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EXPLORING SOUTH KOREA'S CONTRIBUTION TO NASA'S MOON TO MARS ARCHITECTURE AND THE ARTEMIS PROGRAM THROUGH MOBILITY TECHNOLOGY

Abstract

The Moon to Mars Architecture Definition Document by NASA presents a long-term roadmap for Lunar and Mars exploration, defining key Use Cases, Functions, and Architecture-Driven Technology Gaps necessary for achieving mission success. This study examines NASA's architectural requirements and explores how South Korea's mobility technology and industrial capabilities can contribute to the Artemis program and future Mars exploration.

South Korea possesses global competitiveness in autonomous driving, high-efficiency battery technology, robotics, and logistics automation, with leading companies such as Hyundai Motor Company, LG Energy Solution, and Naver Labs developing innovative technologies applicable to extreme space environments. This study analyzes NASA's priority Use Cases, including lunar surface mobility (UC-T-101 L, UC-T-102 L), cargo transport and logistics (UC-T-105 L), and extreme environment navigation (UC-T-104 L), evaluating how South Korean technologies can support these mission scenarios. Furthermore, it examines key Functions such as surface mobility, energy storage and management, remote operations, and structural resilience in extreme environments, highlighting South Korea's potential contributions through electric vehicle-based platforms, cryogenic-resistant batteries, and advanced 5G and satellite communication systems.

In particular, South Korean mobility technologies offer potential solutions for several of NASA's Technology Gaps, including lunar dust mitigation systems (0801), autonomous surface mobility and navigation (0805), extreme environment batteries and power systems (0901, 0902), and payload handling and surface logistics (0806). By systematically matching NASA's identified gaps with South Korea's industrial strengths, this study presents a strategic framework for South Korea to establish itself as a reliable international partner in the Artemis program. Strengthening collaboration in these areas would not only create new opportunities for South Korean mobility companies in the space exploration sector but also enable NASA and its international partners to conduct safer and more efficient exploration missions.