RSIS S. RAJARATNAM SCHOOL OF INTERNATIONAL STUDIES
Nanyang Technological University, Singapore

RSIS COMMENTARY

www.rsis.edu.sg No. 070 – 8 May 2023

The Renaissance in Lunar Exploration

By Chris Leck

SYNOPSIS

A renaissance in lunar exploration is taking place, propelled by science, economics, and strategic rivalry. Private enterprise plays a key role in this renaissance, which could lead to the development of a lunar economy. However, the escalating strategic rivalry in space and a void in lunar governance could derail the renaissance, including through deterring private enterprise from investing in lunar endeavours.

COMMENTARY

On 25 April 2023, ispace inc., a Japanese company, attempted to land its Hakuto-R spacecraft on the moon. This was the second private attempt at doing so, following a 2019 effort by Israeli non-profit organisation SpaceIL to land its Beresheet spacecraft. Both failed to achieve successful landings but have new missions in the works. These count among more than 100 lunar exploration missions by nation states and private players within this decade.

The Role of Private Enterprise in the Lunar Space Race

Unlike the first space race during the Cold War in which a handful of space-military industrial complex players played dominant roles, today's space race features many more private players. Most are relatively new to the space domain – many are startups – and are targeting both government and commercial markets, with the latter expected to see significant growth.

For example, ispace's ambition is to provide commercial transportation services to and on the moon via their lunar landers and rovers. Several other startups, from US-based Astrobotic and Intuitive Machines to Singapore-based Qosmosys, are also working on such services, besides more established ventures like SpaceX.

Others are working on the means for humans to survive and thrive on the moon through in-situ resource utilisation. Companies like Luxembourg's Maana Electric and Norway's Solsys Mining are working towards extracting water, oxygen, hydrogen and minerals from lunar regolith and ice. Oxygen and hydrogen can fuel spacecraft, while nutrients in minerals can support lunar agriculture and the metals used for constructing habitats, robots and even spacecraft.

To be sure, demand for these services and solutions still stems largely from the public sector, and traditional players like Boeing, Northrup Grumman and Airbus continue to dominate when it comes to larger projects. But this paradigm is changing. Much of the innovation in the sector is now driven by startups and young ventures like SpaceX that are more commercially driven. Their business and operating models allow them to deliver innovative solutions much faster and at lower costs.

Recognising this, space agencies like NASA in the United States of America, have started to shift the way they do business. For example, for the Artemis Human Landing System to transport astronauts and cargo to and from lunar orbit and the moon's surface, NASA has adopted the approach of buying the transportation services it needs rather than developing its own spacecraft.

NASA has also introduced a US$2.6 billion Commercial Lunar Payload Services (CLPS) initiative that buys lunar delivery services for smaller payloads, with the aim of incentivising private players to provide frequent and affordable access to such services. In both cases, NASA leaves companies to develop, own and operate their own spacecraft, which they can use to serve other customers.

Lift-off for the Lunar Economy?

The hope is that while governments can provide lead demand and seed funding, there will eventually be commercial take up for the services developed and this will create a space economy that is not dependent on government contracts. For example, NASA encourages the CLPS-contracted companies to fly commercial payloads in addition to NASA payloads. Already, Astrobotic's first CLPS mission will carry 14 commercial payloads, including a DHL MoonBox carrying people's mementos. Intuitive Machines' first CLPS mission will carry six commercial payloads, including a proof-of-concept lunar data centre from disaster recovery-as-a-service player Lonestar.

Access to frequent, affordable commercial lunar transportation services will open up the possibility of more commercial ventures on the moon. Private enterprise could find lunar mining – the moon has deposits of rare earth metals and helium-3, an ideal fuel for nuclear fusion – to now be commercially appealing. With its low gravity and lack of atmosphere enabling spacecraft to be launched much more efficiently than on earth, the moon could also serve as a spaceport for deep space exploration missions.

In addition, the moon could be an attractive space tourism destination. Supporting industries, from manufacturing to construction to hospitality, can become viable. A thriving lunar economy, enabled by private enterprise, can only be beneficial to humankind.

The potential returns are sufficiently enticing that private funding is flowing into lunar

ventures. ispace secured more than US$230 million in venture funding and bank loans and was valued at more than US$1 billion when it went public. Intuitive Machines went public at a close to US$1 billion valuation. According to a 2022 McKinsey report, lunar and beyond ventures accounted for 10 to 15 per cent of total private investment in space companies in recent years, “up from well under 5 per cent only a decade ago”.

Artemis Versus Chang’e – A Clash of Moon Goddesses?

Of course, science and economic payoffs are not the only drivers for the lunar renaissance. There is (inevitably) an element of strategic rivalry to the lunar space race. Through the Artemis Program (named after the Greek moon goddess), the US aims to return astronauts to the moon by 2025 and have a permanent presence there within this decade.

The Europeans have their own lunar plans, while also collaborating with the US on Artemis. China intends to establish an International Lunar Research Station by 2028 and send more Chang’e lunar missions (named after the Chinese moon goddess). Several other nations including India, Japan and South Korea also have lunar ambitions.

The moon is seen as strategic for a few reasons. First, access – or the ability to deny access – to its resources, as well as its potential as a spaceport for deep space exploration, would give states a strategic and economic edge. Second, the technologies developed as part of a lunar (and broader) space race would give states a boost from the economic and national prestige perspectives.

Finally, space is the ultimate “high ground” for conflicts on earth, with space-based systems improving the abilities of militaries to, in simple terms, see, communicate, move and shoot. Whoever dominates the moon and cislunar space would have a military advantage in any space conflict, and correspondingly, conflicts on earth.

Already, the US and China are trading accusations over the other’s perceived intentions to claim parts of the moon. The friction may worsen when they actually rub up against one another there. Both are reportedly eyeing the same choice locations, where water and other resources are known to be present, to establish lunar bases.

Unfortunately, the existing international space governance regime is weak and has not kept pace with lunar developments. While there are attempts, such as through the United Nations Committee on the Peaceful Uses of Outer Space and the US-led Artemis Accords, to elucidate new rules and norms, it will likely take years before a comprehensive, widely accepted regime that can usefully govern lunar activities is worked out.

The Perils of a Void in Lunar Governance

This void in lunar governance can potentially heighten the risk of conflict and slow, or even snuff out, the renaissance in lunar exploration, besides jeopardising the sustainable management of the moon. The lack of certainty over rules and norms, including over property rights, as well as clashes between moon powers could also

impede the participation of private enterprise and their ability to reap commercial returns.

Thus far, the strategic rivalry appears to have incentivised rather than discouraged private players, who have been lured by the prospect of increased government spending on lunar projects, as major spacefaring states up the ante. However, this could change in the future if strategic rivalry continues to escalate and private players suffer the consequences, as is already happening today on earth. This would be unfortunate given that private enterprise is critical to the renaissance in lunar exploration and a lunar economy.

Chris Leck is an Adjunct Senior Fellow at the S. Rajaratnam School of International Studies (RSIS), Nanyang Technological University (NTU), Singapore; and the former Deputy Executive Director of Singapore's national space office, the Office for Space Technology & Industry (OSTIn).

S. Rajaratnam School of International Studies, NTU Singapore
Block S4, Level B3, 50 Nanyang Avenue, Singapore 639798
T: +65 6790 6982 | E: rsispublications@ntu.edu.sg | W: www.rsis.edu.sg