

# Critical Analysis of the Chinese Private Space Sector

## The Past, Present and Future

*Arpan Chakravarty\**

*This article presents a comprehensive review of China's emerging private space industry, including an analysis of government policies, investments and international relations. China's private space industry has grown significantly since 1988, with over 60 startups emerging by 2022, thanks to the strong support from the government and military civil fusion. The industry's focus on creating capabilities, skilled workforces, less reliance on foreign players, a strong funding base, and a Chinese space culture positions it to support China's space ambitions and play a significant role in the global commercial space market. However, pursuing these goals has its own challenges. Therefore, the author provides a critical analysis of how government policies have enabled the growth of China's private industry. The article also offers a perspective on India's thriving space industry, encouraging it to explore commercial possibilities and implement domestic space reforms with long-term strategic goals in mind, especially with the emergence of the Indian Space Policy (2023).*

**Keywords:** *China, Private Space Industry, Military Civil Fusion, India, Government Policies*

*"To explore the vast cosmos, develop the space industry and build China into a space power is our eternal dream"*

— President Xi Jinping

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\* Mr Arpan Chakravarty is a lawyer by training. His research interests include law, national security, and foreign affairs of South Asian countries.

## INTRODUCTION

The year 2021 was arguably the most significant year for space in decades, with nations across the globe aspiring to reach the Moon and Mars. China's commercial space industry made a significant mark in the international arena with its space programme. Multiple missions, such as ferrying taikonauts to its own space station named 'Tiangong', have certainly raised eyebrows. The combined effort of the government, their commercial private companies, and carefully crafted policies is becoming the key to their efforts.

Several nations in Southeast Asia have space ambitions and their own space programmes. Significant and emerging powers such as China, India, South Korea and Japan are currently in competition to establish their dominance in the international arena. China's space programmes, with its recent successes,<sup>2</sup> have captured the world's attention with its coordination with their civilian counterpart to act as a force multiplier for the Chinese Space Programmes. From going to the moon alongside Russia<sup>3</sup> to landing their Mars Rover<sup>4</sup> to the highest number of launches to constructing the ambitious Chinese Space Station<sup>5</sup>. In just a couple of decades, China has effectively gone from no presence in space exploration to being a world leader, led by its own comprehensive Military Civil Fusion (MCF).

The focus of China's private space sector has been to make it more commercialised, more international, and more integrated to its state apparatus and the economy. While it takes up ambitious missions, it has braced through several challenges such as the pandemic. It has focused on striving for space leadership, and framed policies which help them achieve it. Since 2014, there has been a consistent rise in the number of start-ups<sup>6</sup> coupled with various comprehensive strategy of white papers to guide the industries working towards creating space infrastructure and increasing funding opportunities to sustain these capital-intensive private space activities.

With this background, it becomes of utmost importance to examine the Chinese Commercial Space and its critical role in the overall national strategy. Furthermore, with the successes of the private space industry in acting as a support system to the Chinese Space Program. While this article shall analyse what drives these space missions and the role of Military Civil Fusion (MCF), it is even more critical to examine the funding aspect of private space industry in China. Finally, the challenges posed by China are significant and its rise in space industry are essential to examine manage the risk further and forge space strategy accordingly in the region.

## UNDERSTANDING THE MAKING OF CHINESE SPACE PROGRAMME

### Organisations and its related policies

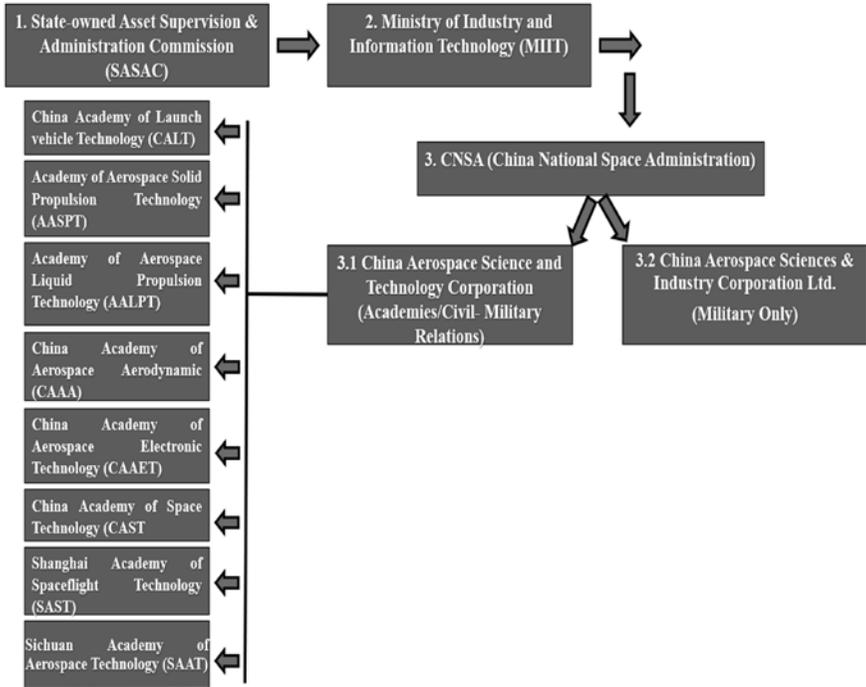
The State Council White Papers on Space related activities by the Chinese administration have been the guiding force for investment in space-related research and development meets.<sup>7</sup> It has strengthened China's military space capabilities and bridged the gap in intelligence, reconnaissance, mapping, navigation, satellite communications, and data relays, which play an essential role in the strategic warfighting capability of any country. These White Papers published in the years 2000,<sup>8</sup> 2006,<sup>9</sup> 2011,<sup>10</sup> and 2016<sup>11</sup> have further charted out future objective for the civil space industry.

