ “张小平跳槽背后：航天国企人才流失严重 两三年换一波” [‘Behind Zhang Xiaoping’s Job-hopping: A Serious Loss of Talents in Aerospace State-Owned Enterprises’], *Interface News*, September 27, 2018, accessed December 2, 2020, https://www.sohu.com/a/256575591_313745; Liu and Linck, et. Al., 2019, p. 41

⁷⁴ “张小平跳槽背后：航天国企人才流失严重 两三年换一波” [‘Behind Zhang Xiaoping’s Job-hopping: A Serious Loss of Talents in Aerospace State-Owned Enterprises’], *Interface News*, September 27, 2018, accessed December 2, 2020, https://www.sohu.com/a/256575591_313745

⁷⁵ *Ibid.*

⁷⁶ Xiang, 2019



admitted to being under “great pressure” to participate in the declassification process.⁷⁷ The Institute appeared “anxious” to have Xiaoping return to “fulfill his contractual confidentiality obligations,” suggesting concern about him transferring expertise to the private company.⁷⁸

The incident also resulted in a public recognition from the SOE involved that SOE’s are in competition with the private sector for talent. Following the public discussion of Xiaoping’s departure, the president of the Research Institute’s parent organization expressed a concern “over the State-owned space institutes’ reduced attractiveness and competitiveness in the contest for talented professionals with private players who have become a rising force in China’s space industry.”⁷⁹ The state media outlet People’s Daily published a commentary asking in part why the Institute was unable to retain this talent.⁸⁰ Other sources have described cultural and management practices in SOEs that result in credit for research going to administrators instead of researchers and promotions being more based on relationships than on performance as element of reducing SOE attractiveness to aerospace sector talent.⁸¹

The transfer of personnel is not the only area where there are challenges for commercial companies to utilize similar resources. Significant infrastructure and manufacturing capabilities are strictly controlled by SOEs or the PLA. Most launch sites for example are controlled by the military, and there are significant hurdles for private companies to access them.⁸² Furthermore, critical components such as rocket engines have been traditionally supplied by SOEs and in some instances this has caused challenges for commercial companies. In 2017 for example, LandSpace had to scuttle plans for a first launch attempt after their engine suppliers pulled out of their agreement, causing what must have been an awkward conversation with investors and early customers.⁸³ Thus, while there is a public emphasis on “win-win” cooperation between the National Team and Chinese private companies, it is evident that there are points of friction between them. Chinese aerospace experts view SpaceX’s cooperation with U.S. government entities as central to its success, but despite this recognition it seems that Chinese private space companies are unlikely to be afforded the same government opportunities as their U.S. counterparts.⁸⁴

There are two key takeaways from recognizing these internal conflicts. First and foremost, they confirm that a non-government run Chinese private space sector truly does exist. If all actors represented the National Team, then there would be little reason for these challenges to exist. Second, these conflicts illuminate many of the weaknesses and limitations of the Chinese commercial space sector. Many of these limitations contradict common narratives about the Chinese space sector that exist within the U.S. commercial sector. The following section will investigate these disparities in greater detail.

⁷⁷ Zhaoqian, Cui, “Key researcher’s resignation sparks online uproar,” *CGTN*, October 1, 2018, accessed January 7, 2021, <https://news.cgtn.com/news/3d3d774d7945544e7a457a6333566d54/index.html>

⁷⁸ Liya, Fan, “Rocket Scientist’s Resignation Sparks Concerns About SOEs,” *Sixth Tone*, September 28, 2018, accessed January 7, 2021, <https://www.sixthtone.com/news/1002983/rocket-scientists-resignation-sparks-concerns-about-soes>; Lei, Zhao, “Rocket institute admits to exaggerating facts about engineer who quit,” *China Daily*, September 29, 2018, accessed January 7, 2021, www.chinadaily.com.cn/a/201809/29/WS5baebdf1a310eff30328025b.html

⁷⁹ Lei, 2018

⁸⁰ Zhaoqian, 2018

⁸¹ Liva, 2018

⁸² Chen, 2016.; Lasakai, 2019.

⁸³ Lasakai, 2019.

⁸⁴ Liu, Danghui and Yin, Yunxia, “Opportunities and Challenges in Commercial Space Launches [商业航天发射的机遇与挑战],” *Journal of Aerospace Science and Technology*, 6:4 (2018), <https://doi.org/10.12677/JAST.2018.64007>; Cao, Cun, “Analysis of SpaceX’s Latest Civil-Military Integration [SpaceX 公司最新军民融合实践分析],” China Academy of Launch Vehicle Technology R&D Center, November 2017, accessed October 21, 2020, <http://www.doc88.com/p-9962814377552.html>



The Impact of SpaceX

A key trend in the growth of China's commercial space sector is "the increased proliferation of private space companies. Launch companies alone include LinkSpace, OneSpace, iSpace, LandSpace, and ExPace (though ExPace is largely funded by CASIC and only nominally private)."⁸⁵ The personality of SpaceX spans across the space community, and China is no exception. SpaceX is a common topic throughout Chinese language sources on space, with several articles asking "Is ___ the new SpaceX?" The emergence of these companies, their seeming focus on the international commercial launch market, and the frequent comparisons (both by themselves and by media) to SpaceX, has contributed to a narrative around expectations of competition in the launch segment. However, a review of literature and discourse results in a more nuanced picture.

