

17th IAA SYMPOSIUM ON BUILDING BLOCKS FOR FUTURE SPACE EXPLORATION AND
DEVELOPMENT (D3)

Systems and Infrastructures to Implement Sustainable Space Development and Settlement - Systems (2A)

Author: Mr. Satinder Shergill
Cranfield University, United Kingdom, s.s.shergill@cranfield.ac.uk

Dr. Jenny Kingston
Cranfield University, United Kingdom, j.kingston@cranfield.ac.uk

ADAPTIVE IN-SITU RESOURCE UTILISATION (ISRU) SYSTEMS FOR LONG TERM SPACE
DEVELOPMENT**Abstract**

This paper aims to present further results from a pilot study assessing the feasibility of designing an 'Adaptive ISRU system', defined here as an ISRU resource extraction system adaptable to different rocky planetary bodies, and adaptive in its ability to extract resources. Preliminary guiding questions for this study related to whether several ISRU processes could be combined within one enclosed system to enhance functionality and allow smoother transition between different levels of processing, and also whether a system that combines such processes can adapt to the different terrains present on planetary bodies within the inner solar system. As the main motivation behind this research is the incorporation of ISRU into long term interplanetary infrastructure, initial work related to how and where ISRU could best be incorporated into novel and reusable long-term interplanetary infrastructure, and led the direction of this research to seriously consider the need of ISRU systems to be adaptable. While upcoming precursor missions will inevitably help constrain mineralogical distribution and general environmental conditions at certain locations, there is still uncertainty inherent with constraining mineral content and distributions at surface and subsurface boundaries as well as regolith compaction at ISRU sites of interest. Hence it is believed by the author that functional ISRU systems will need to be adaptive by nature, particularly if they are required to operate autonomously. This paper addresses criteria that would be applicable to a range of different extraction scenarios suitable for the conditions expected on rocky bodies such as the Moon, Mars and Asteroids, as a means of ascertaining the feasibility of an adaptive ISRU system. As such, the main focus is on excavation, processing, storage and transit. The significance of obtainable and required particle sizes for ISRU processing, and how this should influence the ordering of combined processes is also further considered. The proposal of adaptive ISRU systems is based on a desire to focus on the commonalities found in extra-terrestrial environments to then be in a stronger position to deal with the differences.