China's Space Odyssey

World's Envy?

The race for space dominance has already started, driven by the US on the one hand, and Russia and China on the other. Peacefully, the race has a great deal of promise in extending mankind's understanding of, and reach for, the stars, including scientific, technological, and other civilian benefits that have the potential of changing our lives for the better.

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On June 17, 2021, from the Gobi Desert, China launched three astronauts to rendezvous with the country's nascent space station called 'Tiangong', or 'Heavenly Palace'. The launch is the third of 11 missions planned to complete the construction of China's first long-term outpost in space before the end of next year. The spacecraft, 'Shenzhou' ('Divine Vessel')-12, succeeded in docking to the two modules launched earlier. The crew of Shenzhou-12 is scheduled to spend the next three months in orbit, to be replaced by a second crew of three astronauts afterward.

The astronauts' main tasks are to continue building the Tiangong Space Station, installing equipment, and testing various functions, including life support and waste management. They are scheduled to conduct two spacewalks in the process. The Tiangong is expected to weigh between 80 and 100 tons. It is designed as a third-generation modular space station assembled in-orbit from pieces launched separately. Modular design and assembly in space improve reliability, reduce costs, shorten development cycles, and meet diversified task requirements.

The Chinese station will serve as an orbiting scientific laboratory for the country's space program, allowing it to perfect operations and conduct new experiments. At least nine of these experiments include partnerships with a host of Western nations. Officials have said that once the station is completed next year, they will consider allowing foreign astronauts to be ferried to the station.

The Tiangong will remain in Low Earth Orbit (LEO). It is scheduled to be followed by the launch of the Tianzhou ('Heavenly Vessel')-3 cargo spacecraft and the Shenzou-13 spacecraft later this year, with three replacement astronauts expected to stay six months—by far the longest stay in space by Chinese astronauts.

The Tiangong, when completed, will be rough one-fifth the mass of the current 5-nation NASA-led International Space Station (ISS), which has deliberately excluded China. The four other participating space agencies are Roscosmos (Russia), JAXA (Japan), ESA (Europe), and CSA (Canada).

Launched in 1998, the ISS was originally designed to have a 15-year life span. Decommissioning was later extended until 2024. NASA has proposed keeping the station going for a few more years. If the station is eventually decommissioned, China's could be the only game in town for some time.

According to an insightful piece by Namrata Goswami on May 1, 2021 in *The Diplomat*, a permanent space station has several geopolitical, astropolitics, and technical advantages for China.

First, a permanent space station increases China's global legitimacy, giving it the ability to host astronauts and experiments from the international community, especially after decommissioning of the NASA-led ISS.

Second, it could cement a partnership with Russia. Russian officials have warned that ISS technologies are already outdated and, given fraught US relations, Russia has indicated not to participate in the NASA-led initiative by 2025. China and Russia could well partner in China's space station. Additionally, Russia and India recently established a 2+2 ministerial dialogue between their foreign and defense ministries with space cooperation as one key area. This augurs well for possible future China-India-Russia space cooperation.

Third, China's permanent space station signals to the world that China is openly contesting the US for space leadership. Once China completes its permanent space station, the prestige of being viewed as a capable space power equal to the US has strategic implications. There is potential for China to entice current and potential space partners to create a 'Space Silk Road' along the lines of the Belt and Road Initiative. If successful, this would consolidate China's overall geopolitical power and influence in global norms on space behavior.

Fourth, space capacity translates into military capacity. China's space prowess has military implications such as Space Situational Awareness (SSA), reconnaissance, navigation, and intelligence, as well as space warfare.

Fifth, a permanent space station would enable China to develop technologies for the crewed moon and Mars habitation missions, leading to future permanent settlement. The Chinese space station's lower inclination than the ISS (41-43 degrees vs. 51.6 degrees) makes it better positioned for logistical support for its planned 2036 lunar base.

> As part of the China Dream for national renaissance, Beijing aims to become a leading space nation by 2045, following a long-term strategy of space capacity development and technological advancement to this end.

