

SPACE EXPLORATION SYMPOSIUM (A3)  
Moon Exploration – Part 1 (2A)

Author: Mr. Tom Hoppenbrouwers  
Space Applications Services N.V./S.A., Belgium, tom.hoppenbrouwers@spaceapplications.com

Mr. Diego A. Urbina  
Space Applications Services N.V./S.A, Belgium, diego.urbina@spaceapplications.com

Dr. Anna Barbara Imhof

Liquifer Systems Group (LSG), Austria, bimhof@liquifer.at

Dr. Susmita Mohanty

LIQUIFER Systems Group, Austria, susmita.mohanty@liquifer.com

Dr. Peter Weiss

France, p.weiss@comex.fr

Dr. Andreas Diekmann

ESA/EAC, Germany, Andreas.Diekmann@esa.int

Dr. Matthias Maurer

ESA/EAC, Germany, matthias.maurer@esa.int

## ANALOGUES FOR PREPARING ROBOTIC AND HUMAN EXPLORATION ON THE MOON

**Abstract**

In view of lunar exploration, which is foreseen to be one of the next steps in human space exploration, Lunar Analogues are and will continue to be powerful tools to support the development, demonstration and validation of new technologies and operational concepts. Furthermore Lunar Analogues will serve as an environment for Astronaut training, Behavioural Health and Performance research as well as providing engaging activities for the public.

There is in particular a growing interest in Artificial Lunar Analogues, as they allow improving controllability of the environment and ‘standardising’ the Analogue in order to allow a meaningful comparison between several simulation campaigns, increasing actual test time, while reducing preparation overhead and logistics costs, with respect to Natural Analogues.

Under ESA’s General Studies Programme (GSP) a Consortium consisting of Space Applications Services, Liquifer Systems Group and COMEX has performed the LUNA (Lunar Analogues) study, with the objective to identify missing Artificial Lunar Analogues, taking into account the demands for such analogues and considering existing and planned analogues, and to establish technical, utilisation and implementation concepts for the most needed analogues.

This paper describes the approach and results of the study, from identifying more than 150 Needs addressable by Artificial Lunar Analogues (needs identified through Roadmap analysis, literature review and consultation of more than 100 Subject Matter Experts in a broad variety of fields worldwide), over establishing a Catalogue of already existing or planned Artificial Analogues, to performing a gap analysis identifying which identified Needs are not met by existing or planned Analogues and providing recommendations to close those identified gaps. The paper concludes with some of the Artificial Lunar Analogues concepts proposed to ESA in order to complement existing or build up new facilities that might be a future contribution to the international effort of exploring the Moon.