

16th IAA SYMPOSIUM ON BUILDING BLOCKS FOR FUTURE SPACE EXPLORATION AND
DEVELOPMENT (D3)Novel Concepts and Technologies to Enable Future Building Blocks in Space Exploration and
Development (3)

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URBAN:CONCEIVING A LUNAR BASE USING 3D PRINTING TECHNOLOGIES

Abstract

One of the most critical points in space exploration beyond Low Earth Orbit is the provision of systems which ensure the long-term survival of both crew and technological assets in the harsh space environment. The utilization of the Moon seems to be the next logical step in implementing the global strategy for humans to explore the solar system. The key to any sustainable presence in space is the ability to manufacture necessary structures, spares, in situ and on demand reducing the cost, volume, and up-mass constraints that could prohibit launching everything needed for long-duration or long distance missions from Earth. Additive Manufacturing (AM) has the potential to provide a number of sustainability advantages. These advantages include the reduction of waste during manufacturing; the capability to optimize geometries and create lightweight components that reduce material and energy consumption; the subsequent reduction in transportation in the supply chain; and inventory waste reduction due to the ability to create spare parts on-demand. The establishment of an AM process in support of a Moon base will be strongly correlated to the self-sustainability of the process itself and the possibility in re-using the recycled materials for different purposes. Therefore, AM technology will be one of the enabling building blocks for future exploration. ESA has awarded a GSP study to the URBAN Consortium (Comex, Liquifer Systems Group, Sonaca Space GmbH under the coordination of OHb System AG) to evaluate the feasibility and implementation effort required in establishing the possible use of AM in

easing the construction, expansion and maintenance of a lunar base. The study is implemented through two parallel tasks: 1) Comprehensive survey of the elements/hardware required in a permanent and sustainable manned lunar base, based on a hierarchical investigation from permanent infrastructures to the “on demand” items. 2) Specific survey of additive manufacturing technologies addressing a broad range of applications that can be useful from a lunar base perspective. The assessment includes the state of the art of 3D printing related to several materials such as metals, polymers, ceramics, food ingredients and living tissues. From these two surveys a database related to required hardware and available technology will be presented. A systemic analysis will be described, to define the most suitable printing technologies for hardware manufacturing. Derived from the selected 3D printing technologies, a roadmap for Moon applications will be presented, including the recommendations for “print on the Moon” versus “bring to the Moon”.