Chinese start-ups have clearly been inspired by the success of U.S. companies. STPI reports that "the publicity around Western space start-ups such as SpaceX and OneWeb has encouraged many individuals in China to establish their own companies. Many founders of Chinese space companies cite these Western companies as sources of inspiration; they strive to emulate founders like Elon Musk and Jeff Bezos."⁸⁶ For instance Chinese launch start-up OneSpace "has vowed to become China's version of U.S. rocket launch firm SpaceX"⁸⁷ and the firm's CEO, Shu Chang, has "said that he doesn't mind if others call them the Chinese version of SpaceX."⁸⁸ Yet Chang also has stated that OneSpace is pursuing a differentiated technology path than SpaceX and "wants to be a company like Huawei who has worked hard and done particularly good technology."⁸⁹

The inspiration that Chinese launch start-ups draw from SpaceX may be less about technology and more about identity and visibility. As STPI reports from its interviews with the Chinese space sector:

"according to interviewees, investors are more willing to provide funding for Chinese space start-ups that are modeled after some Western counterpart, lessening the burden on the start-ups to develop their own business models. Without the exemplar Western companies, it would be more difficult for many of these founders to leave their traditional SOE positions and find support in the start-up and VC community."⁹⁰

STPI further reports that Chinese companies may be following a strategy of copycat innovation - looking to learn from the business and market successes of U.S. companies: "Interviewees from several companies noted that they are waiting for U.S. commercial space companies to figure out and understand the needs of the market: who the potential customers are, what downstream applications are feasible, and which business models can be successful."⁹¹

SpaceX may serve as an inspiration for another aspect of China's commercial space development: policy. An interview with a Chinese national conducted for this study reported that "*...the recent Chinese policies on commercial space, I think it's partially due to the pressure from SpaceX, because SpaceX grows very fast and exceeded the Chinese government space in many ways.*" Chinese aerospace sector literature, in both trade press and journals, hold's SpaceX up as an example of successful CMI in the United States. In this view, "SpaceX's close cooperation with NASA and the U.S. Air Force, which yielded the company access to technical support, spin-off technology, and lucrative contracts, was central to its success."⁹²

⁸⁵ Curcio, Blaine and Lan, Tianyi. "Analysis | The rise of China's private space industry." *Space News*. May 25, 2018, accessed October 21, 2020, <https://spacenews.com/analysis-the-rise-of-chinas-private-space-industry/>

⁸⁶ Liu and Linck, et. Al., 2019, p. 22

⁸⁷ Chen, 2016.

⁸⁸ "零壹空间创始人舒畅：造火箭的85后" *cqnews.net*. September 21, 2018, accessed October 21, 2020, http://cq.cqnews.net/cqqx/html/2018-09/21/content_50068054.htm

⁸⁹ *Ibid*

⁹⁰ Liu and Linck, et. Al., 2019, p. 22

⁹¹ Liu and Linck, et. Al., 2019, p. 75

⁹² Laskaj, 2019



What Resources Will Chinese Commercial Space Companies Have?

After the question of whether or not a true Chinese commercial space sector exists, the most prevalent questions U.S. interviewees had were over what kinds of resources Chinese companies will have. Specifically, what financial, strategic, and policy support will they enter the marketplace with. This whitepaper does not seek to examine the funding available to private and non-private companies (e.g. SOEs and other government owned entities). It is difficult to completely track the financing sources of Chinese companies, and is not realistic within the scope of this research. Nor does this whitepaper seek to detail or analyze the full strategic plans and operations of any Chinese entities. However, some critical common narratives emerged during our interviews with U.S. stakeholders that we want to specifically call into question. First, is the perception that Chinese companies have access to near unlimited funding from the central government or CCP. Second, that Chinese companies will have an advantage over U.S. companies due to more long-term vision in both national strategy and investment outlooks. Finally, that the central government directly supports, engages with, and controls Chinese commercial space companies.

Central Government

Several interviewees expressed the view that Chinese space companies have substantial, if not unlimited, financial support from the central government. Several U.S. trade press and government commissioned works further echo this idea, with the warning that U.S. companies require substantial support in order to keep up and maintain their competitive advantage.⁹³ However, it appears that Chinese commercial companies struggle with obtaining funding from the central government. Notably, Chinese trade press articles often mention the U.S. government's strong support of American space companies as an advantage of the U.S. commercial sector, with the relationship between NASA and SpaceX not going unnoticed.⁹⁴ For example, a senior researcher at CASIC was quoted in China Daily: "The rapid rise of SpaceX can't be copied in China because NASA has granted it an unprecedented level of support, ranging from infrastructure and technology to experience."⁹⁵ This comment reflects one of the challenges faced by Chinese space startups - there is no Chinese NASA equivalent in terms of a large government customer that private companies can sell to or maintain a symbiotic relationship with. Some companies have managed to sell to SOEs, but it is common to hear that Chinese companies are focused on customers outside of the government.⁹⁶ It is also not uncommon for many of these companies to say that they have yet to identify customers and are instead focused on obtaining funds via the largest current source of capital, venture capital.

Venture Capital

The success of western companies has inspired not only entrepreneurs and engineers to try their own hand at more commercial endeavors, but it has attracted Chinese venture capitalists as well, with over \$314.2 million invested in Chinese companies in 2019.⁹⁷ The majority of this funding went to two Chinese companies, Qianxun Spatial Intelligence (\$141 million) and LandSpace (\$85 million).⁹⁸ According to Euroconsult's 2020 China Space Industry Report, private funding has been the primary source of capital for Chinese commercial space companies since 2018.⁹⁹ Much like their Western counterparts, these investors are often high net-worth individuals that made

⁹³ See e.g.: Beames, 2020; Butow, Steven J., Cooley, Thomas., Felt, Eric., and Mozer, Joel B. "State of the Space Industrial Base 2020," July 2020, accessed October 22, 2020,

https://cdn.afresearchlab.com/wp-content/uploads/2020/07/27223753/State-of-the-Space-Industrial-Base-2020-Report_July-2020_FINAL.pdf

⁹⁴ Lei, 2018; Dingkun, Hu, "American Counterparts are Taking Off, China's Private Aerospace Grows Stronger," (Cory Fitz, Trans.), Science and Technology Daily, May 27, 2019, accessed December 2, 2020, <https://docs.google.com/document/d/1ekBtNcCrTSr9cEvWAOsD6KUzstFRFPDMvvy2aVPtRHY0/edit>; Zhijia, 2020; Liu and Yin, 2018

⁹⁵ Zhijia, 2020; and Lei, 2018

⁹⁶ Liu and Linck, et. Al., 2019, p. 87; APSCC E-Series #4. (2020, July 21). *China Commercial Space – Reaching a Turning Point?* [Webinar] <https://www.youtube.com/watch?v=v6B4IKQIQ4U&feature=youtu.be> Accessed October 22, 2020

