

OCTOBER 16TH: CHINA'S GREAT LEAP UPWARD: POST LAUNCH ASSESSMENT
AND IMPLICATIONS FOR THE UNITED STATES

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**CHINA'S SPACE CAPABILITIES:
THOUGHTS AFTER SHENZHOU-V**

Introduction

Thank you for that introduction, Bates. Before I begin, let me in fact take advantage of that disclaimer, and note that these comments are solely my own, and do not represent the opinion of the CNA Corporation or anyone but myself.

With the successful landing of the Shenzhou-V yesterday, Yang Liwei now joins Yuri Gagarin and John Glenn in that elite group of pioneers, the first men to orbit the earth for their respective countries. What does this achievement bode for the United States and the Asian region?

My comments this morning are intended to provide the following:

First, a brief overview of the Chinese space program, in order to highlight the fact that the Chinese space effort has consistently received support from some of the highest levels of the Chinese government.

Second, to examine current Chinese space capabilities, not only in terms of their manned program, but their overall space potential.

Finally, I will discuss what the potential implications are of China's space capabilities, in order to better understand the significance of the Shenzhou-V and a Chinese manned presence in space.

Review of the Chinese Space Program

The Chinese space program is an outgrowth of the PRC's missile technology development effort, begun in 1956. With the Soviet Union and United States seeking missile and space-launch capabilities, Mao Zedong sought to push the PRC along the same path. This is quite remarkable, when one considers that this is less than ten years after the founding of the PRC, and when one considers that China was a far poorer nation than either the US or the Soviet Union.

Once the Chinese had constructed a missile, in 1960, they began to devote significant resources towards the development of satellites. China's first satellite, the Dongfanghong-1 (East is Red), was launched on April 24, 1970, making the PRC only the fifth country (after the USSR, the US, France, and Japan) to launch its own satellite into orbit.¹ The DFH was both larger and more capable, a point of pride to Chinese scientists, and setting a trend that the Chinese have sought to maintain in subsequent launches.

While Mao had focused the Chinese space program on national prestige and national security, those goals changed with the accession of Deng Xiaoping to the Chinese premiership. Deng's Four Modernizations program placed highest priority on economic and scientific efforts that would help develop China's economy. The Chinese space program therefore had to "concentrate on urgently needed and practical applied satellites."²

The creation of Project 863, however, in March 1986 moved space back into a major position. The brainchild of four senior scientists, Project 863 was an effort to position the PRC to exploit high technology.

¹ After the USSR [Sputnik-1957], the US [Explorer-1, 1958], France [Asterix-scientific satellite, 1965], and Japan [Ohsumi-test satellites, 1966]

² Li Dayao, "A Survey of the Development of Space Technology in China."

This revived high-level support may have been due, in part, to the belief that aerospace technology could contribute significantly to other national economic development efforts. Subsequently, aerospace projects were highlighted in both the Eighth (1991-1995) and Ninth Five Year Plans (1996-2000).³

From this highly abbreviated history, we can see that the Chinese have long aspired to be a space power.

Current Chinese Space Capabilities

That is, China has sought to be able to exploit space to achieve its own national goals, in terms of scientific and technological development, in support of economic development, and in pursuit of national security aims.

In order to do so, a nation requires a number of distinct elements.

In the first place, there must be interest at the national level to do so. Space launch and space travel is still a very expensive exercise, and at present, is still primarily the purview of national-level programs and efforts. Thus, to be a space power requires political will and high-level political support.

Given the expense and level of effort involved, it also requires a certain degree of spending and of scientific manpower.

Finally, once there is a national will to enter space, and sufficient scientific and engineering manpower and economic resources are available, then there is space infrastructure that must be in place. These comprise launchers, satellites, and a mission support capacity to monitor the satellites and utilize the information.

³ The Tenth Five Year Plan (2001-2005) includes some 15 billion RMB for Plan 863. This is three times the total of the previous fifteen years. Ibid., and Feng Jing, “863 Program Spurs Science and Technology” *Beijing Review* (Beijing) (Internet Version-WWW) (March 29, 2001), in FBIS-CHI (March 29, 2001).