China's space program has had a very successful series of launches and landings in recent years. Despite relatively, a very late start and exclusion from the NASA-led ISS collaboration, China's space program advances so far are truly remarkable.

In May this year, Zhurong ('God of Fire'), a robotic rover, landed smoothly on the surface of Mars. It was China's first rover to land on another planet. This space mission, called Tianwen ('Questions to Heaven'), completed in one go, a trifecta of feats that NASA accomplished over several years. It orbited around Mars in February, safely put a craft on the planet's surface in May, and soon afterward successfully released a robotic rover.

Earlier, on January 3, 2019, Chang'e ('Goddess of the Moon') - 4, a robotic spacecraft, soft-landed on the dark, far side of the moon. Compared to other unmanned lunar missions so far, this lunar landing was technologically more sophisticated. No other nation has made a similar attempt before.

In 2019, China National Space Administration head Zhang Kejian announced that China is planning to build a scientific research station on the Moon's south pole within the next 10 years (by 2029). As mentioned earlier, China plans the establishment of a lunar base in 2036.

China plans to send a second lander to Mars by 2028 and, ultimately, to bring samples back from the planet. It's a complex feat that NASA and the European Space Agency (ESA) are working on, to bring soil and rock samples home in 2031. China's mission could happen this decade, setting up a potential race.

According to a report in the *South China Morning Post* of June 2, 2021, China's Tiangong space station could help pave the way for a manned mission to Mars using a propulsion system that has never before been deployed for a manned spacecraft. The space station's core Tianhe ('Heavenly River') module is powered by four ion drives—also known as 'Hall effect thrusters'—a form of 'electronic propulsion' that could dramatically slash the time needed to travel to the red planet.

In addition to the possibility of a future crewed mission to Mars, China is planning a 10-year mission to collect a sample from an asteroid and pass by a comet. It has also proposed orbiters for Venus and Jupiter. In 2024, it plans to launch an orbiting space telescope similar to NASA/ESA's renowned Hubble

Five Key Themes in the New Space Economy

Climate change, security and telecoms are among the key themes driving a boom in the space economy. Here's a look at what's behind the increased interest.

The rush to explore the expanding frontiers of the space economy is accelerating, with sustainability- and government-related applications driving critical growth and private investment.

"If I had to pick just three words to capture my conversations in this arena, it would be 'space is existential,' from the future of the planet to the future of commerce," says Adam Jonas, Head of the Morgan Stanley Research Space Team.

For example, satellites are now providing a clearer view of how industries and human activities are intensifying climate change, while communications, navigation and national security issues dominate governments' growing interests in space.

To advance the conversation on space development and capital markets, Morgan Stanley Research recently gathered corporates, government representatives and venture-capital participants for its third Annual Space Summit. For investors, here are five key themes that emerged from the summit:

1. A Growing Relationship Between Space and Climate Change

Space and sustainability have aligned. With more investors focused on Environment, Social and Governance (ESG) factors, satellite imagery may provide them with key data on the environmental impact of company activities. Satellite applications include monitoring greenhouse-gas emissions from companies and regions, helping utilities optimize renewable energy infrastructure and mining data to project how climate change could affect particular industries.

2. Increased Capital Formation

Despite Covid-19, last year saw the biggest private investment in space to date, with space capital formation and infrastructure developing on multiple fronts.

3. Mitigating Orbital Debris

According to the US National Oceanic and Atmospheric Administration, the number of active satellites in orbit could increase by 50% or more in 2021. As space becomes more congested, the threat of 'space junk'—orbital debris from old spacecraft and satellites—to new satellites and rocket launches has grown. Some government agencies now struggle to track this orbital debris, creating potential demand for private companies to monitor and manage this potentially catastrophic space waste.

4. Space and Security

Space has become an increasingly contested domain among countries, underscoring the need for 'space domain awareness' by private and governmental players. That means identifying, characterizing and understanding objects in orbit.

5. Telecoms – A Near-Term Focus

Satellite operators see value across all three orbital altitudes—GEO, MEO and LEO (Geostationary Equatorial Orbit, Medium Earth Orbit and Low Earth Orbit, respectively)—with companies taking different approaches to blending them.