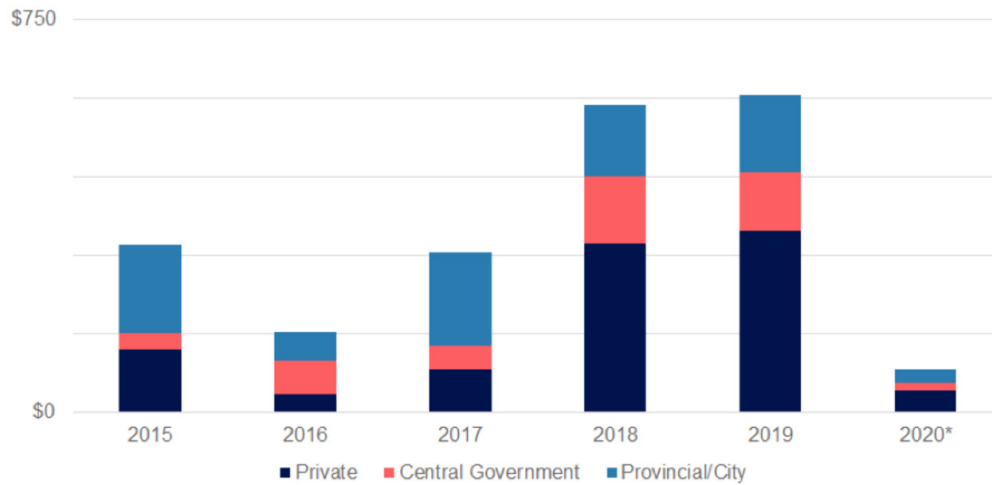
⁹⁷ Bryce Space and Technology, 2020, p. 36; Liu and Linck, et. Al., 2019, p. 22; Sikun, 2018

⁹⁸ Bryce Space and Technology, 2020, p. 36

⁹⁹ Euroconsult. "China Space Industry Report 2020" <https://digital-platform.euroconsult-ec.com/product/china-space-industry/>



Funding for Chinese Commercial Space Companies by Source (US\$ M)



Source: Euroconsult Estimate. *2020 figure is through May 2020

money in other industries and were later drawn to space.¹⁰⁰ Some of these private investors are Chinese affiliates of American VCs (e.g. Sequoia China, Matrix Partners China). Types of space companies being invested in are increasingly wide ranging.¹⁰¹ However, while private funding levels are rising quickly in China, they are still well below what is occurring in the U.S. and there are significant challenges for commercial companies obtaining this funding.¹⁰²

Multiple interviewees either involved in or familiar with VC funding, described a sense that Chinese investors had more long-term view to their returns than their U.S. counterparts. This would give Chinese companies an advantage over U.S. companies to have more time before they must start generating revenue. However, the opposite appears to be true. According to STPI’s research, Chinese investors actually have shorter timelines than western VC’s; reportedly often as short as 3 years.¹⁰³ This challenging timeline paired with a lack of clear customer base has led several Chinese private space companies to engage in “creative” revenue generating activities outside of their intended capabilities in order to generate income until their primary plans can come to fruition.¹⁰⁴ Therefore, while venture capital is more readily available than central government funding, it remains a significant challenge for private commercial companies. In general, the state and the National Team are able to operate on longer timelines, as they can set rules and expectations; whereas commercial investors and private aerospace companies must operate with shorter timelines, as they are subject to changes outside their control. Outside of private funding, provincial and local governments have generally provided more and more reliable sources of capital.

Provincial Funding

Until 2018, provincial and city government funding was the primary source of capital for Chinese commercial space companies.¹⁰⁵ Broadly, provincial governments in China represent a much larger share of total government spending

¹⁰⁰ Astropreneurs. “The Landscape for Space Startups in China,” August 31, 2017, accessed November 30, 2020, Cached version. <http://webcache.googleusercontent.com/search?q=cache:HnpBLwknBUJ:astropreneurs.space/2017/08/31/landscape-space-startups-china/+&cd=1&hl=en&ct=clnk&gl=us>

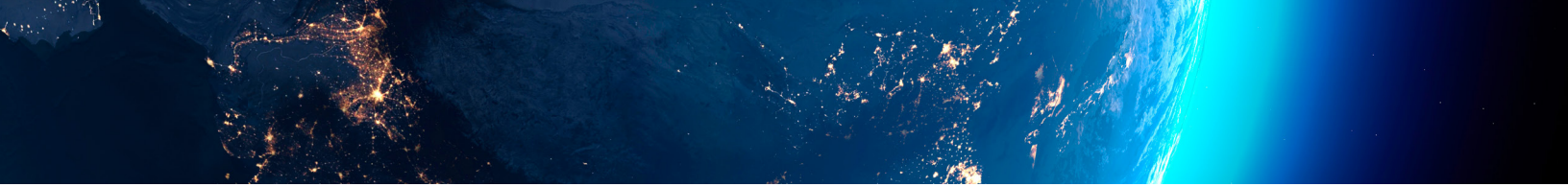
¹⁰¹ Chen, 2016

¹⁰² Liu and Linck, et. Al., 2019, p. 85

¹⁰³ Liu and Linck, et. Al., 2019, p. 33

¹⁰⁴ Liu and Linck, et. Al., 2019, p. 85

¹⁰⁵ Euroconsult. “China Space Industry Report 2020 Brochure”, accessed December 2, 2020, https://euroconsult-ec.com/research/CSI20_Brochure.pdf



than do state governments in the United States.¹⁰⁶ The belief that the central government has direct engagement and control over commercial entities and activities was commonly held with U.S. interviewees. However, most direct engagement appears to occur at the local government level with mostly only “signals” coming from the central government.¹⁰⁷ Analysts based in China suggest that the provincial governments are independently seeking to attract high tech industries and the ensuing workforce to their regions and therefore allow companies to utilize provincial funds without significant oversight.¹⁰⁸ Space is being pursued as part of economic growth and development strategies. A majority of space companies are located close to Beijing, largely due to the high concentration of prestigious science and technology Academies and SOEs.¹⁰⁹ However, significant projects are in development around the country and conversations with stakeholders in China suggest that there is more entrepreneurial freedom and less oversight the further a company develops from the capital city.

