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FACILITY OF LABORATORIES FOR SUSTAINABLE HABITATION - AN INITIAL DESIGN OF A CLOSED-LOOP ENVIRONMENT

Abstract

An effective and self-sustainable artificial habitat design is essential for human spaceflight and expansion of mankind into orbit or towards other celestial bodies. To successfully establish a future habitat, it is imperative to reach a high degree of self-reliance and sustainability. Besides the necessity to create an artificial habitat for the extreme environments of space, development of a self-sustainable habitat can also enable more effective exploration of extreme environments on Earth. One major application of the habitat's closed loop capabilities can also be in enabling ecological habitation of human populations, not exclusively, but especially in megacity areas with limited resources. This could reduce pollution, desertification and be a possible solution for difficulties arising due to human overpopulation, by e.g. including decentralized farming within an urban environment or a living space. There are two approaches that need to be implemented in future sustainable habitats: the usage of recycling technologies in order to gain closed-loop processes and the primary production of resource materials with In Situ Resource Utilization (ISRU) principles. Various products like higher plants (e.g. vegetables, fruits, crops), animal husbandry (e.g. fishery, insects), fuel gases (e.g. Hydrogen, Oxygen), building materials (e.g. structural and isolation materials), but also consumables (e.g. clothes) as well as base maintaining services (e.g. water or waste recycling) and power supply will be provided and where applicable recycled in such a system. Although the theory of closed-loop habitats has been the subject of many research campaigns, the practical implementation and realisation within a real habitat still needs to be established. The paper deals with the interdisciplinary DLR study of a terrestrial Facility of Laboratories for Sustainable Habitation (FLaSH).

This first DLR habitat design workshop has been held in DLR's Concurrent Engineering Facility (CEF) of the Institute of Space Systems. By the help of domains such as Air, Water, Waste, Greenhouse, Animal, Food Processing, Human Factors, Living, Sickbay, ISRU, Workshop, Design and Configuration, a scenario of selected habitat modules with input and output relationships has been set up. With a focus on the life support system the outcome of the FLaSH concept study is presented within this paper.