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LUNAR ORBITAL PLATFORM-GATEWAY (LOP-G) AS AN OPPORTUNITY TO TEST TECHNOLOGIES APPLICABLE TO THE ROBOTIC AND CREWED EXPLORATION OF BOTH MOON AND MARS

Abstract

The objectives of this paper are to determine which of the technologies, that have been identified as being key technologies for supporting crewed missions to Mars could be tested on the Moon beforehand and propose a technological roadmap. In 2018, it has been proposed that the Lunar Orbital Platform-Gateway (LOP-G) project will be the next milestone in the human exploration of space. It has also been discovered that vast quantities of water exist on the Moon. Previous works include a scenario for a crewed mission to the North Pole of Mars with a strategy based on the utilisation of ice, for producing construction materials, providing the life support system with consumables and in-situ propellant production. Some of these technologies may be tested and developed on the Moon before. Furthermore, some of the technologies proposed for Mars may also serve for the robotic and human exploration of the Moon. The methodology consisted of identifying which of the key technologies that have been proposed for crewed Mars missions could be tested on the Moon, as they require in-situ resources, that can be accessed both on Mars and the Moon. An alternative strategy for sourcing and processing the resources has then been proposed for the Moon when needed. Several technologies have been identified. These are: using ice as a construction material in combination with inflatable membranes, especially polyethylene membranes, the testing of ice as a protection against cosmic galactic radiation and micrometeoroids, which is even more effective on the Moon, the production and use of propellants such as hydrogen, ethylene, methane and ALICE and the use of in-situ sourced water and extraction of its oxygen for sustaining life support systems and producing propellant oxide. Furthermore, the need for a crane system on Mars has been identified as a key technology for Mars crewed missions. A crane that is modular, reusable and refuellable with in-situ produced propellant has been proposed. This crane system could also be used to ensure transits between the orbital station and the Moon's surface. Furthermore, it could be gradually upscaled, assisting both small robotic missions and then larger missions, including crews. In conclusion, the testing of water-based strategies and technologies that are applicable to both the Moon and Mars on the Moon will be made available by Lunar Orbital Platform-Gateway and could be beneficial to the robotic and human exploration of the Moon and accelerate the exploration of Mars.