Emirates Lunar Mission: Past, Present & Future. H. Almarzooqi[1], H. Almatroushi[1], S.G. Els[1], S. AlMaeeni[1] and M. Alzaabi[1], [1]Mohammed Bin Rashid Space Centre (MBRSC), PO Box 211833, Dubai, United Arab Emirates

Introduction: Even though the moon is the closest celestial body to earth, we have not understood and studied its environment properly to this day. Space missions are expensive, and they take forever to be developed and this is the main reason that humans have few missions to a limited number of sites to the lunar surface.

To understand the lunar environment better, one needs to increase the frequency of missions to the lunar surface and explore as many landing sites as possible. And this can only be done through cost effective, high cadence missions to the moon. The Emirates Lunar Mission (ELM) was established in 2019 with the aim to tackle this challenge from a new point of view. It aims at developing and landing a series of small rovers to different sites on the lunar surface and expanding our knowledge of the lunar environment. To achieve this goal, the ELM program accepts risks and works directly with commercial lander systems. Also, the ELM achieves rapid development by extensive collaboration with international partners.

Since its inception back in 2019, the ELM program already has three rover missions that were either launched and crashed into the lunar surface or is being developed for soon-to-be-launched or is at early stages for a launch in 2028. This abstract describes the three rovers under the ELM program that are called Rashid Rover 1, 2 and 3.

Past - Rashid Rover 1: Rashid Rover 1 is the first rover that was developed under the ELM program with a mass of 10Kg. It was launched and crashed on April 2023 as part of iSpace Hakuto-R mission. As being the first rover to be developed by UAE, Rashid Rover 1 had technology demonstration as its main objective. In addition, Rashid Rover 1 had wide field of view high resolution optical cameras, microscopic camera that can resolve regolith particles down to 50 micrometers, a thermal imager and a Langmuir probe. These instruments are selected carefully to achieve the objective of studying the geographic and geological features of the lunar surface, understanding the electron sheath and different processes on the lunar surface.

Present - Rashid Rover 2: Even though Rashid Rover 1 was deemed unsuccessful since it failed to achieve its science objectives, its technology demonstration objective was considered partially successful. As a technology, Rashid Rover went through extensive testing and verification program, and was thought to be ready for another attempt using a different mission to the lunar surface. As an exact replica of Rashid Rover 1, Rashid Rover 2 is being developed and is set to be launched soon. It continues to have the same objectives as Rashid Rover 1 by using the same instruments.

Future - Rashid Rover 3: Rashid rover 3 is the third rover under the ELM program with the aim to explore the lunar south pole as a precursor mission for future ISRU missions.

Planned to be launched by early 2028, Rashid rover 3 has two main objectives. First, it aims to continue the study of the geographic and geological features of the lunar surface while targeting a different site such as the south polar. Second, to investigate the presence of water in the lunar polar region. These two objectives are linked to investigations that are in line with the goals and objectives set by LEAG as can be seen in Figure 1. To perform such investigations, Rashid Rover 3 is equipped with instruments that vary from multi spectral imaging systems, infra-red spectrometer, permittivity sensor, ground penetrating radar to X-ray spectrometer. All these instruments are packaged cleverly in a relatively small and light configuration that follows the philosophy of the ELM program for compatibility with small commercial landers and for cost effectiveness.

As part of the technology development efforts, Rashid rover 3 will adopt an advanced navigation system that will allow it to traverse challenging terrains and environments. Such capability is important to enable science investigations in PSRs and to allow the rover to extend the mission lifetime by following carefully designed paths.

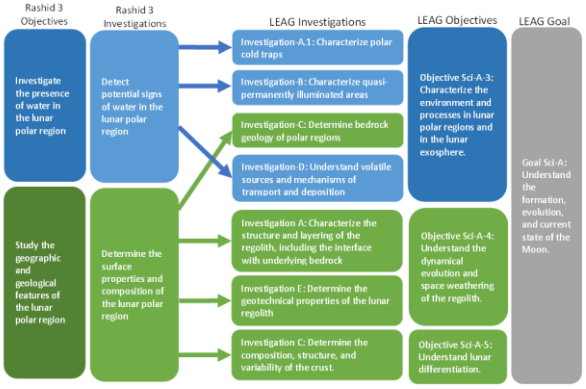


Figure 1 The Link Between Rashid Rover 3 objectives and investigations with the goals and objectives set by LEAG

Conclusion: With three rover missions in a less than a decade, the ELM program hopes to contribute to the ongoing efforts to explore and understand the lunar surface.