Lunar Innovation Park – Initial Surface Infrastructure to Kickstart a Space Resource Based Economy

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ABSTRACT

Executive Order 14369 "Ensuring American Space Superiority" (White House 2025) was signed by the White House in December of 2025 and calls upon the United States of America (USA) to "pursue a space policy that will extend the reach of human discovery, secure the Nation's vital economic and security interests, unleash commercial development, and lay the foundation for a new space age." The Executive Order (EO) identifies several key priorities including: returning humans to the Moon by 2028; laying the foundations for lunar economic development; fostering economic growth in American space markets; and establishing initial elements of a permanent lunar outpost by 2030. Based upon previous national guidance and NASA's Moon to Mars Objectives (NASA 2023), it is expected that a significant portion of a robust and sustainable lunar economy will be based on large-scale In Situ Resource Utilization (ISRU) for the production and sale of commodities and feedstock for construction and manufacturing. Such large-scale ISRU operations are only possible with supporting infrastructure and services to facilitate production and distribution of products. While organizations like NASA, Defense Advanced Research Projects Agency (DARPA), and the NASA Lunar Surface Innovation Consortium (LSIC) have worked to chart a course to a lunar resource-based economy, a clear path with practical implementation has yet to emerge.

Other space-capable nations are beginning to rapidly establish themselves in cislunar space and compete for space resources and territory. These nations are pursuing space with the expectation that these activities will lead to significant economic benefit and have the potential to tip the balance of national power in their favor. The solar system's resources are the key to humanity's future and if in-situ resources and advanced technologies are used, then rapid bootstrapping can radically accelerate a solar system economy with vast potential (Metzger et al. 2013). The US space industry and venture capitalists are also investing significant time and resources to develop technologies, systems, and define architectures towards the creation of a lunar resource-based economy. Some commercial entities aim to produce and sell lunar ISRU-based commodities such as propellant, water, oxygen, Helium-3, and feedstock for manufacturing and construction. Other companies aim to provide services in support of a cislunar space ecosystem including power, communications, mobility and logistics. However,

many potential investors with similar ambitions remain on the sidelines waiting for NASA to initiate a formal and lasting effort to capitalize on space resources with a realistically achievable near-term plan. Establishing Lunar surface infrastructure systems and operations are expected to have the biggest impact towards encouraging investments, enabling commercial operations and kickstarting a lunar economy.

This paper introduces the Lunar Innovation Park (Park) - a concept for establishing the minimum viable infrastructure needed to kickstart Lunar surface operations and commercial development. The Park is permanent co-located infrastructure built up over a series of Commercial Lunar Payload Service (CLPS) scale missions and uses existing and emerging NASA and industry technologies to make the Park feasible in the near term. The first two missions could be completed perhaps in as soon as two years from initiation. The Park will reduce costs and risks for subsequent technology development missions and commercial operations by providing services such as: power, local and direct to Earth communications, Positioning, Navigation and Timing (PNT), robotic regolith manipulation, logistics, and perhaps most importantly, the ability to land spacecraft in extreme proximity within the Park. In addition, the Park will provide an opportunity for technology demonstration, maturation, and risk reduction that will enable future Artemis “Foundational Exploration” and “Sustained Lunar Evolution” segments and lower cost for long-duration science missions. Finally, the Park can play a significant role in addressing the USA Executive Order mandate to “lay the foundation for lunar economic development”, and “establish lunar infrastructure and standards that enable implementation of space priorities and a robust space industrial base”. The Park can be established in the time frame specified in the Executive Order. This basic infrastructure (Communications, PNT, Power, construction robots, precision landing beacons) reduces risk by providing ready services and enables commercial and international partner augmentation for added capability and experimentation.