

INNOVATION

The New Space Race is Not What You Think

by Steven González and Loizos Heracleous



Image Credit | NASA

The new space race is moving beyond state actors and is accelerated by visionary leaders of commercial space startups.

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The commercial space industry is currently a \$546 billion market and is projected to climb to a \$1.1 trillion market by 2030. Yet the media has dubbed the current national endeavors to reach the Lunar South Pole as the latest space race. India's recent successful landing on the moon with Chandrayaan-3 and failed Russian attempt highlight the most recent state-funded missions, while China and the United States also aim to land assets on the South Pole. The first space race in the 1960's was for national prestige, and with the technological advancements came national security implications. However, the current race is focused to a large extent on resources and commercial goals. The lunar south pole offers strategic advantages, as water - a valuable resource for fuel and life support systems - has been discovered there.

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As nations compete to reach the moon's southern pole, an equally important race for commercial outcomes will shape Earth's future markets and create immense opportunities for astropreneurs (space entrepreneurs). Private investments are fueling this commercial race. In just three years, venture financing for space startups increased by 329%, from \$3.5 bn in 2018 to \$15 bn in 2021.

NASA's Lunar Focus

While commercial companies and NASA have their sights set on the moon, their perspectives differ. NASA views the moon as a gateway towards reaching Mars, while commercial entities see it as a profitable destination. NASA has always regarded the moon as a stepping stone to Mars, focusing on discovering how to sustain life on a distant surface

for an extended period. In preparation for a three-year Mars mission, NASA's Artemis Mission is prioritizing the safety of the astronauts by learning how to maximize resources first on the lunar surface. Extracting hydrogen and oxygen from the regolith on the moon will help provide insights into the requirements for a Mars expedition. Even though Mars is the ultimate destination, NASA's Artemis missions will focus on lunar flybys and landings for the next dozen years. The earliest Mars missions would be in the late 2030s or early 2040s. Meanwhile, SpaceX aspires to reach Mars by 2030.

The Emerging Lunar Economy

Numerous companies are exploring the moon as a profitable business opportunity beyond NASA's efforts. Jeff Bezos, for example, is looking forward to the manufacturing possibilities on the lunar surface. Firefly, Draper, and Intuitive Machines will deliver capabilities to the moon to support NASA missions and commercial providers. While Nokia tests a communication grid on the moon delivered by Intuitive Machines, Draper will provide a communications and data relay satellite into lunar orbit. These are only a few illustrations of the growing infrastructure being developed and deployed by commercial companies on the moon. As more options and capabilities become available, more investments and commercial companies will expand to the lunar surface and orbit.

In addition, each new lunar startup will co-create an emergent strategic direction for lunar activities and leverage NASA's assets as needed. Every new capability added to the ecosystem will create an environment for new startups to emerge. For instance, Cemvita intends to use biotech technology to extract hydrogen and oxygen from the lunar surface and convert carbon dioxide into proteins and polymers. Other startups will take these resources to create energy systems, while manufacturers will use the polymers for additive manufacturing of assets required by the growing lunar community.

Future Role of NASA and Commercial Space

NASA has been transitioning to a commercial network model to effectively achieve its mission by capitalizing on the industry's capabilities and assets. The technology spurred by the growing number of commercial space companies in both near Earth markets and the emerging Lunar ecosystem will accelerate over time. The infrastructure created by

these astropreneurs who can “see beyond” will provide the platform for accelerated growth of markets and industries, enabling a circular commercial market between the Earth and the moon. As commercial capabilities expand beyond NASA’s exploration needs, the baton will be handed off to the lunar ecosystem and beyond Low Earth Orbit.

The current commercial network model will not be able to keep up with the rapid pace of technological advancement in the commercial industry or the transition of leadership of Low Earth Orbit (LEO) and lunar activities from NASA to the commercial market. NASA’s ability to lead in space exploration beyond the moon will rely on its successful transition to the Human Space Exploration Integrator role. This concept was introduced in 2006 as part of a twenty-year strategy for the Johnson Space Center. Leveraging its sixty years of integrating competencies across its experience in operations, program management, human health and performance, and astronaut training and selection, NASA is uniquely positioned to integrate the capabilities and resources across the international and commercial space community. Key to the strategy was NASA’s increased focus on partnerships across industries and innovative programs to seed and leverage commercial space capabilities. As NASA progresses toward Mars, it can leverage these platforms and the plethora of technology developed and deployed by commercial space companies. The challenge for NASA will be maintaining its technical competency as the commercial sector increasingly provides space infrastructure development. To maintain its technical competency, it must enable a more fluid workforce between the commercial community and NASA. This will ensure that the integration capability in NASA is built upon a technical experience developed through rotational opportunities at leading-edge facilities developed by commercial partners and universities.

In the coming decades, we will see the execution of Elon Musk’s vision for SpaceX to send humans to Mars. We will also see Jeff Bezos’s vision become a reality as manufacturing capabilities expand on the moon. Both visions will create new market opportunities for visionary astropreneurs. With each new market, NASA will have more technology and space capabilities to integrate into future exploration missions.



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