As an example of this dynamic, after the April 2020 decision by China’s National Development and Reform Commission added ‘satellite internet’ to a strategic list of “new infrastructures,” several provincial governments have announced plans to make massive investments in the similar kinds of industrial parks, focused around satellite internet and manufacturing clusters. These include the Galaxy Space Satellite Super Factory in Nantong (announced July 2020), the Chengdu-Chongqing Satellite Production Science and Technology Research Center, in Chengdu (announced in June 2020), and an April 2020 announcement that Shanghai will create a “5G + Satellite” communication integration innovation laboratory.¹¹⁰ These parks often have one or more private aerospace companies as a key tenant, and may also have involvement from SOE-affiliated companies or institutes. Other similar initiatives exist centered around space launch enterprises. This is significant because it strongly points to regional actors playing a powerful role in developing the Chinese commercial space sector, and that there are interrelated, yet distinct levels or types of companies involved.¹¹¹ These provincial or local government led initiatives appear to be responding to the signal of interest, as shown in policy statements like that of the NRDC, at the national level, but are themselves competing and seeking to satisfy local economic development goals more than national strategic goals. It is unlikely that all such local manufacturing or innovation parks will be successful. In addition to these satellite internet constellation focused initiatives, there are efforts in other regions to develop satellite manufacturing facilities with the specific objective of establishing facilities that are not directly owned by the SOE aerospace companies. For example, Jilin Province is supporting development of what is planned to be the world’s largest Earth observation satellite manufacturing facility by Charming Globe (CGSTL), a leading CAS spinoff.¹¹²

Long-term Strategic Goals of the Chinese Space Industry Sector

There was a widely held perspective that the Chinese government has a long-term vision of the space industry that will give Chinese space companies a competitive advantage. Several interviewees expressed a belief that the Chinese government provides greater strategic support (whether through ‘packages’, government influence, or an international strategy) than the U.S. government gives the U.S. commercial space sector. However, it appears that Chinese commercial stakeholders have quite the opposite perspective. Several voices in China’s space industry

¹⁰⁶ Kroeber, Arthur. “China’s Economy: What Everyone Needs to Know,” 2016, New York, NY: Oxford University Press

¹⁰⁷ Liu and Linck, et. Al., 2019, p. 18

¹⁰⁸ Xi, Cheng, “中国上百家民营航天公司·都想做SpaceX [Hundreds of Private Aerospace Companies in China All Want to be SpaceX],” *iyiou.com*, August 29, 2019, accessed October 22, 2020, <https://www.iyiou.com/p/110740.html>

¹⁰⁹ Future Aerospace. “2018 China Commercial Aerospace Industry Investment Report” May 14, 2019, accessed October 22, 2020, <https://mp.weixin.qq.com/s/uIO66pxt4R3KZCw46c5KjA>

¹¹⁰ “南通捕获卫星互联网第一只独角兽 银河航天卫星超级工厂落户 [Nantong Captures Satellite Internet’s First Unicorn Galaxy Space Satellite Super Factory Settled]” *Digital Communication World*, July 16, 2020, accessed December 2, 2020. [https://c.m.163.com/news/a/IAATR-VA1051492T3.html?spss=newsapp&from=groupmessage&spssid=42e1999264a7e77a7165c34045c4ce09&spsw=4&isFromH5Share=article](https://mp.weixin.qq.com/s?biz=MjM5MDA4N-jc1Mg==&mid=2650229030&idx=2&sn=3bbd381bbd77a0ba1d9c4d9da68a84e7&chksm=be49ca29893e433f0b3c5ec4911cbfa684f63aaf4ce7ab2ff-cdc1e03e4db4d0bcecaec5da05f&mpshare=1&scene=1&srcid=07167icovQ8mRknp6XAcc13V&sharer_sharetime=1594904854868&sharer_shareid=ce-809c3b756c2303d056b5c983e334b8#rd;“这家成都公司要放“大招”：10000颗卫星打造中国的星链计划 [This Chengdu Company Wants to Put a “Big Move”: 10,000 Satellites to Build China’s Starlink Plan]” <i>Red Star News</i>, July 24, 2020, accessed December 2, 2020, <a href=)

¹¹¹ Curcio, Blaine. “#SpaceWatchGL Opinion: Launching Into the New Decade,” *SpaceWatchGlobal*, November 2020, accessed December 2, 2020. <https://spacewatch.global/2020/11/spacewatchgl-opinion-launching-into-the-new-decade/>

¹¹² Lei, 2020



have expressed a need for additional legislation and policies clarifying the role and scope of China's commercial space sector.¹¹³

The Chinese government has been rapidly producing policies and statements indicating that the growth of the private space sector will be critical to increasing its national space capabilities, but signals of support are not a replacement for tangible laws and regulations outlining and protecting activities available to commercial space entities in China. While China's regulatory environment is rapidly developing to encourage the growth of a commercial sector, private stakeholders are openly expressing the inadequacy of current legislation. One of the primary challenges is that while policy directives have encouraged integration between military and civilian companies, they lack specific regulations and do not establish an active support infrastructure.¹¹⁴ So while the central government has encouraged SOEs and the private sector to work together, there are no effective mechanisms to ensure that it actually occurs. After the 2014 directive, startups were put in positions where they believed they would be able to purchase rocket engines from state-owned enterprises but years later discovered that was not actually an option.¹¹⁵ The CEO of OneSpace, a private launch company with both SOE and provincial government support, clearly expressed the role he would like to see the central government play: "We think that the government should be primarily responsible for guiding a fair competitive environment for private launch companies. For example, as in the United States, the private enterprises and state-owned enterprises can participate in project tenders together."¹¹⁶ Notably, he appears to consider the major U.S. military contractors as state-owned enterprises in the same vein as the major Chinese players. Of additional note, it is quite common to see Chinese stakeholders describing how the U.S. commercial space sector gets far more support than Chinese firms receive. Stakeholders in both countries are effectively using the other in their arguments to get more support from their respective governments.

