22nd IAA SYMPOSIUM ON HUMAN EXPLORATION OF THE SOLAR SYSTEM (A5)
Human Exploration of Mars (2)

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SYSTEM LEVEL DESIGN FOR A LARGE SCALE COLONY ON MARS

Abstract

For many years, humanity has looked at Mars as the natural next step of evolution and expansion in the Solar System. Despite the national space agencies' attention being now drawn by the Moon, both for orbital and surface exploration missions, the ultimate, underlying goal remains the colonisation of the Red Planet.

Establishing a sustainable presence on Mars will be extremely difficult: travelling to Mars will subject future crews to prolonged isolation, dangerously high radiation levels and extreme stress. And once on the surface, the hostile environment will require advanced technology, as well as a perfectly balanced and well-prepared crew, to create the beginnings of a sustainable colony. Beyond the obvious technical challenges, which require careful planning and thorough research, the possibility of having a community similar to a small town in a totally isolated environment elicits several questions of a different nature, concerning the economy, the possible forms of society and political organisation, and demographic main drivers. A Mars colony represents an unprecedented chance for a clean, new beginning for humanity.

Presented in this paper is a system level design for a colony on Mars. It is not an outpost, but rather a thriving community, on the path to complete self-sustainability and independence from Earth. Preliminary sizing of essential systems has been performed, with a focus on processes to produce primary resources such as water, oxygen, food and propellant. Industry-oriented processes, for the manufacturing of high-level components such as fabrics, glass and ceramics by using in-situ resources are also included. Architectural choices are described and engineering solutions for construction and expansion of the city's infrastructure are addressed. Environmental control and energy production, storage and distribution are also discussed. Finally, the main operational concerns and logistics are presented, such as orbital transfers and cargo deliveries.

This research was carried out during the participation in the competition "Mars Colony Prize", launched by The Mars Society in 2019.