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China can take lead in tackling looming space-debris crisis that threatens Earth

The Shenzhou XX crew arrived safely back on Earth on Nov 14 using the recently arrived Shenzhou XXI capsule. This has left the Shenzhou XXI crew with no immediate prospect of return if there was another emergency. The Shenzhou XXII capsule has just been sent up early, given the situation is an unprecedented event for the Chinese Tiangong (Heavenly Palace) space station. However, given that the crew of the last two Shenzhou missions have spent some EVA (extravehicular activity, aka spacewalk) time installing additional shielding against space debris, it was clear the risks were understood, and that further precautions were already being taken.

Given what has eventuated, this event will spur the Chinese space program to build more redundancy into the space station sooner than planned and to reevaluate the urgency that China, and indeed the world, attaches to the issue of and threat from space debris. I speculate that China will also plan to add an extra docking port. It would make the space station larger, which is part of the overall plan anyway, but they might now bring those plans forward. This event is sharply focusing the minds of the Chinese and indeed all space-faring nations on the profound impact of space debris.

At the moment, we have a 1 billion yuan ($141 million) space capsule stranded, attached to the space station, and unable to be used at all as a result of the impact of a small, worthless piece of space junk traveling at perhaps 10 kilometers per second. At such speeds, small pieces of debris, a few grams in mass and less than 1 centimeter in size, can have the explosive power of a grenade. It is not the mass of the debris particle that is the main issue; it is the velocity at which it is moving. This is because the kinetic energy of impact is given by the square of the velocity multiplied by the mass of the debris particle, then divided by two. The piece that affected the window on the capsule was likely even smaller, but still had a significant effect. This impact created fissures and cracks in the space capsule's glass. In the searing heat of reentry and the attendant vibrations, these cracks would spread and easily blow the whole window out. This is why they haven't risked it. It's just too dangerous.

Furthermore, the window is not a

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This event will lead to a much stronger, better-resourced, and more urgent global program to address the space-debris issue, and this is the silver lining we need. China can take the international lead in tackling this issue for all of us.

component that can be fixed in situ because it is complex and critical, and the damage is too severe to be repaired on-site. The China Manned Space Agency has now announced that the spacecraft will remain in orbit and be deorbited after the current mission completes its tasks. An alternative is to keep it as a storage facility attached and for experiments, but the docking port is needed.

Despite this unprecedented saga, all is now well for the time being on board the "Heavenly Palace". Though this issue has now grabbed all the headlines, there are still many positives and "firsts" for this mission worth noting.

To begin with, this was the quickest-ever docking between the rocket lifting off and the taikonaut entering the space station in just over three and a half hours, a new world record, and interesting to compare that with the equivalent timings for the International Space Station, which is typically 16 to 19 hours. There was also the youngest taikonaut ever on board, at 32. They also installed a special oven so they could have, effectively, the first barbecue in space, with viral images of the taikonauts tucking into chicken wings and steak. It is not just any oven, but one that filters out smoke and fat effectively, so as not to contaminate the pristine, almost zenlike space station environment characteristic of Tiangong. I am sure the barbecue aromas were still greatly appreciated.

Another fascinating snippet was the crew commander's intention to improve the psychological and cultural well-being of the taikonauts, with plans for poetry, calligraphy, and tai chi to supplement the "gardening" already underway and to provide a few kilograms of lettuce and tomatoes. Interestingly, they also brought up four mice. These were not just any mice, but were selected from dozens of mice that were "specially trained", and they picked the best, the fittest, and most physiologically suitable to be part of the space mission, two male and two female mice. So while this is interesting and even entertaining, there is a very serious side to study and experiment.