Summary of Findings

This analysis presented a wide range of findings with two primary objectives. First, to demonstrate that the most meaningful questions U.S. commercial stakeholders have regarding Chinese commercial space are far more complex than is widely understood. U.S. stakeholders firmly believe that competition from Chinese actors is an inevitable outcome. The questions they would like answered are who will their Chinese competition be, what resources will they have, and what rules will they operate by? The answers to those questions will likely impact the business and investment strategies of a wide range of U.S. stakeholders. This research did not attempt to answer those questions, instead this paper highlights the need for more nuanced investigation in order to best understand this rapidly evolving commercial ecosystem.

The second objective of this paper is to highlight that multiple common U.S. narratives regarding China's commercial space ecosystem appear not to reflect reality. First, was the perception that Chinese companies have access to massive amounts of funding from the central government or CCP. Second, that Chinese companies will have an advantage over U.S. companies due to more long-term vision in both national strategy and investment requirements. Finally, that the central government directly supports, engages with, and controls Chinese commercial and private space companies.

While SOEs may get strong support from the central government, more commercial players struggle to access similar financial support. In fact, STPI's report:

¹¹³ "Xiaomi's Lei Jun: China will Soon Catch Up With U.S. In Satellite Internet," *cnTechPost*, May 3, 2020, accessed December 2, 2020, <https://cnetechpost.com/2020/05/23/xiaomis-lei-jun-china-will-soon-catch-up-with-u-s-in-satellite-internet/>; Astropneuers, 2017; Weiren, Wu, "吴伟仁：在航天大国中，只有我国还没有航天法 [Wu Weiren: Among the Major Space Powers, Only My Country Does Not Have an Aerospace Law], *Guancha*. March 9, 2018, accessed September 3, 2020. https://www.guancha.cn/wuweiren/2018_03_09_449502_4.shtml

¹¹⁴ Yuan and Peeters, 2019, p. 206

¹¹⁵ Xiang, 2019

¹¹⁶ Goh, 2018



“found no evidence that the Chinese central government directly subsidizes commercial space companies, especially private companies. The central government has instead published a series of guiding policies that provincial and municipal governments, SOEs, and other public organizations have cited when making decisions to subsidize commercial space activities.”¹¹⁷

However, even these guiding policies fail to fully support commercial activities, as commercial companies struggle with gaining access to national government markets and not being able to enter the same space as their SOE counterparts.

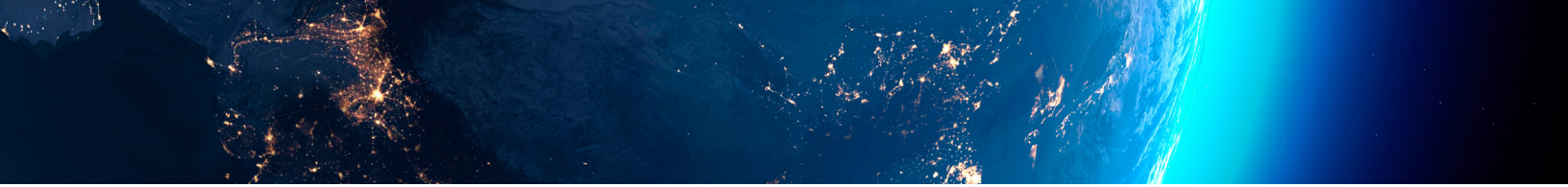
Instead, a majority of private Chinese commercial companies focus their attention on regional governments and venture capital. Regional governments have been a reliable source of funding for China’s commercial space sector. While they do respond to signals from the national government, it is evident that they are focused more on regional economic development rather than contributing to a clear national strategy. Venture capital investment is rapidly growing in China, but the conditions are often more restrictive and with shorter timelines than their Western counterparts. Thus, forcing these companies to engage in revenue generating activities outside of their primary business in order to maintain funding. The realities of venture capital and regional government funding sources suggest that when it comes to the private commercial space sector, that there is far less of a long-term strategy than is commonly suggested.

The future of China’s space industry and its impacts on the U.S. space industry is uncertain, however the rapid growth and long-term ambitions of China’s space industry will remain on the radar of U.S. stakeholders for the foreseeable future. The inescapable overlap/connection between military and commercial technologies can make it difficult to understand the distinction between government and commercial industry, and the political and economic structures of China increase the difficulty of determining where, if at all, the line between government and commercial can be drawn. Despite this, there is compelling evidence of a growing private Chinese commercial space sector that is still finding its footing and carving out its place in the commercial space ecosystem. It has many struggles currently, and it appears unlikely to directly compete with U.S. companies in the near future. However, as it expands this emerging private sector will likely play a significant role within China’s commercial space development and therefore, we firmly suggest that this area be monitored more closely so that non-Chinese stakeholders can have more nuanced and accurate information about the global commercial space ecosystem.

6.0 • CONCLUSIONS AND WAYS FORWARD

The research conducted for this analysis indicates that significant gaps exist in the U.S. commercial space community’s understanding of the goals, positions, and approaches to commercial space activities in China. These gaps range from the structure of the aerospace sector in each country, legal uncertainty regarding trade and competition, to fundamental basics such as whether or not “commercial space” activities actually exist in China. It is clear that there are limited authoritative sources of information on Chinese commercial space that U.S. stakeholders both trust and are able to easily access. Discussions of Chinese space activities in U.S. literature sources often emphasize national security aspects, and treat business implications of developments as secondary at best. Interviewees, and literature sources, with personal familiarity with Chinese industry structure describe the importance of relationships and networks in accessing information on activities and developments in China. Our impression from this research is that U.S. commercial space stakeholders are clearly concerned and interested in China’s commercial space activities, but generally believe that they do not have access to meaningful information about those activities.

