Chapter 4

The Role of Space Development in the National Security of China

Teruhisa Tsujino

1. Introduction

1.1 China's Space Policy

The space policy of the People's Republic of China (hereafter, China) traces its origin to the "two kinds of bullets and one star" slogan Mao Zedong advocated soon after China was founded in October 1949. "Two kinds of bullets" signify nuclear bombs (atomic and hydrogen bombs) and ballistic missile; "one star" signifies satellite. China successfully launched its first satellite in 1970. The Long March 1 (LM-1) Launch Vehicle (LV) was developed based on the Dongfeng missile. Now, 45 years later, the policy objective of China's space development is to realize a "*xiaokang* society." A *xiaokang* society means a "society where everyone can enjoy a moderately happy life." China aims to build a society where its 1.3 billion people can maintain a secure livelihood through sustaining a 100% food self-sufficiency ratio, achieving rapid GDP growth, increasing the attainment of higher education, and developing its socialist market economy, among other measures. Chinese leaders have a clear understanding that space development contributes to improving the lives of the people, even in the face of risk factors such as a declining birthrate and aging population, lack of natural resources (e.g., energy, water), and global economic fluctuations.

The division of Chinese space-related organizations by sector, combined with the space industry's production for the general market, make the exact figure of China's space budget difficult to ascertain. China's space budget is considered smaller than the U.S. and European space budgets but larger than Russia's budget for civil space programs and the Japanese space budget.

China has published about its space development activities in the white paper on space, entitled *Zhongguo de Hangtian* [China's Space Activities], every five years in 2001, 2006, and 2011. The white paper describes China's basic policy for the period of the next five-year plan as well as past achievements and plans for the future.

1.2 China's National Security Policy: Overview of the National Security Law

China enacted the National Security Law in July 2015.[1] The Chinese leadership is concerned about the increasing social contradictions and China's unprecedented exposure to foreseeable and unforeseeable crises. In this regard, the law was newly enacted due to the growing need to abandon the existing National Security Law and to create a new law.

The National Security Law in its entirety consists of 84 articles. The provisions regarding space are found in Article 32. Article 32 states that, for the peaceful exploration of space, China would secure safe passage to space, conduct scientific investigation, acquire capabilities for space development and use, and engage in international cooperation. The article provides that China would protect assets in space as national infrastructure, believing that maintaining activities that utilize space would contribute to national security.

1.3 Medium and Long-Term Development Plan for Civil Space Infrastructure

On October 29, 2015, the National Development and Reform Commission (NDRC) unveiled a medium and long-term development plan for civil space infrastructure[2] through 2025. With the Ministry of Finance (MOF) and the State Administration for Science, Technology and Industry for National Defense (SASTIND) also involved in the establishment of this plan, it is suggested that the plan is backed by budgetary allocations.

Civil space infrastructure consists of three systems: communications and broadcasting; earth observation; and navigation and positioning. Earth observation is the most complex of these systems and plays a critical role in security. The plan outlines that by 2025, China would develop and maintain seven constellations and three types of special purpose satellites for the three applications of land, maritime, and atmospheric observations.

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1 "Chūgoku kokka-anzenhō wo seitei" [China Adopts Sweeping National-Security Law], *The Wall Street Journal Japan Edition*, July 2, 2015 <http://jp.wsj.com/articles/SB10468926462754674708104581082611157755804>.

2 *Guo jia min yong kong jian ji chu she shi zhong chang qi fa zhan gui hua (2015-2025)* [National Medium and Long-Term Development Plan for Civil Space Infrastructure (2015-2025)], National Development and Reform Commission, October 2015 <http://www.ndrc.gov.cn/gzdt/201510/W020151029394768113250.pdf>.

2. Trends in China's Space Development

2.1 Major Achievements of China's Space Development

China's space development program, which spans more than five decades, has made the following major achievements.