Courtesy: Morgan Stanley Research on the future of space development

space telescope, which was first launched in 1990.

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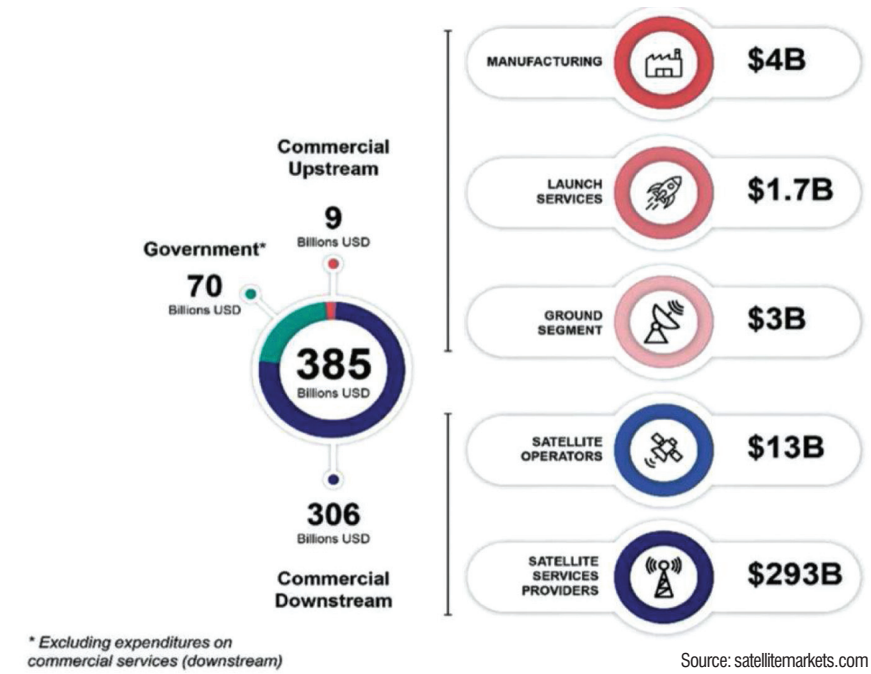
Essential to any space mission is a global satellite positioning system. Wary of the US-controlled GPS, China first started developing its own BeiDou ('The Bid Dipper' or 'Northern Star') navigation satellite system in the 1990s. In 2003, America's invasion of Iraq ("War on Terror") demonstrated what GPS-assisted 'Shock and Awe' could achieve militarily. The BeiDou development soon picked up speed. The final satellite of the system (BDS-3) was sent into orbit in June 2020, completing the entire navigation satellite network of 55 satellites, which claim millimeter-level accuracy.