¹¹⁷ Liu and Linck, et. Al., 2019, p. 36



The reality of commercial space developments in China is more complex and rapidly changing than often described in U.S. literature. The end result of this is a situation of information asymmetry: U.S. commercial space stakeholders generally have less information on China's commercial space sector than what is actually available; and Chinese space actors generally have more information on the structure and nature of the American space industry than vice versa. There is a clear need for further efforts to better understand the nature of commercial space activities in China. An incredible amount of information exists regarding Chinese commercial space, and conversations with individuals in China reveal a great deal. More effort is required to collect and distill this information to better inform practitioners, policymakers, and investors.

All interviewees believed that more information on Chinese commercial space activities is beneficial for U.S. strategic positioning. This information might be developed through two means:

1. Conducting further detailed research studies on China's commercial space dynamics
2. Hosting and developing opportunities for bilateral dialogue

Perceived Willingness to Engage in Conversation and Barriers to Doing So

A key thematic element of the interviews conducted for this study was assessing openness to and perceptions of the potential to establish sustained opportunities for dialogue between U.S. and Chinese commercial space stakeholders. Most participants in the U.S. interviews stated that a topical dialogue between U.S. and Chinese commercial space stakeholders would be beneficial - only two interviewees outright stated that such a dialogue should not be pursued or would not produce any useful outcomes. Those rejections were related to overall pessimism about the overall direction of the U.S.-China relationship and, separately, a belief that there is no business value in such efforts. Conversely more than half of the participants expressed an explicit perception of value in building mechanisms for bilateral dialogue between U.S. and Chinese actors. The number of participants willing to directly participate in such exchanges themselves was markedly lower, however.

Interviewees perceived that the potential value or benefit of such dialogue might generally fall into three broad categories:

- Reduce potential for conflict, tension, and misunderstandings through more direct discussions, awareness, and reducing of information accessibility barriers.
- Improve understanding of the terms of competition between U.S. and Chinese commercial space actors, in particular in the form of better understanding of the structure of the Chinese space ecosystem and in the role of the Chinese government in the development of commercial space in China.
- Develop business opportunities, either through understanding of how third-party countries are interacting with Chinese actors or through accessible downstream markets in China. This was the least common perceived benefit, and was directly stated as not likely by a number of interviews.

Of these three, the first was the most common. As a business development executive at a U.S. in-space logistics company put it: *"...any opportunity where we can better understand why people think the way they do and, and what values people hold, so that we can better manage our own response to that I think is valuable. And it may just come down to in the end that, you know, maybe they do have, you know, a different value set than we do, and maybe they do have different aims in space than we do. And maybe those are, you know, in conflict and in competition. But if we can understand that we can figure out ways to work around that, that don't lead to hopefully don't lead to armed conflict."* The CEO at an U.S. in-space operations company was even more direct: *"We have China as a threat. China's all sorts of threats: political threat, a strategic threat... a commercial threat. You deal with it by sitting down and negotiating with them."* While expressed by U.S. interviewees, it can be expected that similar rationale would also hold true in China.



As interviewees discussed their perspectives on the potential for a dialogue between the U.S. and Chinese commercial space sectors, one of the perceived benefits that was often mentioned was the potential to learn more about the structure and nature of the Chinese space ecosystem. In general, however, U.S. interviews did not expect tangible outcomes or cooperation to immediately result from such dialogues. As a U.S. in-space logistics company CEO explains: *“dialogue is always valuable, more information is always a good thing, and having a better understanding is always a good thing and can help avoid missteps; track II is admirable and serves a useful purpose even if the outcomes are not immediately actionable; but having said that I don’t anticipate a fruitful outcome in terms of business or bilateral collaboration except potential in the area of exploration (scientific).”* Similar sentiments were expressed by several other U.S. interviewees. Interviewees also expressed concerns about lack of trust as a likely barrier to tangible outcomes. In the words of a U.S. space exploration company business development executive: *“I think we just have to be extremely careful because there’s probably a lack of trust probably on both sides, that you have to wonder then how much information will they be seeking from you and how much do you really want to put yourself on the radar.”*

A key example is the issue of IP theft. Most interviewees described this as a trust issue, yet no interviewee specifically raised this issue as a barrier to dialogue, suggesting instead that space companies were particularly conscious to guarding against this risk during conversations. *“Because of maybe the track record on things like IP theft from the Chinese, it just puts me that much more in a trust, but verify, emphasis on verify kind of mindset”* is how a business development executive at a U.S. space exploration company described his approach in conversations with Chinese counterparts. Other interviewees referenced the security conscious mindset and approach within the U.S. space sector. A CEO at an U.S. in-space operations company put it this way: *“there is not an industry more careful and more educated on the perils of tech transfer than mine. And I have more concerns about Hollywood dealing with China and Silicon Valley dealing with China than I do about my colleagues, who, when we wake up in the morning, we literally warn ourselves.”* Many interviewees were keenly aware of the history of U.S.-Chinese relationships, and IP transfer, in the creation of the current export control restrictions that affect the U.S. space industry today, and noted a security conscious mindset that exists as a partial result.


However as referenced earlier in this paper, many of the interviewees for this study described concerns about risk with their U.S. government customers if they engage in conversations with Chinese entities. If this concern is pervasive within the U.S. space industry, it would present a significant barrier to engagement and dialogue with the Chinese space sector; as it suggests there is an internal U.S. challenge to overcome, before any specific risks and barriers related to direct interaction are even considered. The risk perceived is not solely risk from Chinese competition – but risk to relationships with core U.S. government customers.

Conclusion: Understanding the Nature of Industry Competition

From a market and business perception standpoint, this research suggests that U.S. commercial space stakeholders’ concerns about China’s commercial space activities seem to be largely based on a desire for information to better understand future market conditions, plan strategy, and prepare for competition.

Interviewees generally expressed openness to competition with Chinese commercial or private space companies as they believed that fair competition leads to beneficial outcomes overall. However, the overarching concern was over how fair the competitive landscape would be and whether or not Chinese companies will enter with what the interviewees deemed to be “unfair advantages”. Interviewees were most concerned with wanting a better understanding of what that competition will look like.