In 1970, an LM-1 LV launched the Dong Fang Hong 1 (DFH-1) engineering test satellite.

In 1975, an LM-2A LV launched the FSW 1 recoverable earth observation satellite; in 1984, an LM-3 LV launched the STTW-T2 geostationary (GEO) experimental communications satellite; and in 1988, an LM-4 LV launched the Fengyun 1A (FY-1A) meteorological satellite. As the missions became more diverse, the variety of launch vehicles also increased.

In 1992, an LM-2E LV launched Australia's communications satellite. This satellite made in the United States was transported to China for the commercial launch. In 1996, the first LM-3B LV attempted to launch Intelsat 708, but the launch ended in failure.

In 1999, an LM-3A LV was used to launch the Beidou 1A (BD-1A) navigation and positioning satellite; in 2003, an LM-2F LV for the Shenzhou 5 (SZ-5) manned spaceship; in 2007, an LM-3A LV for the Chang'e 1 (CE-1) lunar exploration satellite; and in 2010, an LM-3A LV for the BD-2-IG1 first quasi-zenith satellite. In 2015, the new LM-6 and LM-11 small launch vehicles were launched in succession. Meanwhile, China has improved launch vehicle performance, diversified satellite missions, routinized launches, and launched foreign satellites. As of the end of November 2015, China has conducted 226 launches, and the number of satellites launched has reached 279. Already China has become a space power, putting it shoulder to shoulder with the United States and Russia.

2.2 Number of Chinese Satellites

China is third in the world after Russia and the United States in terms of the total number of satellites launched. The table below outlines China's major missions and applications and number of satellites.

Sector	Mission	Major Applications	Number of Satellites	Number in GEO
Civil	Communications and broadcasting	Data relay, telephone, TV	15	13
	Earth observation	Agriculture, natural disaster, ocean	22	0
	Meteorological	Meteorology	15	8
	Navigation and positioning	Positioning	24	15
	Lunar/planet exploration	Exploration of other celestial bodies	3	0
	Scientific	Near-earth observation	14	0
	Manned spaceship	Human space flight	5	0
	Microgravity test	Biology, material experiment	1	0
	Engineering test, etc.	Development of various space technologies	58	0
Commercial	Communications and broadcasting	Commercial satellite communications	27	22
	University	Technology development, education	21	0
Military	Reconnaissance	Reconnaissance	60	0
	Military communications	Information distribution and collection	11	8
	Military engineering test	Development of new technologies	3	0
Total			279	66

The breakdown by the three major practical systems is as follows: 97 earth observation satellites (including meteorological and reconnaissance satellites); 53 communications and broadcasting satellites; and 24 navigation and positioning satellites.