How does the PRC stack up when it comes to these elements of space power?

In terms of national will, as I noted earlier, the Chinese space program has long enjoyed support from the highest levels of the Chinese government. The civilian side of the space program, including the manufacture of launchers and some satellites, is managed by the China National Space Agency (CNSA), which reports to the State Council.

The Chinese People's Liberation Army, meanwhile, controls the space infrastructure, including launch sites, mission control facilities, etc. Specifically, the General Equipment Department, headed by General Li Jinai, controls these facilities. General Li is often identified in the Chinese press as heading the Chinese space effort. He is also a member of the Central Military Commission, one of the key centers of power within the Chinese political system.

Another aspect of space power is the resources devoted to it. The problem here, of course, is that the PRC does not publish official figures about its space program. Consequently, all we have are estimates, which all place Chinese space spending at some \$1.4-2 billion annually on their civilian space program.⁴ This doesn't take into account lower Chinese labor costs and is not adjusted for purchasing power parities. Nor is money a perfect measure of effort in a command economy. But these estimates **do** provide a very rough sense of scale.

Working with the \$2 billion estimate as a minimum figure, for example, although this is substantially less than total US spending on space (at some \$28 billion), or the total European space budget (\$6 billion), it is nonetheless at least three to four times that of Russia (\$700 million), and comparable to Japan, which has the world's second largest space budget at \$2.4 billion.⁵

⁴ Marcia Smith, "China's Space Program: A Brief Overview Including Commercial Launches of US-Built Satellites," 98-575 STM (Congressional Research Service: Washington, DC, September 1998), p. CRS-2

⁵ Michel Andrieu and Pierre Alain-Schieb, "Space: The Forgotten Frontier?" OECD Observer (April 22, 2003).

These figures indicate that the PRC is prepared to devote substantial resources to its space program, compared with other international space actors.⁶

Finally, to be a space power, a nation requires certain hardware, in the form of facilities, including launch sites and mission control centers, launchers and payloads. China has substantial capabilities in all three areas.

Launchers

The primary Chinese launcher is the Long March or Chang-Zeng (长征) series of rockets. The PRC has fielded some 14 versions of the Long March system, allowing them to cover the gamut:

- from low Earth orbit (LEO), which is generally associated with recon systems and some communications satellites,
- to geosynchronous, for communications and Chinese navigation satellites,
- to polar-orbiting capabilities, which are primarily associated with meteorological and some recon systems.

Some of these launchers are technologically as sophisticated as those in the West. China's Long March-3 launch demonstrated the ability to place a satellite into geostationary orbit; a capability rivaled, at the time, only by the United States and France.

Launch Sites and Mission Control

To accommodate their various launchers, the PRC has constructed multiple launch sites, giving them the ability, like the US and Russia, to launch multiple rockets at the same time.

⁶ US space spending is approximately 1% of the government budget. PRC space spending (based on official figures) is approximately .9% of the government budget. CIA World Factbook, 2003. Office of Management and Budget, Budget of the United States, 2003.

China's launch sites include:

- The Xichang Space Launch Center, in southwest China, which supports all Chinese launches destined for geosynchronous orbit.
- The Taiyuan Space Launch Center, in northern China, which is used for polar orbiting missions.
- The Jiuquan (酒泉) Satellite Launch Center in the Gobi Desert, which focuses on low and medium-orbit satellites. Jiuquan also has been the site of all Shenzhou launches.
- There have also been reports that the Chinese are building a new spaceport on Hainan Island.

China's space missions are controlled and coordinated from near Xi'an in central China. The Chinese Tracking, Telemetry & Control (TT&C) network controls a number of domestic ground stations, as well as four space-tracking ships, which provide the PRC with overseas tracking abilities. More recently, the PRC has begun to forge links with other states in order to establish ground stations. This includes Swakopmund in Namibia and South Tarawa Island in Kiribati in the South Pacific. China has also signed agreements with Sweden, France, and Brazil to access information in those nations.