Given the saga of the Shenzhou XX-to-XXI changeover, the implications of what's just happened will filter through to the highest levels of all spacefaring nations, and I think there may well be a very proactive approach going forward, and hopefully, greater collaboration and cooperation to solve the debris problem before it becomes too difficult. This event will lead to a much stronger, better-resourced, and more urgent global program to address the space-debris issue, and this is the silver lining we need. China can take the international lead in tackling this issue for all of us. This is also in the context of all the pushing and warnings from certain vocal quarters, including me, that have stressed the existential threat posed by space debris to the entire low earth orbit ecosystem and, by extension, the whole of the global space program. Space sustainability is included as a theme for the upcoming Asia-Pacific Regional Meeting of the International Astronomical Union, a massive mega-science event to be held in Hong Kong in May. There will be talks addressing this very issue of space debris and the Kessler syndrome, and how it threatens all of space. The relevance to astronomy is that if that ecosystem is destroyed, the Chinese space station and the Chinese space station telescope for astronomical research will be gone as well.

In summary, China can take a global lead in tackling space debris for us all. At the same time, the Hong Kong Special Administrative Region could play a pivotal role by establishing a global space sustainability hub. It's a very opportune moment with enormous potential — can we grab it?

The views do not necessarily reflect those of China Daily.

Institute to build space data centers

By YANG CHENG and WANG SONGSONG

An institute in Beijing is preparing to launch its first new type of high-computing-power experimental satellites by late 2025 or early 2026, as China seeks new ways to meet surging demand for computing power amid global energy constraints driven by artificial intelligence, experts said on Thursday.

"Large-scale data centers have expanded rapidly worldwide, but further growth faces major obstacles, including heavy land use, soaring energy consumption and limits on atmospheric cooling," said Zhang Shancong, director of the Beijing Astro-future Institute of Space Technology and chief scientist at Beijing Orbit Twilight Technology Co.

A report released by the International Energy Agency in April warned that global electricity demand from data centers is expected to more than double by 2030 to around 945 terawatt-hours, exceeding Japan's current total electricity consumption. AI is expected to be the biggest contributor to the increase.

Space-based solutions offer abundant solar energy and the stable minus 270 C cosmic environment, enabling continuous solar power generation and highly efficient passive radiation cooling — a potentially groundbreaking approach to meeting future computational needs, according to the Beijing institute.

The institute plans to build a constellation of 16 centralized space data centers in a dawn-dusk orbit 700 to 800 kilometers above Earth. The orbit would allow near-continuous access to solar power, supplying an estimated 16 gigawatts to the network.

The design features concentrated solar cells and flexible radiating panels. The project has now entered its initial research phase, including the development of first-generation test satellites.

The push comes as technology companies globally race to build orbital computing infrastructure. On Nov 5, Alphabet, Google's parent company, unveiled its "Sun Catcher" project to build a space-based AI data center using solar-powered satellites equipped with Google TPUs, with trial launches planned for 2027. Starcloud, an Nvidia-backed company, launched its first test satellite carrying H100 chips on Nov 2 and aims to develop a space data center spanning tens of square kilometers with five-gigawatt-level power within five years.

Computing satellites will be used in many sectors, said Liu Liang, deputy director of the satellite-terrestrial integration technology research institute at China Mobile Research Institute. In-orbit AI models will be able to process and analyze monitoring data rapidly, allowing real-time observation of environmental elements such as the atmosphere, water and soil. Liu said this will provide critical data support for weather forecasting, environmental governance and agricultural production.

"With wide-area coverage and low-latency computing services, the computing constellation also contributes to building an intelligent transportation network," Liu said.

Zhang said development will unfold in three stages. From 2025 to 2027, the team will test key technologies needed to power and cool computers in orbit, and several trial computing satellites and data-relay satellites will be launched. Computing capacity is expected to grow as more satellites join the network.

The second stage, from 2028 to 2030, will focus on reducing the cost of space-based computing so it becomes comparable to running data centers on the ground.

The final stage, from 2031 to 2035, aims to build much larger orbital facilities powered by vast amounts of solar energy that could one day support the training and operation of advanced AI systems directly in space.

Beijing's rocket enterprises are expected to launch the majority of missions.

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Editor's note: The burgeoning NewSpace economy in Hong Kong represents an exciting frontier of innovation, investment, and professional services. The final piece of this series explores how the city's space vision is advancing toward true commercialization.

Hungry for space

As space shifts from science to commerce, Hong Kong is searching for its entry point. Entrepreneurs, investors and researchers see openings in finance, leasing, high-value manufacturing — niches where the city's strengths could matter as global competition for the space economy intensifies. **Luo Weiteng** reports.

