Bridging the Gaps in Space Life Sciences and Health Research

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In his essay "Letting Rocket Scientists Be Rocket Scientists: A New Model to Help Hardware Startups Scale" in the Spring 2024 *Issues*, John Burer eloquently describes a new paradigm to strategically assemble and develop hardware startup companies to enhance their success within specific industrial sectors. While the article briefly mentions the integration of this novel approach into the spaceflight marketplace, it does not fully describe the tremendous benefits that a successful space systems campus could provide to the government, military, and commercial space industries, as well as academia. Such a forward-thinking approach is critical to enable innovative life sciences and health research, manufacturing, technology, and other translational applications to benefit both human space exploration and life on Earth.

The advantages of such a prescient approach are clearly beneficial to many research areas, including space life and health sciences. These research domains have consistently shown that diverse biological systems, including animals, humans, plants, and microbes, exhibit unexpected responses pertinent to health that cannot be obtained using conventional terrestrial approaches. However, important lessons learned from previous spaceflight biomedical research revealed the need for new approaches in our process pipelines to gain the most from spaceflight investments that would accelerate advances in space operations and manufacturing, protect the health of space travelers and their habitats, and translate these findings back to the public on Earth.

A well-integrated, holistic space campus system could overcome many of the current gaps in space life sciences and health research by bringing together scientists and engineers from different disciplines to promote collaboration, consolidate knowledge transfer and retention, and streamline, simplify, and advance experimental spaceflight hardware design and implementation. This type of collaborative approach could disrupt existing "silos of knowledge and experience" that profoundly slow hardware design and verification by repeatedly requiring reinvention of the same wheel. Indeed, the inability of current spaceflight hardware design and capabilities to perform fully automated and simple tasks with the same analytical precision, accuracy and reproducibility as that in terrestrial laboratories is a major barrier to space biomedical research, which creates unnecessary risks and delays that impact scientific advancement. In addition, the inclusion and support of manufacturing elements in a space campus system can allow scaled production to meet the demands and timelines required for the success of next generation space life and health sciences research.

The system described by Burer has clear potential to optimize our approach for space life and health sciences research that can lead to new medical and technological advances to benefit astronauts, military and commercial space travelers, as well as the general public on Earth. By strategically nucleating our knowledge, resources, and energy into a single integrated and interdisciplinary space campus ecosystem, this approach could redefine our concept of a productive space research pipeline and catalyze a much needed change to advance the burgeoning human spaceflight marketplace while “letting rocket scientists be rocket scientists”.