Given the interconnectedness and jointness between China's space programme and the military-security affairs<sup>12</sup>, it is not surprising that the China National Space Administration (CNSA) unifies the work of both China Aerospace Science and Technology Corporation (CASTC) and the various academies which manages the Civil Military Relations with industries<sup>13</sup> namely:

1. China Academy of Launch Vehicle Technology (CALT)
2. Academy of Aerospace Solid Propulsion Technology (AASPT)
3. China Academy of Space Technology (CAST)
4. Academy of Aerospace Liquid Propulsion Technology (AALPT)
5. Sichuan Academy of Aerospace Technology (SAAT)
6. Shanghai Academy of Spaceflight Technology (SAST)
7. China Academy of Aerospace Electronics Technology (CAAET)
8. China Academy of Aerospace Aerodynamics (CAAA)

Figure 1 showcases the structure of the China's Space Program.

CNSA is responsible for the administration of the China Aerospace Sciences & Industry Corporation Ltd (CASIC) which focuses on the military applications only. Some of the other important key players in the Chinese Space Industry are CETC (China Electronic Technology Group) which has been the key to satellite and maintenance of the ground stations communications of digital systems and electronics.<sup>14</sup> While the Chinese Academy of Sciences (CAS) has played a key role<sup>15</sup> in planning, developing, and operation of Chinese space technology developments as from Dongfanghong-1 (DFH) to now, this academy has essentially been pivotal in the planning and support to the growth of Chinese Space Dream. They also coordinate space development technology and collaboration with Russia, and other international cooperation with other countries.



**Figure 1** Structure of China’s Space Program

### Drivers of Chinese Space Industry

In November 1944, the then President of United States, Franklin Roosevelt wrote in a letter<sup>16</sup>, “*New frontiers of the mind are before us and if they are pioneered with the same vision, boldness and drive, through this war, we can envision a fuller and a more fruitful life.*” Vannevar Bush,<sup>17</sup> an electrical engineer by training led under his leadership, a war effort which aimed at developing powerful technologies. In the report, “Science, the Endless Frontier”,<sup>18</sup> he showcased a blueprint which would bring in the triumvirate of academia, industry, and government to develop technologies. This effort incubated many of the technological breakthrough. Moreover, the goal was to leverage the commercial sector to influence the evolving character of warfare and the dual application of technology.<sup>19</sup> This is what is presently seen in the evolving private space industry in China with key players being State, Military, focused Academic Institutes, government hand-held private players and researchers.

The Chinese government has been carefully calibrating their efforts through these key players since last seven decades of growth. Unlike democratic societies, it is the state which decides objectives to be followed.

However, there was a change in policy in 2014 when the Chinese government decided to encourage private investment in certain space activities since it would receive support from the government (Document 60)<sup>20</sup> in funding from the provincial/municipal government, technical facilities. The PLA has already developed and integrated the private companies into the military chains of the government to push for better civil–military integration. Moreover, the private commercial sector, particularly the technology and innovation are enabling critical transition in China's rise in space.

The Chinese Communist Party (CCP) has been closely observing the shortcomings of the American model of space development. China has been known pioneering the second-movers advantage in space industry.<sup>21</sup> Now, it is systematically calibrating its efforts in Science and Technology especially in space technologies to eliminate all barriers of civil and military. By leveraging the strengths of both its military and civilian sectors, China's strategy for military–civil fusion has significantly improved its private commercial space industry. This approach not only led to a robust development of China's commercial space sector, but also strengthened their national security and economy simultaneously. Historically, China's space industry was dominated by the State-owned enterprises but with the support from the government, private industries in space technology development have access to military's resources which becomes critical during the start of any company. Moreover, the government takes benefit from outsourcing research, development and innovation which restricts huge enterprises.<sup>22</sup> The China Beidou navigation system is a noteworthy outcome of military–private sector collaboration. It resembles GPS and has both civilian and military applications, boosting the nation's defence prowess as well as its commercial space industry.

