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Introduction: In the context of developing a long-term strategy for European human spaceflight and exploration ESA has been conducting several activities with stakeholder communities as well as architecture and system studies with industry. A significant part of the architecture work was dedicated to the analysis of different options for Human surface exploration, assessing crew size, stay times, tasks and operations, surface infrastructures, mobility and logistics of these scenarios.

The lightest approach involves simple surface sortie missions of up to 14 days, where full habitation is provided by the lander element and no pre-deployed surface elements are strictly required. For sortie missions the following mission operations and associated activities have been identified: geological fieldwork (observations, assistance through telerobotic robotic survey, collection (and caching) of samples, including drilling), mapping of lunar resources (ground truth confirmation of orbital measurements).

Assuming global access capability of the crew lander, reasonable science return can be obtained through multiple missions to different surface sites. The mobility at each site is severely limited by the rover capability and contingency requirements. This could potentially improved by delivery of a redundant mobility element on a logistics lander, which could also enable further science through dedicated equipment delivery. However, the sortie scenario is highly hardware-intensive since no reusability of surface systems is possible.

Super-Sortie scenarios involve a pre-deployed pressurized rover for extended surface mobility as well as logistics delivery with an Ariane 5 based landing system. They therefore offer significantly increased surface exploration range and duration, enabling higher science return. Reusability of the pressurized mobility on the surface for subsequent missions depends on its autonomous roving capability to reach other sites, but could be envisioned, thus reducing the hardware investment cost for multiple missions.

The outpost scenario is designed to support a crew of two astronauts visiting a particular site of interest more than once for short time duration (typically 14 days). The interest in this site might be linked to highly valuable science to be done around the same location that would require more than a single sortie mission or the construction, operations and maintenance of some high value assets such as telescopes or very deep driller that would need to be located for scientific reasons far from the main base.

Finally, a lunar surface base provides fully developed systems for sustained permanent presence, enabling six-months crew rotation. The base location, contrarily to the outpost, is selected primarily for engineering reasons offering the more favorable illumination conditions to facilitate the support of astronauts for extended stays of up to several months. The following activities have been identified as major outpost tasks, based on analysis of the European stakeholder objectives: Life and physical sciences experiments, geological fieldwork, laboratory analysis of collected samples, construction and commissioning of a large cosmic ray telescope, ISRU processing and various support tasks associated with the base.

Furthermore, establishing a sustained human presence in a base on the Moon has a critical role for preparation of further exploration. It is an opportunity to learn how to support astronaut crews living far from home in harsh environments for long duration and to operate effectively on another planet.