Interestingly, the PRC constructed, at enormous cost, a dedicated facility to manage just their manned space flights, the Beijing Aerospace Directing and Controlling Center (BADCC). A new astronaut training facility was also constructed nearby.

Satellites

Since the (DFH-1) in 1970, the PRC has launched approximately fifty satellites. Of particular note, almost all have been dual-use in nature, supporting both civil and military efforts.⁷ Chinese satellites have fallen into several primary categories:

COMMUNICATIONS SATELLITES, which include the most sophisticated satellites that China has yet produced, the DFH-3, as well as dedicated military communications satellites, such as the Feng Huo-1.

METEOROLOGICAL SATELLITES, the Fengyun [风云] series. Thus far, the PRC has launched a total of four FY-1 and two FY-2 satellites.

RETRIEVABLE REMOTE SENSING SATELLITES, the *Fanhui Shi Weixing* (FSW), which is probably China's most numerous series of satellites, which dropped capsules back to Earth. So far, seventeen of these have been launched

EARTH-IMAGING SATELLITES, the *Ziyuan* [资源] series, which is the successor to the FSW, which can beam digital pictures back to China, rather than having to drop canisters.

It is interesting to note that, in Chinese reporting on Operation Iraqi Freedom, the Chinese apparently utilized their Fengyun weather satellites, as well as their Zhiyuan earth-imaging satellites, to monitor the progress of the war.

NAVIGATION SATELLITES. The PRC is only the third nation to deploy a satellite navigation system, after the US and the former Soviet Union. Indeed, at this point the Chinese system may actually operate closer to its planned parameters, since the Russian GLONASS system is believed to have fewer than 11 of its 24 satellites functioning.⁸

⁷ Zhang Guofu and Zheng Shangmin, "Thirty Years of China's Satellite Technology," *Zhongguo Hangtian* (September 1996), pp. 20-24, in FBIS-CHI (August 5, 1997).

⁸ Wei Long, "China Completes First Satellite Navigation System," *Space Daily*, www.spacedaily.com (January 8, 2001).

OCEANOGRAPHIC SATELLITES. The Haiyang series, which, when complete, will provide the PRC with a substantial capability of monitoring the world's oceans.

Satellite Size Terminology⁹

Group name	Wet Mass	
Large satellite	>1000kg	
Medium sized satellite	500-1000kg	
Mini satellite	100-500kg	Small Satellites
Micro satellite	10-100kg	
Nano satellite	1-10kg	
Pico satellite	0.1-1kg	
Femto satellite	<100g	

In addition to these satellite programs, the Chinese have also shown a great deal of interest in small satellites, which vary downward, from 500 kg to as small as 1 kg. Despite their smaller size, however, such systems nonetheless may be able to carry significant payloads, especially with advances in miniaturization. Thus, one Chinese analysis concluded that employing larger numbers of much smaller satellites may have the same or greater capability than deploying a smaller number of larger, individually more capable systems, with less vulnerability.¹⁰

To support this interest in small satellites, the Chinese space authorities have pushed the development of a new rocket, the Kaituoze [开拓者], specifically intended for launching these systems.

Manned Space

⁹ http://www.ee.surrey.ac.uk/SSC/SSHP/sshp_classify.html

¹⁰ Bei Chao, Yang Jiawei, and Zhang Wei, "Nanosatellite Distributor Design Proposal," Zhongguo Hangtian Bao (August 23, 2002), p. 4, in FBIS-CHI.

Finally, the PRC has devoted significant resources to its manned space effort. Putting a Chinese astronaut in orbit was apparently a consideration from the early days of the Chinese space program, specifically with the founding of the Space Flight Medical Research Center by Qian Xuesen, in 1968. There have been reports that the Chinese seriously considered trying to put a man in orbit early in the 1970s.

Other priorities, including economic development and satellite construction, however, apparently took precedence over such a prestige objective, and the Chinese manned program languished. With a much stronger economic and technological base, though, the PRC took renewed interest in its manned space program in the late 1980s and early 1990s.