In order to develop this improved understanding, we suggest four questions through which the likely terms and nature of future competition between the U.S. and Chinese space industry sectors might be better elucidated. These questions frame a better understanding of the Chinese space industry ecosystem and under each question



specific research topics or themes are further identified. They focus on structure and relationships, instead of the viability of the Chinese space industry, as other analysis has suggested.¹¹⁸

1. *Is there such thing as a private space sector in China, and if so, how is commercial space defined in the Chinese context?* – The Chinese space ecosystem is not a monolith, different types of companies exist, and have a range of interaction types with the central government. This theme of analysis is aimed at understanding the different types of Chinese space companies, and how they operate. Specific research topics which might be studied to add to understanding of this theme include:
 - Can the different types of Chinese aerospace companies (see e.g. example typology suggested by interviewee earlier in this paper) be further defined and matched with real world examples?
2. *What is the nature of internal competition in China's space sector?* – This theme of analysis is aimed at understanding how different types of Chinese space companies interact with each other, and how that relates to how products and services are or are not relevant to the international market. It would explore topics such as: the emerging dynamic of “national team” and others; limitations to government contracting for commercial companies; and human capital competition. Specific research topics which might be studied to add to understanding of this theme include:
 - Further research into movement of employees from SOEs/the National Team to the “private aerospace companies” – to what extent does this occur, what types of employees are moving, do those that move suffer any consequences, are there similar dynamics in other sectors/industries?
 - Analyzing the extent to which Chinese private space companies are motivated by domestic vs international markets. Assessment of where Chinese companies are looking to compete in international markets.
3. *What is the role of the Chinese government in ownership and control of commercial or private space companies?* – This theme of analysis is aimed at understanding how various levels of the Chinese government - including the provincial governments - interact with and influence Chinese space companies and how the activities of China's space industry relate to strategic objectives of China's national space program. Specific research topics which might be studied to add to understanding of this theme include:
 - The relationship of MCF to China's “private aerospace companies” - does MCF present tangible and effective opportunities for companies that are not considered to be part of the National Team?
 - Does the discussion of the “lack of a Chinese NASA” in the Chinese sources reflect reality?
 - What role and objectives do the central government and the provincial governments occupy relative to private space companies?
4. *What resources do/will Chinese private space companies have access to, and will that create “unfair” advantage?* - This theme of analysis is aimed at understanding whether Chinese private space companies have access to support or resources that are unique to them, and how that access informs or relates to the terms of competition in the international market. Specific research topics which might be studied to add to understanding of this theme include:
 - Increased efforts to document the role of private capital and government capital in Chinese private space companies; and whether different types of companies and/or capital entail different timelines and activity types.
 - To what extent are U.S. perceptions of the competitive strengths and weakness of the Chinese space sectors similar or dissimilar to perspectives on the same from other regions (e.g. East Asia, Europe)?

¹¹⁸ See Liu and Linck, et. Al., 2019, p. 94-98



It is evident that there are complex, meaningful, and challenging conversations happening in China about the issues that U.S. stakeholders want to better understand. Unfortunately, many U.S.-based outputs on the topic oversimplify this reality and fail to fully explore the true nuances that exist. These obscurities limit the abilities of commercial stakeholders in both countries to fully navigate and participate in the emerging global space economy. There remain significant gaps in understanding between stakeholders from both countries of goals, positions, and approaches to commercial space development in the other country. In this research we have laid out a set of initial questions, through which improved information engagement between space industry related stakeholders in the United States and China might be framed. Engagement of this type would help improve both policy and business strategy.



APPENDIX 1 • INTERVIEW GUIDE

The following questions were used to guide the semi-structured interviews for this project. Interviewees were provided with a general description of the project prior to the interview, but were not provided with the interview questions in advance of the interview. The project team used these interview questions as the primary structure of the interview, but followed up to the open ended answers with further unplanned probing or clarification questions to gain further depth in responses. These secondary questions were not consistent across all interviews.

Primary Questions

1. How would you describe your role within the space sector?
2. How would you define commercial space?
 - a. Do you perceive China as having a commercial space sector?
3. How would you describe the relationship between U.S. and Chinese “commercial” space sectors
4. How would you describe the relationship between your business activity and the activity in the commercial space sector of the other country? (or alternative phrasing: Do you perceive “commercial” activities in the opposite country to have an impact on your own business activities?)
 - a. How much do U.S. and Chinese commercial stakeholders think about stakeholders on the other side? (as competition, adversary, inspiration?)
5. Strengths/Weakness:
 - a. [For U.S. Interviews]: What are the key strengths/weaknesses of the Chinese commercial space sector?
6. In your opinion - what are the key motivating factors behind the commercial space sector in China?
7. Information Sources
 - a. How/where do you get information about space activities in China/the U.S.?
 - b. Do you believe information coming from China on commercial space activities there is accurate?
8. Do you see any value in maintaining a dialogue between the U.S. and China regarding commercial space activities?
 - a. What subjects do you believe should be discussed in such a dialogue?
 - b. Who do you think should be involved in such a dialogue?
 - c. Would you be willing to participate in such a dialogue?
9. Is there anyone else we should we talk to?



APPENDIX 2 • ADDITIONAL REFERENCES

The following is a list of additional works that the authors reviewed during the course of the analysis contained in this paper, but did not cite in the final publication. They are provided here as additional reference for the readers.

Bender, Bryan, “A New Moon Race Is On. Is China Already Ahead?,” Politico, June 13, 2019, accessed June 1, 2020, <https://www.politico.com/agenda/story/2019/06/13/china-nasa-moon-race-000897/>

Brown, Tanner, “Opinion: Private Sector is no Longer a Bit Player in China’s Big Space Plan,” MarketWatch, January 7, 2020, accessed June 1, 2020, <https://www.marketwatch.com/story/private-sector-is-no-longer-a-bit-player-in-chinas-big-space-plans-2020-01-06>

Dong, Zhenxiang, and Xue, Huifeng, “A Study on the Trend of China’s Space Legislation,” Aerospace China, 18:3 (2017): p. 48-56.