2.3 China's Space Transportation System[3]

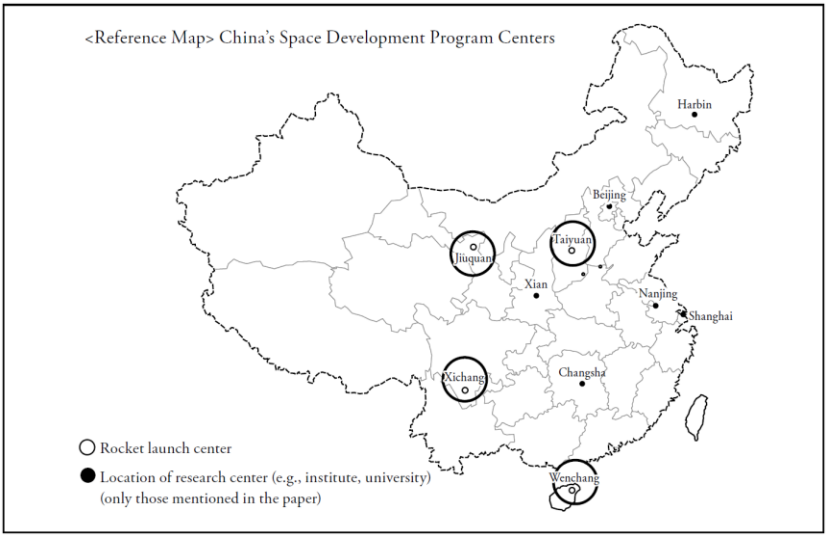
2.3.1 Number of Launches

China has conducted 226 LV launches as of November 26, 2015. The launches are listed according to the type of LV used and the launch site. China's four launch sites are located as shown in the map below. The southernmost Wenchang Satellite Launch Center is expected to commence launches in 2016.

LM-1: 2 launches (Jiuquan: 2 launches)
LM-2: 88 launches (Jiuquan: 61 launches, Xichang: 10 launches, Taiyuan: 17 launches)
LM-3: 80 launches (Xichang: 80 launches)
LM-4: 46 launches (Jiuquan: 8 launches, Taiyuan: 38 launches)
LM-6: 1 launch (Jiuquan: 1 launch)
LM-11: 1 launch (Jiuquan: 1 launch)
Total LM launches: 218 launches
(Jiuquan: 73 launches, Xichang: 90 launches, Taiyuan: 55 launches)

[3] Teruhisa Tsujino, "Chūgoku no Uchū Kaihatsu Jijō (Sono 1): Uchū Yusō" [The Space Development Situation of China (Part 1): Space Transportation], Japan Science and Technology Agency (JST), Science Portal China, November 2012 <http://www.spc.jst.go.jp/hottopics/1212/r1212_tsujino1.html>.

Map of centers of China's space development activities



2.3.2 Planned Launches

At the beginning of the year, China planned 20 launches in 2015. As of November 26, 16 launches have been conducted, and three more are expected to take place by the end of December.

It is anticipated that China plans to conduct many launches in 2016 and beyond. Leading examples drawing attention include the first LM-5 launch from the Wenchang Satellite Launch Center in Hainan Island and the first LM-7 launch of a cargo resupply vehicle in 2016, and the launch by the LM-9 super-heavy launcher in the future.

2.4 Achievements in Human Space Flight and Future Plans

China successfully conducted its first human space flight in 2003 under the leadership of the People's Liberation Army—the military forces of the Communist Party of China.[4] The spacecraft launched through Shenzhou 4 (SZ-4) were

[4] Teruhisa Tsujino, "Chūgoku no Uchū Kaihatsu Jijō (Sono 2): Yūjin Uchūhikō" [The Space Development Situation of China (Part 2): Human Space Flight], JST, Science Portal China, December 2012 <http://www.spc.jst.go.jp/hottopics/1301/r1301_tsujino1.html>.

unmanned engineering test satellites developed by the China Academy of Space Technology (CAST).

The SZ-5 mission was carried out with one crew member in 2003, the SZ-6 mission with two crew members in 2005, and the SZ-7 mission with three crew members in 2008. The SZ-7 mission performed China's first extravehicular activity.

Subsequently, a docking experiment between the unmanned Tiangong 1 (TG-1) and SZ-8 was conducted in 2011. In 2012, the SZ-9 mission was carried out with a three-person crew including one woman. Similarly, in 2013, the SZ-10 mission was carried out with a three-person crew including one woman. This brought the total number of taikonauts (Chinese astronauts) to 10, the total number of Chinese nationals who departed to space to 12, and the total number of days spent in space to 104 days.

Future plans include the launch of SZ-11 and TG-2 in 2016, the launch of Tianzhou 1 (TZ-1) cargo resupply vehicle in 2016, the launch of the Tianhe core module for China's space station in around 2018, and the completion of the Tiangong space station by adding the Xuntian and Wentian modules in around 2020 and 2022. The illustration of the postal stamp below shows the completed Tiangong space station.