Venture capitalist Ron Chiong recalls advising a British entrepreneur, currently operating from the United Arab Emirates, to consider Hong Kong for his next fundraiser.

The entrepreneur is chasing an idea that's ambitious yet commercially grounded — converting space into tradable digital assets. His blockchain-based platform envisions trading everything from satellite spectrum and Earth-imagery data to lunar resources and space-station leases.

Chiong sees the future of commerce in a most unexpected place: outer space. Tokenizing space assets is one of many commercial experiments emerging beyond Earth — the kind of innovation and investment opportunities he hopes Hong Kong could draw into its orbit. Yet for now, the center of gravity sits across the Pacific. The entrepreneur himself is fundraising in the United States where space entrepreneurship and risk-hungry capital are setting the pace.

Seeking new markets

Global space tech funding — from rocket-makers to low-Earth-orbit satellites — rallied to $3.1 billion in the second quarter of this year, with US firms securing the lion's share with $2.2 billion. In the first half of 2025, investment in US space businesses surpassed that for the entire 2024, according to investment firm Seraphim Space. In Hong Kong, an emerging constellation of policymakers, space entrepreneurs, scrappy startups, adventurous investors and aerospace researchers are planting the seeds of what may sprout into a full-fledged space economy. It's a grand vision that could, with time, take shape and evolve into a marketplace where companies build, launch and monetize their innovations.

Chiong has tracked the early stir. "Hong Kong's space ecosystem is still in its infancy," says the founder and managing partner of Perpetual Space Ventures. He sees rising awareness and an expanding calendar of gatherings across the city. Yet, much of it centers on spreading ideas and advancing science, not on building businesses.

US billionaire entrepreneur Elon Musk took space commercialization to new heights in 2017 when SpaceX launched its first recycled rocket — an accomplishment he compared to finally achieving reliable aircraft rather than throwing away a functioning airplane after every flight.

Space has always been an expensive and exclusive frontier. Its economics hinge on the ability to reuse what goes up. "The success marks a big turning point that makes a new breed of space ventures possible," says Chiong. "Think of how budget airlines democratize air travel for everyone. The bottom line is being able to reach space at a reasonable cost."

The US leads the way, as far as reusability is concerned, with SpaceX extending the lifespan of a reused booster up to 32 flights, says Anthony Neoh who co-chairs the Asian Academy of International Law.

The impact is visible in launch cadence. "For every six launches by the US, China has about one," notes Neoh.

With new investors bidding up a space economy said to be worth $613 billion last year, the bulk of that is tied to the lucrative satellites business.

Again, the US leads the pack with SpaceX launching 10,501 satellites, according to US astronomer Jonathan McDowell, who tracks Starlink — the company's constellation delivering broadband internet. As of Nov 23, there were 9,103 Starlink satellites in orbit, of which 9,088 were working.

Hong Kong is now home to four local companies actively engaged in space business. Two of them — AsiaSat and APT Satellite — operate geostationary-Earth-orbit satellites, covering 45 percent of Asia's broadcasting services. The other two manufacture one-meter-class small satellites.

Six Chinese mainland-based firms have expanded into the special administrative region, with four of them specializing in satellite launches.

"At least two companies have completed successful trials of reusable launchers, and they should be ready for production next year," says Neoh who formerly chaired Hong Kong's Securities and Futures Commission.

The momentum is undeniable, but venture capital (VC) — responsible for 77 percent of global space funding in the first half of 2025 — is where commercial reality gets tested, according to VC fund, Space Capital.

Chiong says Hong Kong-based founders he has talked to often provide technical sophistication but lack commercial readiness. What they offer are engineering solutions born in university labs or business models that are still too early to scale.

"An engineering solution fixes the problem," he explains. "A business solution fixes it and generates tangible revenue. This is one of our bottom-line requirements when investing in space tech."

Startups that grab investors' attention share the ingredients — a working product with technology moat, recurring income backed by government contracts, commercial operations underway or imminent, and a demonstrated rationale for fresh funding. "That's the tipping point — the moment a space startup becomes genuinely investable," Chiong reckons.