Foust, Jeff “Assessing China’s Commercial Space Industry,” The Space Review, January 27, 2020, accessed September 3, 2020, <https://www.thespacereview.com/article/3872/1>

Gong, Yukun, Qin, Tong, Wei, Wei, and Mou, Ya, “Analysis of International Commercial Space Market and Policy,” Aerospace China, 20:4 (2019): p. 39-48

Goswami, Namrata, “China’s Grand Strategy in Outer Space: To Establish Compelling Standards of Behavior,” The Space Review, August 5, 2019, accessed June 1, 2020, <https://www.thespacereview.com/article/3773/1>

Jones, Andrew, “Chinese Commercial Launch Sector Regulations Released, New Launch Vehicle Plans Unveiled,” SpaceNews, July 2, 2019, accessed September 3, 2020, <https://spacenews.com/chinese-commercial-launch-sector-regulations-released-new-launch-vehicle-plans-unveiled/>

Lan, Chen and Myrre, Jacqueline, “Will LandSpace be China’s SpaceX?,” The Space Review, September 3, 2019, accessed June 1, 2020, <https://www.thespacereview.com/article/3787/1>

Pollpeter, Kevin, Anderson, Eric, Wilson, Jordan and Yang, Fan, “China Dream, Space Dream China’s Progress in Space Technologies and Implications for the United States,” US-China Economic and Security Review Commission, 2015, <https://www.uscc.gov/research/china-dream-space-dream-chinas-progress-space-technologies-and-implications-united-states>

Pollpeter, Kevin, “The China Aerospace Science and Technology Corporation and the Concept of Integrated Innovation: A Case Study,” IGCC, 2013, <https://escholarship.org/uc/item/5dd6x16q>

Rose, Frank, “Managing China’s Rise in Outer Space,” Brookings Institution, April 2020, https://www.brookings.edu/wp-content/uploads/2020/04/FP_20200427_china_outer_space_rose_v3.pdf

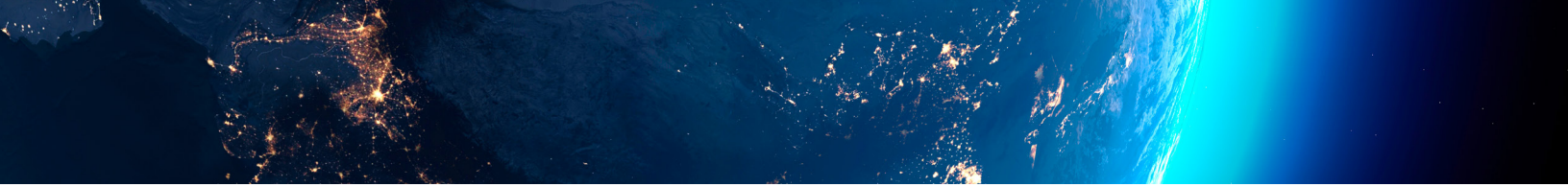
Shen, Xinmei, “Does Elon Musk’s dream of satellite internet for all matter to anyone in China?,” South China Morning Post, May 20, 2020, accessed September 3, 2020, <https://www.scmp.com/abacus/tech/article/3085146/does-elon-musks-dream-satellite-internet-all-matter-anyone-china>,

Wall, Mike, “China Looms as Main Launch Competition, SpaceX Says,” Space.com, October 15, 2013, accessed September 3, 2020, <https://www.space.com/23207-spacex-commercial-launch-competition-china.html>

Wang, Changqing, Yuan, Hongyi, Zhao, Qiming and Liu, Yuxiang, “Reflection on Small Satellite Constellation Operations from the Commercial Space Perspective,” Aerospace China, 20:4 (2019): p. 31-38

Yang, Baohua, “Exploration of CASC’s Commercial Space,” Aerospace China, 19:1 (2019): p. 27-30

Zhou, Yi, “Perspectives on Sino-US Cooperation in Civil Space Programs,” Space Policy, 24 (2008): p.132-139, <http://doi:10.1016/j.spacepol.2008.06.002>



ACKNOWLEDGEMENTS

SWF wishes to acknowledge and thank the more than 15 industry professionals who contributed their time in being interviewed for this analysis; as well as those who served as reviewers for this paper. This work was funded by internal resources of Secure World Foundation and Caelus Foundation, and was not directly supported by any source of external or grant funding.

ABOUT SECURE WORLD FOUNDATION

Secure World Foundation is a private operating foundation dedicated to the secure and sustainable use of space for the benefit of Earth and all its peoples. SWF engages with academics, policy makers, scientists, and advocates in the space and international affairs communities to support steps that strengthen global space sustainability. It promotes the development of cooperative and effective use of space for the protection of Earth’s environment and human security. <https://swfound.org>

ABOUT CAELUS FOUNDATION

The Caelus Foundation is a 501(c)(3) non-profit with a mission to “Bring Space Back Down to Earth”. Caelus Foundation believes that every individual on Earth is a stakeholder in the development of the space domain, and that maximizing the benefits of space requires deliberate and thoughtful engagement from all stakeholders. By focusing on the human elements of space, i.e. diplomacy, commercialization, policy, and public engagement, CF works to expand space industry participation and to shine a light on problematic areas within the space sector. <https://www.caelusfoundation.org/>



U.S. commercial space stakeholders firmly believe that competition from Chinese actors will be an inevitable part of their future decision making. However, beyond this surety there are significant gaps in understanding of how this competitive relationship will develop. For these stakeholders it remains unclear who their Chinese competition will be, what resources they will have, and what rules they will operate by.

By comparing common U.S. stakeholder perspectives with discourse and analysis on China's commercial space sector, this paper highlights where more effort is required to better understand these emerging dynamics.

This research challenges common narratives of a Chinese commercial space sector with unlimited financial support, direct government control, and long-term vision. It illuminates barriers to understanding the complexities and conflicts within China's commercial ecosystem, thus providing nuance for one of the most challenging and heated topics in the space industry: U.S.-Sino space relations. This paper raises more questions than it answers, but these questions will help U.S. researchers, analysts, practitioners, and policymakers better investigate and understand the complex dynamics emerging in China's nascent commercial space sector.



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