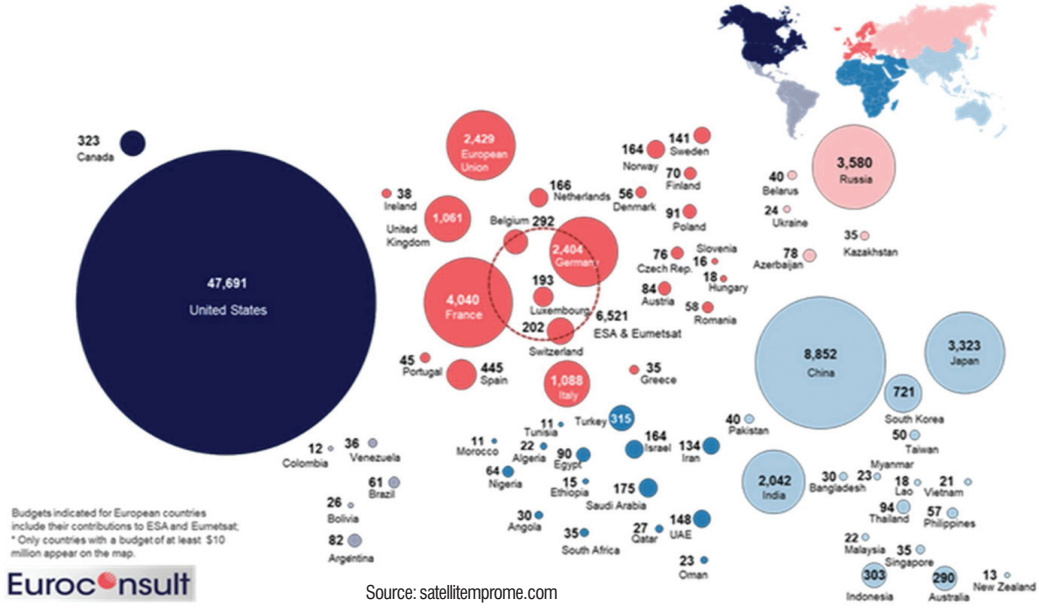
2020 Space Economy



* Excluding expenditures on commercial services (downstream)

Source: satellitemarkets.com

World Government Expenditures for Space Programs (2020)* Total $82.5 bn



Source: satellitemprome.com

As in the case of the American GPS, along with positioning, navigation, and timing services, the BDS-3 system offers a variety of advanced civilian applications like global search and rescue assistance, early-warning for geological disasters, short message communication, precise-point positioning, and automated transportation services such as process monitoring, highway infrastructure safety monitoring, high-precision real-time positioning and dispatching for port operations. The system has also wide applications for agriculture and forestry. About 45,000 pieces of BDS-based automatic agricultural machinery are already working nationwide, cutting labor costs by 50%. Coupled with the ubiquity of global satellite navigation system-embedded smartphones, BDS-3 is rapidly changing how people, businesses, and other human activities are conducted.

China's advancing pace of space exploration has been awakening American concerns about the US' capacities for a new Space Race for "dominance of the stars". However, as recently as in 2019, the focus was on America's current reliance on Russia's RD-180 engine to power national security space launches. As reported in a *Foreign Policy* article of May 14, 2019, the debate was largely dominated by rival commercial interests between aviation and space technology firms like Lockheed Martin, Boeing, and SpaceX. In contrast to different American administrations' policy uncertainty and periodic shifts in the direction facing NASA, China has stuck to its plans and timetables, with the country's space program serving as a source of national pride and another tool of international diplomacy. All along, China has been consistent in opposing the militarization of space. Together with Russia, it proposed a joint draft treaty in 2008 on the "Prevention of an Arms Race in Outer Space", which was revised in 2014. However, the proposal was rejected both times by the US.

On December 20, 2019, President Donald Trump signed the 2020 National Defense Authorization Act including the establishment of a Space Force as the sixth branch of the US armed forces. On November 6, 2020, the First Committee of the UN General Assembly voted in favor of adopting five resolutions on outer space security. These resolutions were "Prevention of an arms race in outer space," "Further practical measures for the prevention of an arms race in outer space," "No first placement of weapons in outer space," "Transparency and confidence-building measures in outer space activities," and "Reducing space threats through norms, rules, and principles of responsible behaviors." The US voted against all of these resolutions except the last resolution on reducing space threats.

This followed directions set in a Pentagon Report in September 2020, which referred to China's capabilities of using an Anti-Satellite (ASAT) missile to shoot down its weather satellite in 2007. The report alleges that despite public stance against the militarization of space, China continues to develop "counter-space" capabilities including kinetic-kill missiles, ground-based lasers, orbiting space robots, and space surveillance to monitor objects across the globe and in space. China's arsenal of counter-space systems is said to include electronic weapons—such as satellite jammers, cyber capabilities, and directed-energy weapons.

The race for space dominance has already started, driven by the US on the one hand and Russia and China on the other. Peacefully, the race has a great deal of promise in extending mankind's understanding of, and reach for, the stars, including scientific, technological, and other civilian benefits that have the potential of changing our lives for the better.

Militarily, however, the space race could spiral into a seemingly "science-fiction" "Star War" arms race that could further destabilize international relations. It also expands the risks of miscalculations with catastrophic consequences for mankind. ■

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