While the technologies and companies will change, it is expected that the fundamental role of the commercial space sector will endure. In an analysis of the space start-up market from 2000 to 2016,<sup>23</sup> it is seen that hundreds of angel investors, altruists, venture capital firms, private equity firms, corporations, banks, and public markets provided over US\$ 16.6 billion to over 140 start-up space companies.<sup>24</sup> The private space companies that had the state government's backing directly oversaw more funding than their other counterparts.<sup>25</sup>

### **Identification of key areas for China's Commercial Sector**

In this way, China kept its national interest protected while achieving a goal of encouraging the industries since space-based technology, capabilities, and services are interwoven into how their militaries train and fight. It was noted that space derived services which play a critical role in military operations such as satellite communication, remote sensing, and global positioning services were often funded by the government and the municipal corporations.

Due to the dual nature of many products which are developed by the Chinese Commercial Space companies, it would be difficult to discriminate between military and civil space activities. Moreover, during conflicts, it becomes of critical importance as military and associated systems are legitimate targets in conflict according to International Humanitarian law.<sup>26</sup> This shared architecture has enabled China to push the tide in a specific direction and get a headway in a short period. While there are certain implications of mixing military and commercial activities; it has always been seen that land, sea and air operations have always blended within military and commercial sectors.

Suppose one looks into the manufacturing capability of China; in that case, it is by far one of the largest manufacturing countries in the world of consumer electronics, telecommunications equipment, solar panels, and high-speed railcars and locomotives, among other items.<sup>27</sup> It has a thriving, internationally competitive, and innovative (especially on cost) high technology manufacturing sector<sup>28</sup>. It is home to many skilled manufacturers that can meet a variety of price points. With access to the large, young and well-trained workforce, it becomes easier for China to thrive under pressure due to less reliance on foreign players.

Finally, one cannot oversee the discrimination on the part of the United States, which led to what China is in today's Chinese Private Space Industry. In 1999, The Select Committee on US National Security and Military/Commercial Concerns with the People's Republic of China (Cox Report)<sup>29</sup> published its findings. This report made various allegations against China's 'Sixteen Character' policy which stated that the military development is the core of general 'economic modernisation'—a vital policy affirmation by Deng Xiaoping in 1978. Since then, China's economy, global influence and space capabilities have increased due to state-owned firms developing the Chinese space industry.

It is noteworthy that even after being kept out of US-led international missions, it has not prevented China from developing its space capabilities. In 2011, China launched its own Tiangong-1 and Tiangong-2 space

laboratories<sup>30</sup> as testbeds for a permanent space station. This led to the United States passing a law named as the Wolf Amendment<sup>31</sup> which would prohibit National Aeronautics and Space Administration (NASA) from engaging directly and bilaterally any cooperation with Chinese government or any other affiliated organisations without the approval of Federal Bureau of Investigation (FBI) to prevent Beijing to achieve its “Space Dream”.<sup>32</sup>

Under Xi Jinping’s leadership, the current status of contention from existing and emerging Indo-pacific space capabilities<sup>33</sup> from India, Singapore, Japan, South Korea, China has pushed for military-civilian fusion to combine defence and civilian industrial bases to combine defence and civilian industrial bases meet the demands. The 18th Party Congress Meet in 2012,<sup>34</sup> aspired for development of Space Programs with State and Private Enterprises collaboration due to which Ministry of Industry and Information Technology was tasked with this of its ambitions to shape global governance. The key to domination would be the development of emerging technologies and guarantee that the norms and values that govern how these technologies would be used support the country’s geopolitical objectives. Therefore, we see countries focusing on the development of such technologies.

With China’s ambition is to establish a permanent space station by 2022 in order to challenge the US hegemony of ISS which is due to retire in 2024, a lunar research outpost by 2036, a Solar Power Satellite (SPS) transmission capacity from geostationary orbit (GEO) by 2050, and to establish itself as the world leader in space cannot be overlooked<sup>35</sup> as the private commercial companies shall have a vital role to play in coming times. One cannot overlook the policy guidance of five-year plans that was a cue for foreign investors and others to invest in the growing private space industry in China.

