IAF SPACE SYSTEMS SYMPOSIUM (D1)
Innovative and Visionary Space Systems (1)

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AN INNOVATIVE AND INTERDISCIPLINARY APPROACH TO A SELF-SUSTAINABLE LUNAR VILLAGE.

Abstract

The Dedicated Infrastructure and Architecture for Near-Earth Astronautics (DIANA) is a design concept for a self-sustainable lunar village near the de Gerlache crater, on the lunar South pole, comprising tourists and astronauts alike. The village will be permanently inhabited and will exploit future technologies to achieve independence from Earth resupply missions. This concept focuses on in-situ resource utilization (ISRU), architecture and scientific research.

Current standards for human spaceflight alongside low-TRL technologies still under development served as inspiration for this original futuristic design concept. The ISRU concept enables human-assisted robots to extract the necessary raw materials for self-sustainability. The architectural concept focuses on overcoming the challenges and exploiting the benefits of the lunar environment, embedding them within the design. The development of a science center specializing in lunar technologies allows DIANA to reach self-sustainability. Chosen fields incorporate both advancements for lunar living and translatable research for future missions to Mars.

The development of the ISRU infrastructure and the design of advanced robotic systems enable the extraction, transport and processing of raw materials. To optimize sustainability and minimize resupply missions, solar modules will be constructed in-situ. Habitability needs, including life support, will be incorporated into the architecture. Examples include porous walls acting as ventilation and algae systems that generate oxygen. Miniature communal greenhouses where residents can grow plants will be provided, in addition to the main greenhouses providing life support and food for the entire base. The science center serves not only as a testbed for Moon-to-Mars technologies, but also controls a baseline interferometry radio telescope located on the far side of the Moon. The telescope's separate stations build the core of a vast free-space optical communication network to preserve the natural radio-noise-free environment for astronomical observations.

The DIANA lunar village concept fuses innovative ideas across an array of disciplines. This collaborative approach addresses the architectural challenges of lunar gravity, considers diverse human factors needs, fulfills ground-breaking lunar astronomy and exploration objectives to realize financial self-sustainability.

International collaboration, including both public and private entities, is an absolute must to ensure the successful implementation of this visionary base. With all these stakeholders working together, DIANA provides a platform to enable independent human life on the Moon and a potential stopover for future interplanetary missions to Mars and beyond.