

14TH IAA SYMPOSIUM ON BUILDING BLOCKS FOR FUTURE SPACE EXPLORATION AND
DEVELOPMENT (D3)Strategies & Architectures as the Framework for Future Building Blocks in Space Exploration and
Development (1)

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A FRAMEWORK FOR INTERNATIONAL COLLABORATION ON LUNAR MISSIONS

Abstract

This paper addresses the topic of deep surface lunar drilling mission feasibility through a proprietary 3I (intercultural, international, interdisciplinary) framework. Scientific, political, economic, business, and cultural rationales are discussed and engineering capabilities and trade-offs are reviewed. The motivation for this feasibility study is derived from a renewed interest through missions from NASA, ESA, Roscosmos, JAXA, ISRO and CASC with recent talks on permanent human and robotic presence on the Moon. It also stems from the increasing commercial interest in the Moon, with private industry participants aiming to extract Moon's natural resources and self-fund exploration and scientific missions, all in the context of developing and profiting from a future lunar and cislunar economies.

A set of scientific and engineering objectives were devised to limit the scope of the study. The paper focuses on a minimum viable engineering mission architecture to develop a drilling system, execute a soft landing on the Moon, deploy the drill to a depth of at least 20m, recover and analyze samples, and return data back to Earth. Scientific exploration trade-offs related to landing location, and types of experiments and instrumentation, as well as engineering trade-offs of key systems are analyzed and synthesized. Based on the literature available for both past and proposed government/private lunar missions, this paper also highlights the combined effects of state and space agencies' policies, international collaboration, economic rationales, business objectives, and societal impacts of a deep drilling lunar mission. Considerations related to exploration, exploitation, property rights, and other legal aspects are discussed in relation to a selected subset of mission scenarios and potential future international law frameworks. The paper also provides recommendations on mitigating the various challenges faced by different stakeholders, analyzes various cases related to funding, TRL access, risk aversion costs, marketing, and outreach while presenting

a holistic view of complementary opportunities for public and private stakeholders. Finally, the study aims to add new perspectives for future missions to the Moon and thus contribute to space development.