The purpose of these white papers which are published by the State Council include specific successes made in from the previous five years, significant tasks for the next five years, supporting legislation and policies that will aid in the completion of these tasks, and a section on international space relations and cooperations. These White Papers which are published during half-decade includes an extensive list of notables. If the study is any indicator, China’s space sector will become increasingly commercialised, internationalised and integrated with the rest of the economy, particularly China’s digital infrastructure,<sup>36</sup> during the next five years. A trifecta of government, SOEs, and private venture funding will support ambitious missions and cutting-edge technology development.

**Policy Frameworks (From 2000s to December 2021)**

Table 1 collates all known policies related to Commercial Space Industry in China.

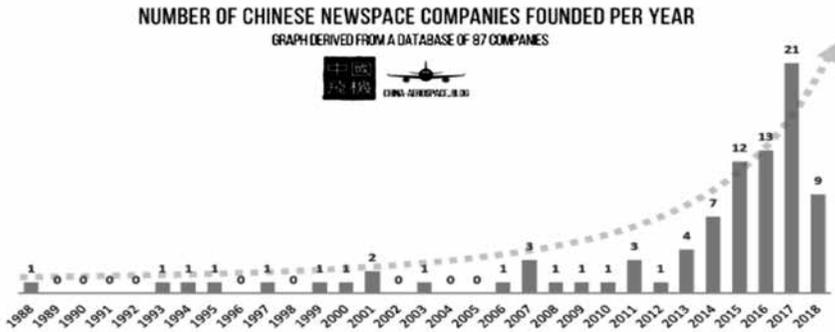
**Table 1** Policies related to Commercial Space Industry in China

Date	Official Government Document	Relevance in Commercial Space
12/21/2002	Interim Measures on the Administration of Permits for Civil Space Launch Projects <sup>37</sup>	The policy controls all civil space launches and outlines the license and approval requirements for civil space launches.
2000, 2006, 2011, 2016	State Council White Papers on Space Activities <sup>38</sup>	<p>These papers outlined detailed key achievement made and further outlines objectives which shall be achieved by the Private Civil Space Industry.</p> <p>Since Space Industry is a finance intensive industry, the 2016 white paper focuses only on the finance mechanisms and the encouragement by the local municipal governments.</p>
2013	Belt and Road Initiative	The Belt and Road Space Information Corridor <sup>39</sup> focuses on providing greater access to infrastructure, information and data. Aim is to use international commercial cooperative agreements with countries part of its ambitious BRI project.
11/26/2014	Guiding Opinions on Innovating Investment and Financing Mechanisms (Document 60) <sup>40</sup>	Document 60 is a financial document encouraging private investment. It focused on development of satellite industry. The media (Chinese and English) often credits Document 60 for opening up the space industry to private investment.
10/1/2015	2015–2025 Medium- and Long-term Development Plan for National Civil Space Infrastructure <sup>41</sup>	This policy outlines the priorities for the civilian space sector. It includes providing support and assistance to foreign countries in terms of commercial application of space-based goods and services.

2015	Made in China (MIC) 2025 <sup>42</sup>	The policy prioritizes the space industry but does not address the commercial space sector.
12/1/2016	People's Republic of China Radio Regulations	The policy regulates spectrum licensing for all entities, including commercial space companies.
2016	Strategic Emerging Industries <sup>43</sup>	The policy prioritizes the space industry but does not address the commercial space sector.
6/1/2019	Notice on Promoting the Orderly Launch of Commercial Vehicles <sup>44</sup>	Policy codifies the regulations for the 2002 Interim Measures for private commercial space launches.
7/30/2019	Industry Catalogue Encouraging Foreign Investment <sup>45</sup>	The policy promotes foreign investment in several previously closed or semi-closed industries, including many related to satellite manufacturing and satellite communications.
–	Civil-Military Integration	The policy does not address commercial space, but commercial space companies have the potential to benefit from this policy.
2020	The New Infrastructure Project <sup>46</sup>	The policy includes civil-military integration of satellite and private participation included a focus on digital connectivity for BRI projects.
2021	China's Space Program: A 2021 Perspective <sup>47</sup> China's Space White Paper	Identification of several planetary exploration missions to Jupiter, Mars, and Moon among the others. Furthermore, it talks about partnership with countries and international organisations. The 2021 China's Space White Paper focuses on the principle of exploration and utilization of outer space for peaceful purposes.

Source: Updated by the Author, Adapted from the Original Source<sup>48</sup>

## Rise of the Chinese private space industry



**Figure 2** Private Space Startups in China

Source: The chart given in Figure 2 signifies the rise of private space startups in China (1988–2018).<sup>49</sup>

After the Third Plenary Session of the 11<sup>th</sup> Central Committee of the Chinese Communist Party,<sup>50</sup> under the leadership of Deng Xiaoping, China adopted series of economic reforms which combined twin goals of attracting more investment and greater flexibility in responding to the market. They pursued a stance to achieve economic growth as their economy and society was devastated by the Cultural Revolution. Therefore, in order to do that, there started an active introduction of foreign capital and technology while maintaining their commitment to Communism. The emergence of “Guidance Planning<sup>51</sup>” was implemented to the rise of the commercial private space industry. Similarly, the Chinese Space Policies (military/civil) are centred on the concept of “guidance planning” done by the National Development and Reform Commission (NDRC), which the State Councils later implement. They essentially frame policies related to investment for private players who would want to invest in the commercial market of China.