	
(Issued by China in 2014)	(Issued by China in 2014)

Ordinary Chinese nationals as well as foreign nationals could board Tiangong. European countries including Germany have already cooperated with the space station for space experiments. Some European Space Agency (ESA) astronauts are even studying Chinese. Under consideration are the space station's connection with foreign modules and docking of foreign spacecraft. In addition, negotiations are under way between China and Russia on the unification of their docking systems. Tiangong is capable of connecting up to six modules.

2.5 Achievements in Lunar Probes[5] and Future Plans

Chang'e is the name of a woman who went to the moon in Chinese ancient stories.

Chang'e 1 was launched in October 2007 and conducted observations in a circular orbit 200 km above the surface of the moon.

Chang'e 2 was launched in October 2010 and put into the orbit by a method similar to Japan's Kaguya. Like the Kaguya, Chang'e 2 orbited at 100 km from the moon. It used leftover fuel to perform close distance observations of an asteroid as well as move to a Lagrangian point.

Chang'e 3 was launched in December 2013 and successfully landed on the surface of the moon. It released a rover called "Yutu" to conduct intercommunication, among other tasks. The landing spot was named "Guang Han Gong (Moon Palace)." The illustration of the postal stamp on the above right shows Chang'e 3 and Yutu.

Chang'e 5 T1 was launched on October 24, 2014. After conducting a flyby of the moon, it succeeded in reentering and returning to Earth.

Future plans include Chang'e 5's attempt at a sample return in 2017 and Chang'e 4's landing on the far side of the moon in around 2020. A manned lunar base may be built in around 2025 to 2030 and shift from accommodating short-term stays to long-term stays.

2.6 Achievements in Communications and Broadcasting Satellites[6] and Future Plans

China Telecommunications Broadcast Satellite Corporation (ChinaSat), affiliated with China Satellite Communications Co. Ltd. (ChinaSatcom), operates 12 satellites. Their breakdown is as follows: 4 Zhongxing satellites for civil uses such as television broadcasting; 5 military communications satellites; and 3 Tianlian data relay satellites for manned spaceflight.

APStar was integrated into ChinaSatcom and operates three satellites.

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[5] Teruhisa Tsujino, "Chūgoku no Uchū Kaihatsu Jijō (Sono 3): Tsuki Tansa" [The Space Development Situation of China (Part 3): Lunar Exploration], JST, Science Portal China, December 2012 <http://www.spc.jst.go.jp/hottopics/1301/r1301_tsujino2.html>.

[6] Teruhisa Tsujino, "Chūgoku no Uchū Kaihatsu Jijō (Sono 4): Eisei Tsūshin" [The Space Development Situation of China (Part 4): Satellite Communications], JST, Science Portal China, January 2013 <http://www.spc.jst.go.jp/hottopics/1302/r1302_tsujino1.html>.

Asia Satellite Telecommunications Co. Ltd. (AsiaSat), an independent satellite communications company in Hong Kong, currently operates four satellites.

China has exported satellites made in China to countries such as Nigeria, Venezuela, and Bolivia through on-orbit deliveries. On November 21, 2015, China successfully launched a Laotian satellite.

Future plans include the development of a large satellite, namely, the DFH-5 bus with a mass of 8-9 tons.

2.7 Achievements in Navigation and Positioning Satellites[7] and Future Plans

China launched five BD-1 GEO satellites. All have completed their operations.

BD-2 launched 15 satellites: 5 GEO satellites; 5 quasi-zenith satellites (IGSO: Inclined Geosynchronus Orbit); and 5 medium earth orbit (MEO) satellites. Although at least 24 MEO satellites are needed, the mission was suspended at five MEO satellites.

Alternatively, BD-3, with four times better positioning accuracy than BD-2, launched four satellites in 2015: 2 quasi-zenith satellites; and 2 MEO satellites. BD-3 is expected to launch around 31 satellites to build a global navigation satellite system (GNSS).