Commercialization is not a sidetrack, but the thread running through the entire space economy, spanning investment, financing and insurance, data collection and analytics, satellite commissioning and in-orbit servicing, as well as advanced robotics for manufacturing, among other domains. Last year, the commercial sector accounted for 78 percent of the global space economy, according to the US-based Space Foundation.

Hong Kong's location on this ladder lies in what the city knows best — finance — says Dewey Yee, professor of practice (aviation management and finance) at the Department of Logistics and Maritime Studies at the Hong Kong Polytechnic University.

Chiong agrees, calling finance and professional services the "low-hanging fruits" Hong Kong can grasp before heavier industrial groundwork is in place.

Tokenization has been floated as one possible path — a satellite operator could raise funds before the satellite is even in orbit.

Yee sets his sights on a more immediate and proven lever — leasing. "Leasing is one of the most powerful tools to unlock dormant capital," he says. "Structurally, spacecraft leasing is the next extension of aircraft leasing, where the real difference sits in the underlying asset-backed equipment."

As spacecraft become reusable, the logic sharpens. Engines, fairings and other capital-intensive assemblies begin to resemble durable, financeable assets, lending themselves to leasing and sparing operators hefty upfront costs.

Yee speaks from experience. Decades ago, he talked his way into Guinness Peat Aviation which is credited with kick-starting Ireland's aircraft-leasing industry. Leasing has since become the preferred option for airlines over buying globally, rising from roughly 10 percent of the total fleet in the 1970s to 58 percent at the end of 2023, according to the International Air Transport Association.

Hong Kong was a late arrival to this sphere. For all its weight in aviation financing, the city didn't begin cultivating its leasing business until 2013. When Yee served on the Hong Kong Economic Development Commission from 2012 to 2017, he helped craft a new tax regime to entice aircraft leasing companies with competitive profit tax concessions — one that could, with modest tweaks, extend neatly to spacecraft.

Yet, the much-awaited framework remains underused as it applies only to lessors with equipment registered locally, Yee says. Ireland still dominates, backed by a mature commercial aircraft registry and generous tax depreciation allowances on aircraft assets.

That raises a broader issue — international registration of rights over aircraft and spacecraft. In 2001, the Convention on International Interests in Mobile Equipment (Cape Town Convention) and its associated Aircraft Protocol wrote the rulebook for ownership, leases, and security interests in aircraft. The Space Protocol, drafted in 2012, still awaits the 10 ratifications required to take effect — an institutional silence that Neoh sees as an opportunity.

Riding high on blockchain verification and smart contract technologies, "Hong Kong has every reason to build the world's first commercial-grade registry of space assets," says Neoh.

If institutions matter, so do people. Even today, aircraft leasing remains a niche. It requires a rare mix of structuring, tax planning, credit assessment and cross-jurisdictional legal judgment. Such a breadth of expertise, Yee points out, transfers naturally to spacecraft leasing where Hong Kong's experienced leasing professionals and international lawyers could become the early architects.

For Gao Yang, director of Hong Kong Space Robotics and Energy Centre, the city's pool of talent also gives it room to climb up the space value chain. "Hong Kong needs to play cleverly and intelligently," she says. "High-value manufacturing is the key word."

Embracing high value

Tomorrow's space manufacturing won't depend on sprawling factories or ground-based infrastructure, but on embedded artificial intelligence, robotics, and compact, lower-cost devices. As more production moves off Earth, the launch burden lightens, operating costs drop, and innovation is freed from land and scale — constraints Hong Kong has always lived with.

"You can definitely service others with finance and a legal system. But having a layer of homegrown tech as a foundation will make the whole thing more sustained," Gao stresses.

That foundation, she argues, is where Hong Kong can carve out its niche business. Instead of squeezing into the crowded arenas of small-satellite manufacturing and Earth observation, the city is well-positioned to specialize in the higher-value, less-saturated segments — AI-defined space modules and smart in-orbit robotics components where global supply is thin, but the commercial pull is real.

The space robotics expert paints the Guangdong-Hong Kong-Macao Greater Bay Area and Hainan province, which is home to China's first commercial spaceport, as forming a naturally self-sustained space supply chain.