Since 2014, a total of the number of start-ups in China has been rising; the result is that 78 commercial space companies operate from various parts of China, most of them focusing on satellite manufacturing and launch services, as reported by a report prepared by the Institute for Defence Analyses<sup>52</sup> since Document 60 was the key to the development of these start-ups. If we look closely, the Military–Civil Fusion of China has two central mechanisms, it is as follow:

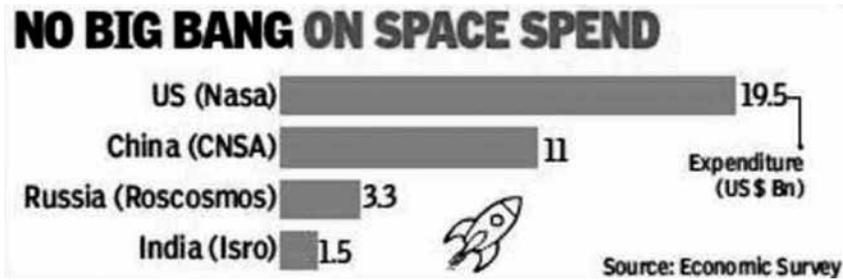
- The architecture of the Military–Civil Fusion in China is more of an authoritarian top-down approach, it is precisely implemented strategy with the support of the local and municipal level body helps in greater standardisation and reduces the range of obstacles in the process, a problem which other space-faring nation programmes face. It enables them to spin-off technology with commercial potential and makes it available for use and sharing.
- Over the long term, the implementation policies and compliance enabled with the marshalling of resources—both by the state-owned municipals and venture capitalists—increase commercial enterprise participation in defence development and production. Thus, the innovation ecosystem actively supports China’s fledgling space start-ups by transferring technology and technical know-how.

Every other start-up is linked to two state-owned conglomerates and contributes to the doctrine of Civil–Military Fusion in China. The conglomerates are CASC (China Aerospace Science and Technology Corporation) and CASIC (China Aerospace Science and Industry Corporation) respectively.

Even though China closely monitors the policy decisions made by the United States, it tweaks the policy according to its own geographical and political suitability. China monitored the growth of NASA-SpaceX growth and brought out solutions that would essentially lead to the growth of the private space sector, which becomes a critical factor to increase its national space capabilities and integration between the civil and military infrastructures. Therefore, China closely observes established business models in the West. They not only reduce the level of ‘risk’ involved in leading innovations but make them more successful than their counterparts due to the economic might.<sup>53</sup> It has been seen in various fields such as information technology, manufacturing and high-speed rail equipment, as CNSA in terms of overall government funding for space activities outspent every country in the world in 2020, except for the United States.

Figure 3 shows expenditure each year as declared by the space agencies.

Chinese private space companies like One space have already launched to space.<sup>54</sup> They have been developing reusable rockets as the investment continued to rise to US\$ 2 billion in its private space sector.



**Figure 3** Expenditure each year as declared by Space Agencies.

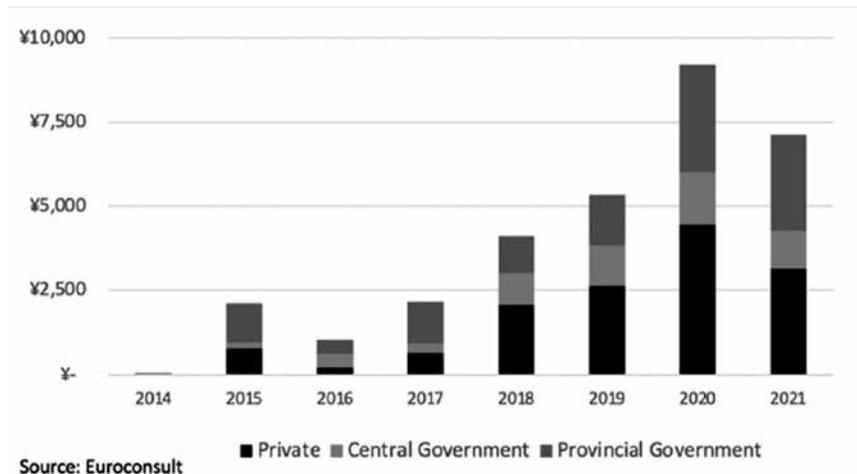
Note: The author cannot confirm this due to the nature of Chinese Space Program which adapts Military Civil Fusion Strategy

Since 2019, China continues to increase the number of launches from 39 in a year, only shying away from the US, which continued to dominate with an astonishing 44 launches. In 2020, China deployed major scales communication constellations<sup>55</sup> such as its ambitious Beidou, Haiyang, Gaofen or Yaogan satellites which are essentially known for their high resolution, marine and reconnaissance programmes. These instances showcase that China has significantly pumped up its performance in terms of the deployment of Chinese communication satellites.