The illustration of the postal stamp on the right shows several navigation and positioning satellites. It states, “China’s dream is to be a prosperous and strong nation.”

Three quasi-zenith satellites make up a set. Its orbit traces a figure eight pattern in the course of a day as shown in the illustration below.

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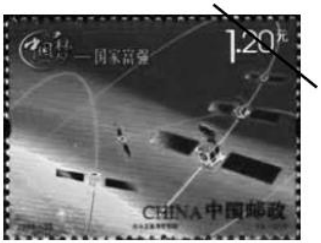
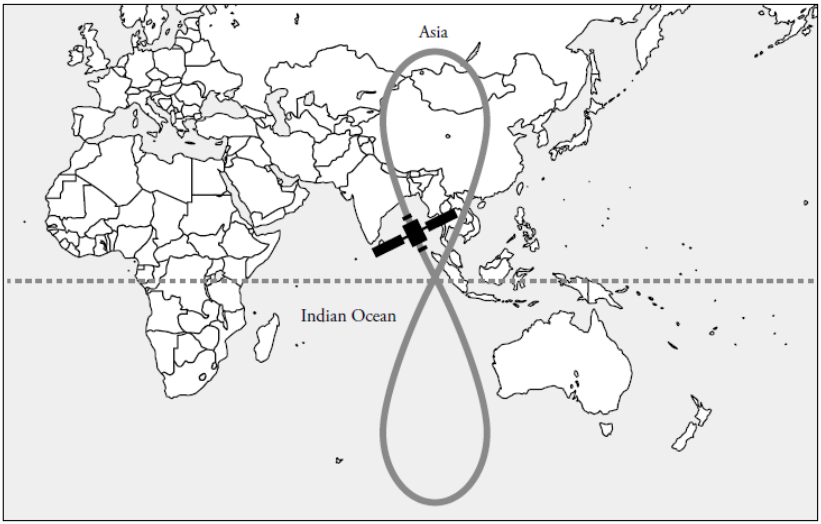
[7] Teruhisa Tsujino, “Chūgoku no Uchū Kaihatsu Jijō (Sono 6): Kōkō Sokui” [The Space Development Situation of China (Part 6): Navigation and Positioning], JST, Science Portal China, January 2013 <http://www.spc.jst.go.jp/hottopics/1302/r1302_tsujino3.html>.



(Issued by China in 2013)



2.8 Achievements in Earth Observation Satellites[8] and Future Plans

2.8.1 Land Observation Satellites

China has launched the following land observation satellites:

Gaofen 1, 2, 8, and 9;

Huanjing 1A and 1B for optical observation and 1C for radar observation;

Tianhui 1A, 1B, 1C for stereo-topographic mapping;

4 China-Brazil Earth Resources Satellites (CBERS) developed with Brazil, of

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[8] Teruhisa Tsujino, "Chūgoku no Uchū Kaihatsu Jijō (Sono 5): Chikyū Kansoku" [The Space Development Situation of China (Part 5): Earth Observation], JST, Science Portal China, January 2013
<http://www.spc.jst.go.jp/hottopics/1302/r1302_tsujino2.html>.

which one is operational; and

3 Ziyuan satellites.

Jilin Province, one of the regional governments, launched the Jilin 1 commercial satellite. Jilin Province plans to develop a constellation consisting of over 100 satellites.

2.8.2 Maritime Observation Satellites

In the area of maritime observation, China has launched three Haiyang satellites (1A, 1B, and 2).

2.8.3 Atmospheric Observation Satellites (Meteorological Satellites)

Six satellites of the Fengyun series are currently in operation.

All of the polar-orbiting satellites in the first series (Fengyun 1) completed their operations. One of these, the Fengyun 1C, was destroyed by a Chinese missile in 2007, creating more than 3,000 fragments of space debris.

In the Fengyun 2 series, seven GEO satellites (A to G) were launched, of which three satellites are operational. Only Fengyun 2H remains in the series. After this satellite, China will shift to the Fengyun 4 series under development.