The result was Project 921. As with the rest of China's space program, the original Project 921 proposal was for **indigenous** development, of both a series of new rockets and new spacecraft, over the course of the Eighth and Ninth Five Year Plans. These would have been in addition to the ongoing Long March series. The launcher program did not proceed, but construction was started at that time on a new flight control center capable of handling manned spacecraft (which eventually became the BADCC).

Then, in 1994, a cash-strapped Russia indicated its willingness to sell space expertise to China, and when Jiang Zemin visited the Russian Flight Control Centre in Kaliningrad, he noted that there were broad prospects for co-operation between the two countries in space.

In March, 1995 a deal was signed to transfer manned spacecraft technology to China. This included cosmonaut training, provision of Soyuz spacecraft capsules, as well as information on life support systems, docking systems, and space suits.

In 1996 two Chinese astronauts, Wu Jie and Li Qinglong, began training at the Yuri Gagarin Cosmonaut Training Centre in Russia. After training these men returned to

China. It is believed that they have had a hand in the selection, and possibly the training, of the current class of 12 Chinese astronauts.

It is this element of cooperation that has raised a number of questions about the Shenzhou. In particular, the question has been raised repeatedly, “Is it simply a copy of the Russian Soyuz?”

On the surface, there are certain similarities. At a minimum, both are comprised of three separate modules:

- A. An orbital module, containing experiments or other payloads;
- B. A descent module, which the crew rides into orbit, and back to earth (it is the only part of the system that returns to earth); and
- C. A service module, containing the propulsion systems. (This detaches prior to final reentry of the descent module, and burns up.)

Upon closer examination, however, the Shenzhou is clearly different from the Soyuz. To begin with, the Shenzhou is physically larger than a Soyuz capsule. The Shenzhou is wider, and longer, and about half a ton heavier.¹¹ This suggests significant internal changes, and Chinese writings indicate that, among other things, the craft’s electrical system was entirely revamped after the Shenzhou-II test shot.

Furthermore, the Shenzhou has two sets of solar panel arrays, compared with the single set of arrays on the Soyuz. The two arrays together generate approximately 1.2 kW, which is comparable to that of the entire Mir station, or three times that of an individual Soyuz vessel. This gives the craft more power to run various systems, and could give it longer endurance, or the ability to run more extensive systems or experiments.

¹¹ Ben Iannotta, “China’s Divine Craft,” *Aerospace America* (April 2001).

One of those solar arrays is on the Shenzhou's orbital modules, which also has its own set of engines. This allows the Shenzhou's orbital module to maneuver and sustain itself on its own, unlike the orbital module on the Soyuz.

This was clearly demonstrated in the Shenzhou-IV test-flight when the orbital module was boosted to a higher orbit after separating from the descent module, and left in orbit for nine months on its own, coming down only a few weeks ago. The combination of its own power and propulsion could make the orbital module a suitable building block for a Chinese Skylab or Mir.

Indeed, one issue that analysts will be wondering about in the coming months will be what the Chinese do with the orbital module from the Shenzhou-V mission. In particular, if the Shenzhou-VI mission (and there will BE a Shenzhou-VI mission, eventually) is within the next nine months, will they choose to dock with the orbital module from this mission? That would mean a very quick move to space-docking. Even if they don't do it on Shenzhou-VI, however, the ability to maintain a Shenzhou OM in orbit will eventually offer the Chinese the opportunity to undertake docking maneuvers, should they so choose.

Another thing that is interesting to note about the Russian contribution to the Shenzhou is the docking collar. The Shenzhou's docking collar is apparently identical to that used on the Soyuz. This means that the Shenzhou, at least in theory, is capable of docking with the International Space Station.

Speaking of docking, it might also be noted that the ISS is at an accessible orbital altitude for a Chinese mission. The ISS orbits at an altitude of approximately 340 km above the Earth. This is the same band (roughly) as the Mir space station, to which Soyuz craft regularly ventured. Now, they are not at the same orbital inclination, so docking would require a different orbital insertion for a Shenzhou than has been seen thus far. Nonetheless, since the *Shenzhou-II* mission orbited at approximately the same altitude, it

would seem that there is no obvious technical reason the PRC could not orbit and dock with the ISS, given practice and demonstrated ability to undertake such a maneuver.