Most recently, “The New Infrastructure Project” focused on “promoting the construction of new digital infrastructure which will act as an economic multiplier to creating jobs and emerging industries” which essentially meant emerging technologies such as 5G, AI, Big Data, and ‘Satellite Internet’<sup>56</sup> would be in focus for the next few years.<sup>57</sup> It was implausible considering the nature of a policy paper which signals towards the role of private players to play a role in space start-ups since 60+ start-ups have sprouted to diversify their activities into space.

Figure 4 shows the rise in the Chinese Commercial Space with focus on funding from the Chinese Government<sup>58</sup>. It is important to remember that China relies on aggressive state-backed financing to develop a dominant position in the commercial launch and satellite sectors, which international market-driven enterprises cannot match. It would essentially hollow the efforts of various spacefaring nations such as India, Japan, South Korea and other nations which have ambitions to become spacefaring nations<sup>59</sup>.

## FUNDING FOR CHINA'S COMMERCIAL SPACE SECTOR



**Chinese Commercial Space Funding by Source, 2014-2021 (¥M)**

**Figure 4** Chinese Commercial Space with focus on funding from the Chinese Government

In 2019, according to a report prepared by Bryce Space and Technology, it was observed that China surpassed all the other countries in terms of receiving financing, the amount of money invested, the number of deals done and setting up an investor base.<sup>60</sup> One of the key features that make the Chinese commercial space attractive was the low cost of production, clear policy directions, and the Chinese diaspora through its strategic investment in various firms and universities abroad. It is propelled by the increased investments, namely Sequoia China,<sup>61</sup> Matrix Partners China which are essentially American Venture Capitalist's but with Chinese affiliates.

Most of the companies established in the private commercial space in China have become specialised and competitive to stay relevant due to cut-throat competition with other players and government-funded organisations.<sup>62</sup> Year after year, the amount of funding raised by Chinese space start-ups has shot up, and 2020–21 was no exception. This competition has led to record fundraising by several companies to stay relevant and find a very narrow customer base,<sup>63</sup> notably governments. The Chinese want the world to accept that Chinese space start-ups are commercial rather than an extension of the state-owned defence sector. As a result, they believe it is crucial for Chinese

launch providers and satellite manufacturers to recognise the importance of international customers in West Asia, Africa and Europe to their success.

The Central Military Commission (CMC) has a monopoly on commercial rocket launches. It clearly means that private companies cannot launch rockets without the approval of the military.<sup>64</sup> Furthermore, the private commercial space companies are in a very nascent stage of development which means that the military sees a clear advantage in handholding these private companies through technologies and funding which could help them grow. Moreover, there are strong ties between the commercial space sector and the state-owned defence industrial base since majority of the talents and CEOs of the organisations either have experience in foreign countries and have returned to China to start a venture or have previously worked in state enterprises, the technical teams of commercial space start-ups are filled with former employees of defence conglomerates and state research institutions.<sup>65</sup>

Apart from talent, space-intensive businesses need three things—money, technology and a manufacturing base. China's state-owned defence base has granted access to all three of China's new commercial space enterprises. Despite garnering significant private investment, China's space start-ups rely significantly on governmental investors for finance and approval. Major institutions providing funding to these space start-ups were SASTIND (State Administration for Science, Technology and Industry for National Defence) and CAS (China Academy of Sciences).

A report titled "Opinions on Promoting the Deep Development of Military-civilian Integration in National Defense Technology Industry"<sup>66</sup> suggested the integration of banks, security, insurance and other financial institution to formulate and work on "One enterprise, One Policy" leading to full civil–military integration. It would embody the characteristics of comprehensive and full-process service, funding which would make the civil and military work together while furthering the channels of expansion through other enterprises. These expansion channels would mean two things possibly: one, the money market and second, the capital market. The money market would essentially be used for short-term financing—the seed funds from various municipals and provinces, which would create trust in the market. When a government body invests in a company, it increases its credibility and reduces the risk for various capital investors in the market. Then, these companies would approach the capital market and, through various funding rounds, would raise money that can be used for long-term funding. Primarily, these are the tools being used by these military–civilian integrated enterprises. Thus, we can see how these civilian military enterprises grow.