The new Fengyun 3 series of polar-orbiting satellites have three satellites in operation, and their performance have been highly commended by the West.

2.8.4 Recoverable and Reconnaissance Satellites

Recoverable satellites are designed to return to Earth photographic film, samples from microgravity experiments, and other materials aboard the satellite.[9] The photographic film is used for reconnaissance. To date, 22 recoverable satellites have been launched.

China launched its first recoverable satellite in 1975. It landed not in Sichuan Province as intended, but in the neighboring Guizhou Province 400 km away, near the entrance of a coal mine. The satellite was successfully recovered thanks to a report from a coal miner. At the time, the Chinese government instructed that

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[9] Teruhisa Tsujino, "Chūgoku no Uchū Kaihatsu Jijō (Sono 10): Kaishūshiki Eisei" [The Space Development Situation of China (Part 10): Recoverable Satellites], JST, Science Portal China, April 2013
<http://www.spc.jst.go.jp/hottopics/1305/r1305_tsujino1.html>.

satellites must be landed on Chinese territory. On the right is a postal stamp that illustrates the moment of the recovery.

(Issued by China in 2014)

The Yaogan series, which are deemed to be mainly for reconnaissance purposes, are subdivided into eight groups. Thirty-eight satellites have been launched, the majority of which are still operational.

2.8.5 Development Plan for Civilian Earth Observation Satellites (through 2025)

China plans to develop seven constellations and three special purpose satellites for the three applications of land, ocean, and atmosphere.

Type of Earth Observation Satellite	Land Observation	Maritime Observation	Atmospheric Observation
Constellation	High resolution optics observation constellation	Ocean color constellation	Weather observation satellite constellation
	Medium resolution optics observation constellation		
	Synthetic aperture radar (SAR) observation constellation	Ocean dynamics constellation	Climate observation satellite constellation
Special Purpose Satellite	Geophysical explorer	Ocean environment observation satellite	Atmospheric composition explorer

These satellites will be useful for responding to natural disasters, supporting the

agricultural and fishery industries, conducting civil engineering work, making weather forecasts, among other uses. Using satellite data, China will secure food by efficiently managing the agricultural, forestry, and fishery industries, reduce disaster risks, and decrease damages. Such roles of the satellites are intended to contribute to ensuring the security of the Chinese people.

2.8.6 Development of Early Warning Satellite Technology

Missile early warning satellites are needed as part of the ground-based missile defense system developed to swiftly detect foreign missile launches. Whereas the United States and Russia are already operating such satellites, China is still developing the technology.

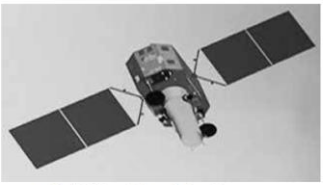
The United States has launched 23 Defense Support Program (DSP) satellites and is currently transitioning to the Space-Based Infrared System (SBIRS).

Russia's US-KMO launched in 2012 suffered on-orbit failures, and therefore, Russia was without an early warning satellite. Russia launched its new early warning satellite (Kosmos 2510, Tundra#1) on November 17, 2015.

In December, China plans to launch its first non-meteorological GEO earth observation satellite, the Gaofen 4 (GF-4). Its main mission is to swiftly detect forest fires using infrared sensors. The satellite has technological similarities with early warning satellites. In particular, GF-4 and early warning satellites both feature a long barrel telescope.

DSP of the United States ©USAF

US-KMO of Russia ©Novosti Kosmonavtiki



GF-4 of China ©Gunter's Space Page

3. Organizations Related to Space Development

In the government, the ministries under the State Council related to space development include the Ministry of Industry and Information Technology (MIIT) and the Ministry of Science and Technology (MOST).