"Once you have independence, you can push into new frontiers faster and more cost-effectively," she asserts.

This drive for self-sufficiency mirrors a global trend, as the US, China and Europe race to strengthen their domestic defense-space industries.

The US allocated $49.5 billion to defense space expenditure last year, dwarfing the combined $11.3 billion from the rest of the world. Over the past five years, non-US military space spending has soared 76.5 percent, according to the Space Foundation.

"Space always has sensitive and non-sensitive sides. The key is drawing a clear line so capital knows where to go," Gao says.

Chiong wants that clarity. Preparing a space-tech fund focused on Southeast Asia where he finds the startup scene more coherent, the venture capitalist highlights Hong Kong's missing piece — a space agency or office dedicated to laying out overall policy. Without it, entrepreneurs and investors would hesitate before a window of opportunities.

The window is opening rapidly. China's commercial space sector attracted over 15 billion yuan ($2.1 billion) last year, up almost 40 percent year-on-year. For the first time, the US accounted for less than half of global space VC funding, as figures from the European Space Policy Institute show.

Chiong believes this is precisely where Hong Kong's superconnector role matters. A one-stop coordinating body could bridge global businesses and mainland stakeholders, offering clear guidance needed to buy into the country's race into space.

Policymakers too are warming to the idea. Veteran politician Regina Ip Lau Suk-yee has raised the issue of prioritizing the space economy with the HKSAR government, with a space industry office as the anchor.

Mainland space companies are already knocking on the door. Satellite company Adaspace Technology filed for a Hong Kong listing earlier this year, seeking capital, professional services and a launchpad to the world stage.

For Neoh, Hong Kong's proximity to the mainland is its strongest commercial lever. The senior barrister recently met insurance giant Marsh McLennan's chief executive in Beijing, who was assessing China's vast potential in space insurance — a market long under the United Kingdom's sway.

"As China's space ambitions hit a new gear, the center of demand will inevitably shift," Neoh says. The SAR's deep bench of insurers, reinsurers, brokers and actuaries are well-placed to underwrite the future — just one example visible on the horizon.

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Space economy 2024

The space economy includes all activities and resources for the exploration, research, management, and use of space.

Source: Novaspace, a leading global consulting firm in the space sector

Data Journalism *Let the facts speak*

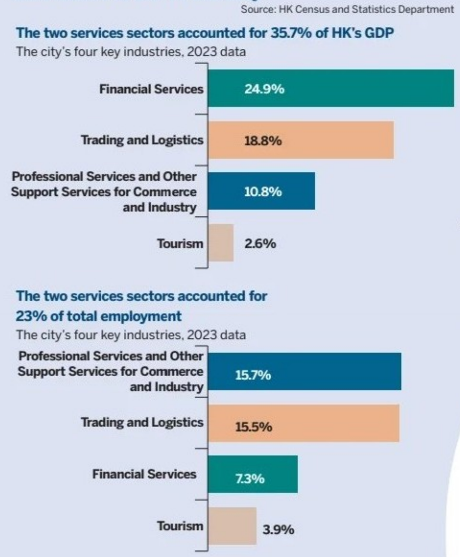
Our data journalism reports map the options for the community to resolve its challenges with consensus.

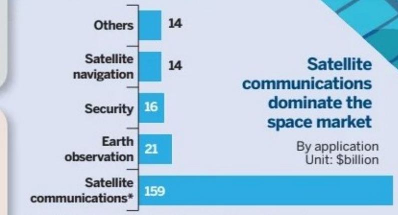
We analyze data from governments, industries, corporations, scholars, think tanks and nongovernmental organizations.

We integrate the insights and policy prescriptions from domain experts.

Financial, professional services and other support services for commerce and industry are significant contributors to the HK economy

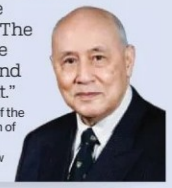
Source: HK Census and Statistics Department





*The use of artificial satellites to provide communications links

"Technology is no longer the limiting factor on how far humanity's ambitions could stretch across the solar system. The key lies in a viable commercial model and long-term commitment."