Implications of the Chinese Manned Space Program

Since we are gathered here today because of the prospective Shenzhou-V launch, the question naturally arises, what is the reason for this massive expenditure? Why are the Chinese so interested in a manned space program, especially given the costs?

While I do not pretend to know the thinking of Jiang Zemin, Hu Jintao, Wen Jiabao, or Zeng Qinghong, I would suggest that there are several likely factors influencing their thinking, or not influencing their thinking, as the case may be.

Military Implications

Let me start with a negative. While much of China's space program clearly has military benefits and implications, I do not believe that its manned program does. A manned program, as we have seen with the United States and the Soviet Union, imposes enormous costs, both at the mission, and at an overall programmatic level. A human in space is incredibly fragile, with huge demands in weight and cost for life support, redundancies, emergency back-up systems, etc.

For which the gains are limited. What is it, exactly, that a manned platform can do that an unmanned system cannot? China already fields reconnaissance, meteorological, and communications satellites---a manned program does not provide significant advances in any of these areas.

Instead, I would suggest that the primary considerations for the ***manned program***, as distinct from the overall Chinese space program, are in terms of prestige and economics.

Prestige

The space program, especially a manned program, is in many ways like hosting the Olympics. It represents a “coming out” party, a statement that “we have arrived.” For many states, hosting the Olympics marked their transition from lesser developed state, to more developed state. This was true for Japan, in 1964, West Germany in 1972, and South Korea in 1988.

I believe that this is a huge element of Chinese decision-making. As I noted earlier, two of the prerequisites for becoming a space power is both national will, and a level of national resources, measured in terms of both money and scientific talent. A manned program underscores both leadership determination to be a space power, as well as a surplus of resources that can be devoted to that end.

And a manned presence says, in a very distinct way, that China cannot be ignored on the world stage. One Chinese analyst said that the Shenzhou-V mission showed that China was now a major space power, but not yet a space superpower.

This is particularly true if we consider the likelihood that the Shenzhou is not an end, in and of itself, but rather, a mere way-station. Chinese writings clearly suggest that the aim is more than simply introducing a Chinese citizen or three to the rigors of outer space. Recent statements from Chinese authorities suggest a desire for a manned Chinese foothold in space by 2010-2015. Assuming that such efforts retain national-level priority, and given the level of technology currently displayed, the Chinese approach does not appear outlandish, nor even necessarily excessively optimistic. It is worth noting that the US managed to put a man on the Moon within ten years of first putting a man in space.

And the Chinese have a far easier development phase than we did, since much of the fundamental theoretical work has already been accomplished. Indeed, space science has been sufficiently open that the Chinese can almost certainly benefit from lessons learned by both the US and the Soviet Union in the course of the “space race,” with regards to

space-suit construction, atmosphere mix in the modules, effects of extended weightlessness, etc. The idea of a Chinese space station, or even a lunar mission, given China's economic base, thus moves from the exorbitant to the merely expensive.

Whether this will come to fruition remains to be seen, but the idea seems to be alive in China's S&T community that the explorers of the final frontier should include Chinese among their number.

Economic Considerations

A more practical, and mundane, element to the manned effort may be economic considerations. A successful Shenzhou launch would represent an enormous bit of advertising for China's space launch program, which has been in the doldrums for most of the last several years. The last major commercial effort was the launches, between 1997 and 1999, of the Iridium satellites.

The logic, if this is a motivating aspect, would be that Chinese launchers are sufficiently reliable to put people into orbit---presumably it would meet the needs for satellite launch as well.

There is also an interesting question of whether the manned program serves to keep not only production lines but design teams employed.

Conclusion

At this point, I think I'd like to wrap up my remarks, and thank Bates and CSIS, again, for putting together this panel.