Space-related research institutes under the Chinese Academy of Sciences (CAS) directly under the State Council include the: Technology and Engineering Center for Space Utilization (CSU), which is engaged in the design of space stations; Institute of Remote Sensing and Digital Earth (RADI), which performs research related to earth observations; National Space Science Center (NSSC), which conducts research on space science; and National Astronomical Observatories of the Chinese Academy of Sciences (NAOC), which is involved in the development of Chang'e.

Xu Dazhe, Vice Minister of MIIT, concurrently serves as the Directors of MIIT's China National Space Administration (CNSA; around 100 people) and the State Administration for Science, Technology and Industry for National Defense (SASTIND). Organizations that cut across various ministries and relevant agencies include the China Manned Space Engineering Office (CMSEO) for human space flights, Chinese Lunar Exploration Program (CLEP) for lunar explorations, and China Satellite Navigation Office (CSNO) for navigation and positioning.

In industry, two state-owned enterprise groups are concerned with space development: China Aerospace Science and Technology Corporation (CASC;

130,000 people); and China Aerospace Science and Industry Corporation (CASIC; 100,000 people).

As regards universities, National University of Defense Technology, Beihang University, Harbin Institute of Technology, Tsinghua University, and Zhejiang University are among the universities that make and launch small satellites.

The People's Liberation Army carries out important work related to space development. Its General Armaments Department conducts launches and satellite control. In addition, the PLA has a *hangtianyuan* (astronaut) battalion.

4. International Cooperation

The National Security Law identifies international cooperation as a means of space development, meaning, having more partners will lead to the security of China.

China and Russia have been moving to unify their space specifications to realize manned lunar explorations. With a view to achieving such explorations in the future, the two countries have started working together to unify their specifications, such as docking unit, electrical connections, and the air inside spacecraft.

China and Europe have been engaged in a variety of collaborative activities, including earth observations through the Dragon Program, navigation and positioning utilizing Galileo and Beidou, the import of communications satellites made in Europe, and commercial launches of European satellites by Long March LVs.

With respect to developing countries, China is working to increase partner countries for satellite exports, facility installation, education and training, the Asia-Pacific Space Cooperation Organization (APSCO),[10] as well as other areas of cooperation.

With the United States and Japan, there are opportunities for partial collaboration on space science and earth observation.

5. Conclusion

China's human space flight activities will ramp up from 2016. It is expected that China's own Tiangong space station will be built, and that the Shenzhou manned

[10] Teruhisa Tsujino, "Chūgoku no Uchū Kaihatsu Jijō (Sono 7): APSCO" [The Space Development Situation of China (Part 7): APSCO], JST, Science Portal China, February 2013 <http://www.spc.jst.go.jp/hottopics/1303/r1303_tsujino.html>.

spaceship and the Tianzhou cargo resupply vehicle will begin nominal operation. If the operations of the International Space Station are terminated in 2024, Tiangong may become the only manned space base of the world.

With regard to its lunar exploration program, China aims to conduct a lunar sample return mission in 2017 and a landing on the far side of the moon in around 2020, and is eyeing to build a manned lunar base in the future.

In the area of space transportation, China is developing the LM-5 and LM-7 LVs to launch the Tiangong and the Tianzhou, and the first launch is expected to take place in 2016.

With respect to navigation and positioning satellites, China plans to shift to the BD-3 with high position accuracy, and thereby, expand to global coverage and develop its own GNSS. This system will become an essential infrastructure for civil applications. It can also be utilized for military purposes.

According to the medium and long-term plan until 2025 just released in October, China plans to develop seven constellations and three types of special purpose satellites for three applications of earth observation satellites. It is interesting that, according to these classifications, satellites with the same name may be divided into different constellations.

The National Security Law prescribes that China's space development contribute to realizing a *xiaokang* society, and that China would maintain space assets and activities in space.

Opinion is split on whether Chinese space development is seen as a threat or as an opportunity for collaboration. The relevant developments will continue to be watched closely.