

**ESA STUDY CONTRACT REPORT**

<b>ESA Contract No:</b> 4000106522/12/F/MOS	<b>SUBJECT:</b> Moon & Asteroid sample return facility study	<b>CONTRACTOR:</b> Systems Engineering & Assessment Ltd.
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**ABSTRACT: Concept for a Moon and Asteroid Sample Return Facility**

The objective of this study was to examine an initial concept and requirements for a Lunar and Asteroid Receiving Facility (LaARF). Then based on previous Mars Sample Receiving Facility (MSRF) studies determine an optimal ‘Scenario’ that will allow evolution from a facility dealing with Moon and asteroid returned sample material to a facility dealing with Mars returned sample material with potential biohazard.

The LaARF concept and requirements were broadly derived from 10 High Level Capabilities (HLCs) which took into account Infrastructure, Equipment, People & Knowledge. The facility concept was required to deal with samples from a number of possible missions returning from Asteroids or the Lunar surface. A number of past and planned missions were outlined to draw both general features that can be used to develop the concept, and more importantly to derive the range of likely hardware / samples to be handled by the facility. Requirements for the general sample quantity and make-up expected were given, specifically; the facility will be able to accommodate 500g of samples comprising dust, grains and rocks of varying composition and sizes.

The LaARF initial concept was evolved using review of literature and via inputs from a dedicated Concept Definition Workshop involving scientific and industry experts. An overall diagram showing identified functional areas and interfaces was developed with each area broken down into sub functions. From this functional architecture technologies & techniques were assessed and it was recognised that tele-operations are especially needed. In addition, it was identified that any consideration of the LaARF development must consider the information flow that is inherent within the facility and is required to deliver scientific & engineering research, as well as contributing to public outreach & education

After the LaARF initial concept was established commonality with the MSRF was assessed and possible evolutions to a MSRF were considered. Then Scenario Definition Workshops were held with leading scientists and industry experts to determine the optimal scenario to evolve the LaARF to an MSRF. The result of this analysis was that independent facilities without ‘future-proofing’ prior to expansion were the optimal solution. This approach maximised the potential future capability in a cost-efficient manner.

Finally, analysis of potential users for the facility was made which identified that Planetary Protection (PP) Hardware Samples, Meteorites & planetary analogues as the most promising users for a shared facility. In addition non-space samples such as those from widely dispersed geological collections may also benefit from the shared facility use.

In conclusion there is considerable planetary analogue expertise in Europe that would vastly benefit from consolidation and using this analogue expertise the facility will deliver significant science prior to the return of samples. A short-term and long-term development plan was developed which would ensure that all the capabilities needed are in place when samples are returned to Earth, and that best science will be delivered from these samples.

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