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HUMAN SPACEFLIGHT SYMPOSIUM (B3)
Advanced Systems, Technologies, and Innovations for Human Spaceflight (7)

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SUSTAINABILITY IN HUMAN SPACEFLIGHT

Abstract

Following the recent success of NASA's first flight of Orion and the excitement generated by ESA's Rosetta mission, space exploration is realizing a momentum that will be further driven by the anticipation of upcoming missions like the one-year increment on the International Space Station, NASA's first commercial crew launch, JAXA's Hayabusa2, and the ESA-Roscosmos lunar lander. By leveraging these important milestones and amplifying successful models of colossal international collaboration such as ISS and CERN, humans can pioneer space. In this decade, we will go farther into space than ever before to explore, work, and return — and someday we will go to stay.

Innovative and unconventional approaches are essential to breaking the barriers to a sustainable human presence in deep space. Advances in reusable launchers and planetary landers, lightweight materials, in-situ resource utilization, in-space manufacturing, and reduce-reuse-recycle systems will decrease the amount of mass we need to launch from Earth. Alternate mixes of high-thrust chemical propulsion versus low-thrust solar electric propulsion to transport humans and cargo will offer more balanced launch cadences and lead to reusability for long-term, evolving human spaceflight campaigns. Robotic missions will scout future human destinations, filling our gaps in data about deep-space environments and planetary bodies. Commonality and standardization of hardware and software will enable us to collaborate more effectively with spacefaring partners. For game-changing developments in the next decades – those we can and cannot anticipate – modular systems design will allow us to adapt and upgrade to the newest technologies.

Long-term and complex endeavors embraced by the "pioneering space" approach will inevitably encounter financial and political challenges, but we are learning ways to be more resilient to these dynamics. By focusing long-term investments on core capabilities that are destination-agnostic, development can continue in the face of changing policies. By increasing cooperative global efforts, governments and private industry can support, encourage, and further legitimize new enterprises in space. And by forging creative partnerships to share cost and development burdens, the spaceflight stakeholder base will continue to grow, making it increasingly more affordable and accessible not only for national interests, but also for industry, academia, and all citizens of Earth.

This paper will investigate logical extensions of past and current successful endeavors with a focus on strategy, technical readiness, and programmatic challenges we face in the next decades. It will explore solutions to make the global human spaceflight effort more sustainable.