Exploration Sustainability: Benefits and Hurdles of Incorporating In-Situ Resource Utilization

Gerald B. Sanders
NASA Johnson Space Center
2101 NASA Parkway
Houston, TX 77058
281-483-9066
gerald.b.sanders@nasa.gov

ABSTRACT

While the U.S. Apollo program was both technically and scientifically highly successful, it has been argued that the Apollo program was not sustainable once it accomplished its primary objective of landing a man on the Moon and returning him safely to the Earth. To have a sustainable human lunar exploration architecture, it must incorporate both Exploration and Programmatic sustainability attributes. Exploration sustainability attributes include continually improving performance and capability, continually reducing risk to mission and crew, continually reducing cost for performing missions and operations, and continually reducing dependency on Earth supplied logistics and infrastructure. Programmatic sustainability attributes include continually engaging and exciting the public, increasing benefits to countries supporting exploration, establishing a common 'vision' and long-term plan that the public supports, and having a robust and flexible plan and capabilities to allow for new ideas and priorities over time. In-Situ Resource Utilization (ISRU) is an area of development that can significantly change how systems required to sustain a human presence on the Moon are designed and integrated, leading to potentially breaking our reliance on Earth supplied logistics and infrastructure, and promoting the establishment of commercial space products and services. ISRU can encompass many aspects of human exploration such as the extraction and processing of local resources into mission critical consumables (i.e. propellants and life support gases), the ability to modify the lunar landscape for safer landing and infrastructure emplacement, the ability to build structures and habitats, and the creation of in-situ energy generation and storage systems. This presentation will address how ISRU can help the lunar architecture currently under development achieve both Exploration and Programmatic sustainability attributes, and discuss the advantages and difficulties associated with incorporating ISRU systems and capabilities into future human lunar exploration plans even though it has never been flown on a space mission to date.