

45th STUDENT CONFERENCE (E2)  
Student Team Competition (3-GTS.4)

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MUSE: A NOVEL MISSION ARCHITECTURE FOR ADVANCING HUMAN SPACEFLIGHT AND  
SCIENCE THROUGH MOON UTILISATION**Abstract**

The Moon is the logical next step for combined international efforts in human spaceflight. Resum-

ing lunar exploration can provide significant opportunities for science, advancing current understanding of the history and evolution of the solar system, and for the testing and validation of technologies and capabilities critical for long duration missions in deep space. Recent surveys have also revealed that the lunar environment hosts resources that can be exploited for the benefit of human exploration. Water, oxygen, hydrogen, and iron-rich minerals are among the local resources available for in situ utilisation on the Moon. Capitalising on these may reduce lunar vicinity mission costs through enabling the local resupply of life support consumables, propellant production, and additive manufacturing for structural applications. Presented is the MUSE (Moon Utilization for Science and Exploration) mission; an architecture to be implemented in the post-2025 timeframe, centered around a lunar space station inspired by NASA's Deep Space Gateway concept, and which employs exploration systems currently in development. The MUSE architecture includes the initial infrastructure required for leveraging Moon resources, while simultaneously providing a platform for demonstrating the capabilities needed for the first human missions to Mars. A description of the key mission elements and their operational scenario is detailed. This includes exploration rovers, landing and ascent systems capable of transferring resources to the lunar space station, a human-tended outpost, and a Mars transfer vehicle. This paper is a summary of six months of project work completed by an international and multidisciplinary team of graduate students, as part of the ninth edition of the 'Space Exploration and Development Systems' (SEEDS) Master's programme. The MUSE mission views the Moon as a vital stepping stone toward the eventual exploration of Mars, and aligns with key objectives presented in the Global Exploration Roadmap. Successfully utilising the Moon's potential toward advancing human spaceflight and science can provide the basis for the next giant leap in exploration.