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Author: Mr. Maneesh Kumar Verma
Delft University of Technology (TU Delft), The Netherlands, The Netherlands

Mr. Mayank Mayank
Germany
Mr. Udit Kumar Sahoo
Germany
Mr. Ryszard Zawiła
Warsaw University of Technology (WUT), Poland
Mr. Dimitar Boev
RWTH Aachen University, Germany
Ms. Gabriela Mystkowska
Warsaw University of Technology (WUT), Poland
Mr. Guhan Sundaramoorthy
TU Berlin, Germany
Ms. Jillian Oduber
Delft University of Technology (TU Delft), The Netherlands
Ms. Gabriela Ligeza
University of Basel, Department of Environmental Sciences, Switzerland
Prof. Volker Gass
Ecole Polytechnique Fédérale de Lausanne (EPFL), Switzerland
Mr. Juan Carlos Arañó Romero
RWTH Aachen University, Germany
Dr. Tatiana Benavides
Space Innovation, Swiss Federal Institute of Technology in Lausanne, Switzerland

SCALE: A COLLABORATIVE PAYLOAD TO DEMONSTRATE MULTIPLE TECHNOLOGIES FOR A LUNAR HABITAT AND INFRASTRUCTURE

Abstract

The student team carried out a Pre-Phase A study to establish the SCALE payload's feasibility as a lunar mission. During the IGLUNA 2020 (ESA_Lab@ initiative) Field Campaign, a collaboration between ESA and EPFL Space Innovation was setup for academic training where a team of university students had to study the feasibility of a payload for future lunar missions. As a result, this study brought together three international teams with the three different experiments, that are combined into one payload named SCALE: Sample Celestial Ampex Lunar Endeavour).

Ampex's goal is to demonstrate the technological capability of the automatic production of continuous mineral fibre from lunar regolith. Although for SCALE, the lunar regolith is not collected from the lunar surface, but a lunar regolith simulant of the regolith is present at the time of launch. This will lead to fiber-based materials produced autonomously by textile machines. The objective for SAMPLE is to grow edible plants in extreme lunar conditions outside of the human habitat. This will help to study the

cultivation of edible plants for human space missions to the Moon and Mars. Lastly, Celestial envisions a highly integrated lunar communications infrastructure. For the SCALE payload, Celestial provides a low-power lander independent S-band communication channel for the payload.

The study led our team to establish the SCALE payload's mission requirements, identify the European Large Logistics Lander (E3L) as its preferred lander, and choose Shackleton Crater's rim as the best place to land due to it being illuminated for 89% of the lunar day. The study also established both the concept of operations for a lifespan of one lunar day and to carry all three experiments as one static payload on the lander. The team also simulated thermal and mechanical loads induced during the mission especially during the launch and surface operations phase, which resulted in making modifications to the lander-payload interface and overall housing and operations of this 55kg payload. An extensive cost analysis was also carried out to determine the total budget of the payload's design, manufacturing, testing and launch cost along with a business model to have a revenue stream.

The project attained its latest milestone by successfully completing a Pre-Phase A study at ESA's ESTEC CDF in December 2020.