ROBOTIC PRECURSORS TO HUMAN EXPLORERS: ESA MISSION ACTIVITIES AND STUDIES.
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Introduction: Exploration of the Moon is the next step for human spaceflight, building on the experience of the International Space Station, which has seen human spaceflight restricted to Low Earth Orbit (LEO). This transition from LEO to Moon requires the development of new technologies, new capabilities and new knowledge across multiple domains and the progression of international partnerships exemplified through the ISS. The progression to lunar surface will be achieved through a combination of developments in robotic and human spaceflight systems and missions.

ESA’s strategic approach to lunar exploration, the approach to technology development and synergies with other exploration destinations will be presented elsewhere in this meeting. Here we describe the current precursor robotic mission activities.

Contributions to the Russian lunar exploration programme: In advance of human surface missions robotic missions to the surface provide an opportunity to drive up the technology and system maturities of key elements for the future, to generate relevant operational experience, to build partnerships and to generate knowledge.

To this end ESA is investing in a series of robotic precursor missions that will be implemented as a collaborative effort with Russia. The first mission in this campaign is the Russian Luna-25 (‘Luna-Glob Lander’) lander mission in 2019. ESA will provide an imaging system for this mission as a precursor of a complete precision landing and hazard avoidance system, PILOT, which will be deployed on the Luna-27 lander mission in 2021. The Precise Intelligent Landing using On-board Technology system, PILOT, is a generic exploration product, which will be available as a European contribution to future missions to enable pinpoint and safe landing.

The Russian Luna-27 (‘Luna-Resurs’) mission also includes the “Package for Resource Observation and in-Situ Prospecting for Exploration Commercial exploitation and Transportation”, PROSPECT. This system will be used to investigate the presence, provenance and viability of lunar resources at the Luna-27 landing site. This mission also provides the basis for future deployments of PROSPECT as a system for comprehensive resource evaluation across the lunar surface. PROSPECT emphasises cold trapped polar volatiles but is intended to provide a broader investigatory capability, which could be deployed more broadly across the lunar surface.

ESA will provide communications support across the sequence of Russian missions including both landers and the Luna-26 orbiter.

Mission studies: Following these flights ESA is looking to build on the demonstrated capabilities and further support the definition of Europe’s path to the lunar surface. To this end a number of mission studies are on-going including sample return and mobile surface exploration. It is important that these next steps address key knowledge and capability gaps for human exploration, build strong partnerships and build the user base for the exploration missions that will follow.

Two mission robotic mission concepts are being studied; a lunar polar sample return mission, in cooperation with Russia and a Lunar Volatile Prospecting rover missions. Both of these missions would investigate lunar polar volatiles.

Precursor missions integrating human and robotic capabilities are also being investigated as potential future international partnerships.

Partnerships: International partnerships have been and continue to be an essential element in ESA’s approach to exploration. The ability to work and operate together in space also represents one of the key benefits delivered by exploration. In addition a new partnership model with the private sector is being explored, with initial pilot phases into commercially led activities to prepare robotic capabilities and infrastructure for the future.

Conclusions: We will present the current robotic precursor activities in ESA to prepare for future human exploration to the surface. Emphasis will be placed on the development activities for PILOT and PROSPECT, mission studies which are on-going with European industry, as part of a partnership between ESA and Russia, on the LPSR and LVP mission studies and on activities related to developing partnerships with the private sector.