### CHINA'S INTERNATIONAL FOOTPRINT AND LINKAGES TO BRI

The Chinese space program has been instrumental in advancing its terrestrial geopolitical objectives, including cultivating Border Road Initiative (BRI) customers. At the same time, it is using diplomatic ties to further its space aims, such as through growing its network of international satellite ground stations.

China's diplomatic efforts through the Belt and Road Initiative have been instrumental in creating economic opportunities for the country across the globe. However, China's space program has also played a crucial role in advancing its geopolitical objectives.<sup>67</sup> Through a two-pronged approach, China has focused on both military applications such as information warfare, communication systems, and space access, as well as on the development of the BeiDou global navigation system. Moreover, collaboration with Russia<sup>68</sup> on various fronts such as China's Space Silk Road initiative aims to increase participants' reliance on Chinese space-based services by promoting its launch services, satellites, and navigation systems to countries participating in the Belt and Road Initiative.<sup>69</sup> China has also signed multiple space cooperation agreements with various nations and has installed ground stations for BeiDou in several countries, including Argentina,<sup>70</sup> Iran,<sup>71</sup> and Thailand, which specifically addressed the issue of reliance on its information systems. Between 2007 and 2018, China launched 20 satellites for 13 countries namely Algeria, Argentina, Belarus, Bolivia, France, Indonesia, Laos, Nigeria, Pakistan, Saudi Arabia, Sri Lanka, Thailand and Venezuela.

Moreover, China has helped numerous countries launch communication satellites, which has allowed them to gain confidence in their satellite diplomacy efforts. This has led to increased deals regarding launching satellites<sup>72</sup> and has helped countries track urban development and prevent disasters. China's Spatial Information Corridor initiative saw the participation of 48 African countries as part of the First China–Africa BeiDou System Cooperation Forum,<sup>73</sup> and Pakistan became a full military partner eligible to use Beijing's BeiDou navigation satellite.<sup>74</sup> Additionally, China has extended cooperation to Russia in plans to establish a joint moon base. These initiatives demonstrate China's increasing influence in the global space industry and its efforts to establish itself as a major player in this field.

### DATA ON PRIVATE ENTITIES IN THE CHINA

The author has compiled a list of ten commercial space companies that have raised funds with the help of investors and entrepreneurs—if you look

closely, the initial seed fund rounds have been the Chinese state and PLA play a formidable guiding role in the development of the space industry through their national, provincial, and municipal governments (see Table 2).

**Table 2** Top 12 companies

No	Private Companies/ Year of Establishment	Funding	Rounds of Investment	Sector	Initial Seed Fund
1.	<b>Chang Guang Satellite Technology</b> (2014)	2.46 billion RMB (375 million USD)	1	Remote Sensing Satellites	Chinese Academy of Sciences & Municipal Government.
2.	<b>i-Space China</b> (2016)	1.7 billion RMB (276 million USD)	4	Commercial Launch Firm	SASTIND (State Administration for Science, Technology and Industry for National Defense).
3.	<b>LandSpace</b> (2016)	2.1 billion RMB (336 million USD)	5	Commercial Launch Firm	Municipal and State-owned Capital.
4.	<b>Galactic Energy Aerospace Technology</b> (2018)	200 million RMB (30 million USD)	1	Commercial Launch Firm	Details Not Known.
5.	<b>GalaxySpace</b> (2016)	8 billion RMB (approx. 1.2 billion USD)	4	Broadband Communications Satellites	Details Not Known.
6.	<b>Commsat</b> (2015)	270 million RMB (40 million USD)	6	Satellite Manufacturer and Service Provider	Chinese Academy of Sciences (CAS), Wuhan Municipal Corporation and CASIC

7.	<b>Qianxun Spatial Intelligence Inc</b> (2015)	1 billion RMB (154 million USD)	1	Precision Geolocation	Alibaba and China State-Owned Capital Venture Investment Fund and others.
8.	<b>ExPace</b> (2016)	1.2 billion RMB (180 million USD)	1	Commercial Launch Firm	CASIC (China Aerospace Science and Industry Corporation) and China Sanjiang Space Industry Group (Municipal) and others.
9.	<b>Spacety</b> (2016)	236 million RMB (36.7 million USD)	1	Commercial Micro Satellites	Chinese Academy of Sciences (CAS) and others.
10.	<b>Mino Space</b> (2017)	300 million RMB (46 million USD)	3	Development of Commercial Satellite applications	Municipal Government (Shenzhen Capital Group) and others.
11.	<b>One-Space</b> (2015)	270 million RMB (43.6 million USD)	2	Suborbital Rockets	Chongqing Aviation Industry Investment Group, and others.
12.	<b>LandSpace</b> (2016)	2 billion RMB (336.1 million USD)	5	Suborbital Rockets	National SME Development Fund and others.