Anthony Neoh, former chairman of the Securities and Futures Commission of Hong Kong and co-chairman of the Asian Academy of International Law

"The basic conditions like ease of setting up a local company, free capital flow, a low tax rate, a liquid stock market and accessibility to professional services are always available in Hong Kong and are generic to investment capital. However, there's not a solid cluster in Hong Kong where space capital can identify opportunities. Something like a government space office or a public/private space accelerator could be helpful."

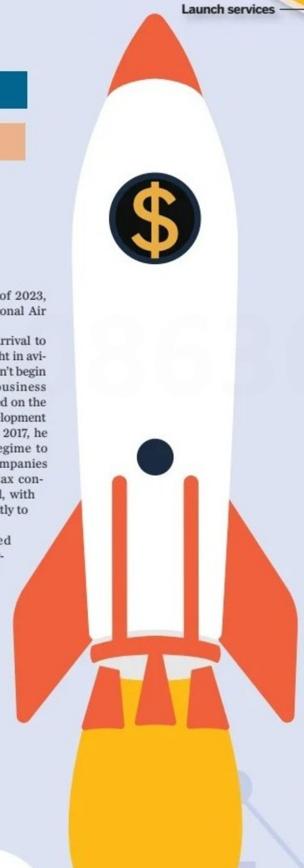
Ron Chiong, founder and managing partner of Perpetual Space Ventures

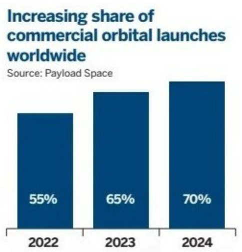
"Hong Kong's strength lies in being a global free-flow capital hub right at the Chinese mainland's doorstep. And, the country now sees space as a strategic industry. The SAR is well-positioned to finance that ambition. The most straightforward path forward is to encourage space-related financial instruments and products, for example, space ETFs and space asset-backed offerings."

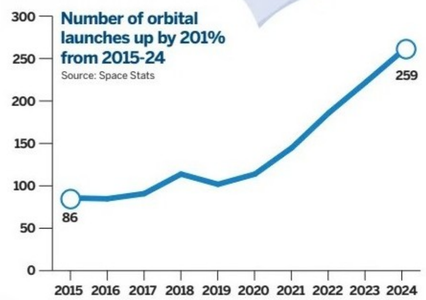
Dewey Yee, professor of practice (aviation management and finance) at the Department of Logistics and Maritime Studies, The Hong Kong Polytechnic University

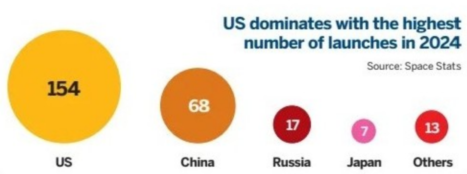
"It's a good time to invest in space tech because we now have a vanguard — people who have tried and tested different approaches. So, we don't have to reinvent the wheel and have a lot of lessons to learn. That foundation means we're in a fortunate position. We can build on what has come before and reach success much faster."

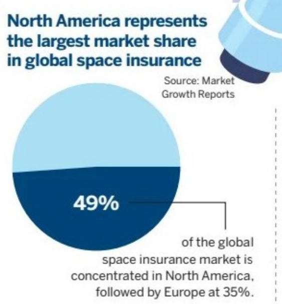
Gao Yang, director of the Hong Kong Space Robotics and Energy Centre, and co-director of the Space Science and Technology Institute at the Hong Kong University of Science and Technology











Four types of space insurance

Type	Key coverage scope
Satellite insurance	Assets in orbit post-deployment (deployment failures, subsystem breakdowns, partial loss)
Launch insurance	Events from lift-off through orbital testing
In-orbit insurance	Satellites beyond launch (radiation exposure, power loss, aging)
Liability insurance	Third-party damage from launch accidents or satellite debris

Source: Market Growth Reports

NEXT ACTIONS

1. Creating one agency to unify government efforts
2. Facilitating interdisciplinary collaboration
3. Adopting more entrepreneurial mindsets
4. Exploring public-private partnerships
5. Cultivating more talent

Infographics: Dong Kai, Mok Kwok-cheong