Source: Collaborated through CrunchBase<sup>75</sup>.

Note: The author corroborates the list of top 12 companies which are in prominence and initial funding secured through provincial or state backed enterprise.

## ANALYSIS

While the commercial space companies in China are relatively small, each of these companies has a very specific level of operations and areas where they can contribute. For instance, the international lunar research station is beneficial to the commercial space sector since it can provide for the state-owned companies. As the state-owned companies can focus on taking bigger and more sophisticated projects, it would create room for the private companies to do the lower-end of the work. Since China is ambitious with its space station and its other allied lunar projects, it would lead to the need for a bigger commercial sector that could absorb the projects, as opposed to the state-owned companies stretching themselves too thin.

However, when it comes to developing countries like India, which is known across the globe for its cost-effective products and economical space launches,<sup>76</sup> it becomes difficult for the Chinese commercial industry to rival. India's private space sector should pursue a more aggressive approach with increased innovation, investment, direction by the government, and collaboration within industries. Over the past decades, India has showcased its ambition of taking the space programme to the next level and has gone through a significant amount of transformation.<sup>77</sup>

In order to promote private sector participation in the space sector, India has established the Indian National Space Promotion and Authorization Centre (IN-SPACe)<sup>78</sup> to regulate and promote private sector activities in space. In comparison to other space-faring nations, India already has the expertise to produce space technologies at an affordable rate in the market. With the private sector participating, it would allow more entrepreneurial pursuits, and with the goodwill India has among its partners, it can leverage the growing space economy. Currently, India's private space industry sees the participation of more than 104 start-ups and 368 space technology-focused companies.<sup>79</sup>

Nevertheless, India has an edge over China in terms of making use of the space commerce opportunities, as China's indirect state control over its commercial industry has been a concern for nations lately. With the release of the Whitepaper<sup>80</sup> on "Space Technology: The Next Business Frontier—Opportunities and Challenges for the Indo-Pacific" various research organisations such as IIT-Madras in collaboration with the US Consulate (Chennai) and ISpA (Indian Space Association) projected India's growth trajectory in years to come.

## CONCLUSION

The opening of the space programme has definitely helped the Chinese Space Program. First, in order to understand this, one must observe that China wanted to address the issue of a shortage of launch services for small satellites.<sup>81</sup> Now, state-owned enterprises fully focus on large-scale launches while short and medium-scale launches are undertaken by private players. Recently, the success of Ceres-1 by Galactic Energy is testament to this.

Secondly, with increased access given by Chinese state-backed enterprises, different launch sites are made available to private players as private industry can participate only in small and medium lift rocket launches which has increased opportunities<sup>82</sup> for customised launch services in the region. While the state-backed enterprises focus on the heavy lift rocket launches. This leads to serving customers both abroad and in-house, leading to more access to untapped markets overseas.

Third, leveraging the resources of already established companies does provide a reduction in the cost of launch for Chinese state-backed enterprises, leading to a high number of launches in the recent past. Since these private players have orders from the government and can become a critical component in the supply chain, specialisation could increase innovation and reduce the required time. Overall, it is a win-win situation for the Chinese Space Program to include and bring funding to these companies.

Fourth, in the past, space exploration was always considered the frontier of human race and technological advances. During the Cold War, the Soviet Union (USSR) and the United States (US) locked into a battle to achieve superior spaceflight capabilities. With China evolving as a major player in the space industry, these commercial industries could be the new face of Chinese 'space culture'.<sup>83</sup>

In conclusion, China's successful space programme is grounded in three essential "spirits"—the traditional spirit, the "two bombs one satellite" spirit, and the crewed space spirit. These influences are rooted in significant historical periods of China's development and continue to shape their values and culture. The traditional spirit draws from Chinese civilisation to promote a unique national identity through exploring outer-space as an extension of cultural expression.

Therefore, understanding that the world is changing, national space agencies are no longer the sole space service providers.<sup>84</sup> There is a need to look at how capabilities can be monetised and handled in a more business-like manner to create economies for the space sector to grow. If one observes

the Chinese Space Program closely, one will understand that the challenges to having a Commercial Private Sector is that these industries have a long gestation period. Moreover, with the lack of established business models and guidance, it becomes a challenge for nations to develop such industries.

Today, the space sector is thriving with commercial possibilities, and it is destined to grow with time as it becomes critical for a nation's security and overall development and growth with its wider application. Therefore, India's priority at this point of time, should be to effectively implement the domestic space reforms with a long-term strategic goal in mind.

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### NOTES

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