

## **Towards A Moon Village: Vision and Opportunities**

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The new DG of ESA, Jan Wörner, has expressed from the very beginning of his duty a clear ambition towards a Moon Village, where Europe could have a lead role. The concept of Moon Village is basically to start with a robotic lunar village and then develop a permanent station on the Moon with different countries and partners that can participate and contribute with different elements, experiments, technologies, and overall support. ESA's DG has communicated about this programme and invited inputs from all the potential stakeholders, especially member states, engineers, industry, scientists, innovators and diverse representatives from the society. In order to fulfill this task, a series of Moon Village workshops have been organized first internally at ESA and then at international community events, and are also planned for the coming months, to gather stakeholders to present their ideas, their developments and their recommendations on how to put Moon Village into the minds of Europeans, international partners and prepare relevant actions for upcoming International Lunar Decade.

**Moon Village Workshop:** The Moon Village Workshop in ESTEC on the 14th December was organized by ILEWG & ESTEC Staff Association in conjunction with the Moon 2020-2030 Symposium. It gathered people coming from all around the world, with many young professionals involved, as well as senior experts and representatives, with a very well gender balanced and multidisciplinary group. Engineers, business experts, managers, scientists, architects, artists, students presented their views and work done in the field of Lunar Exploration. Participants included colleagues from ESA, SGAC Space Generation Advisory Council, NASA, and industries such as OHB SE, TAS, Airbus DS, CGI, etc. . . and researchers or students from various Universities in Europe, America, and Asia.

Working groups include: Moon Habitat Design, Science and Technology potentials on the Moon Village, and Engaging Stakeholders.

The Moon Habitat Design group discussed principles and concepts for a minimum base that would start with 4-10 crew, allowing a later evolution to 50 crew and elements contributed by Moon Village partners at large. Various aspects were assessed including habitats, laboratories, EVAs, pressurized vehicles, core modules, inflatable extensions, power systems, life support systems and bioreactors, ISRU using regolith, emergency, services, medical, escape, shelters.

The Science and Technology group analyzed the importance and readiness level of technologies needed for lunar robotic landers and for the Moon Village. The current ESA lunar exploration activities focus on the contribution within ISS operations barter of the ESA service module to bring Orion capsule to the Moon starting with an automatic demonstration in 2018. It is encouraged to consolidate this path for using the service module for crewed missions EM2 and EM3 giving also the possibility of an ESA astronaut, together with advanced technology, operations and science utilization. They noted the interesting contribution of instruments, drill, communications, and landing in support to Russian lunar polar lander missions Luna 27.

The Engaging Stakeholders working group started by identifying the main stakeholders and groups that play a role or that could play a role towards the Moon Village project. These stakeholders were classified on their influence towards the programme, and their attitude towards it. One clear conclusion was that most of the stakeholders showed a positive view towards the Moon Village programme, and that the most important step within a short term strategy should focus on the actions to be taken to engage stakeholders for the next ESA Ministerial to support the programme. Finally the group came up with some recommendations on which should be the actions to be taken by the ESA DG to engage the most direct stakeholders: ESA delegations, media, national governments, citizens, taxpayers, and to invite partners.

Building on previous studies (EuroMoon, lunar polar lander) ESA should develop a mid-class lunar lander (affordable in cost 300 Meu class), demonstrating the expertise at system level for a platform, that could carry innovative competitive robotic payload contributed and already with advance development from member states and international or commercial partners. With teleoperations from Earth and cis-lunar orbit, this will advance progress towards the next steps of Moon Village and beyond.

**Recommendations:** The participants encourage the design and operations of a Moon base simulation at EAC with facility and activities in the context of SpaceShip EAC, with the support of EAC, DLR, ESTEC, ISU and other

partners, and collaborations with other Lunar Research Parks worldwide.

It was also proposed to have an “ESTEC Moon Village pilot project” where 20 young professional in-terns could be hosted to work concurrently on various aspects (technology, science, instruments platforms, Moon base design, human factors, programmatic, outreach, community events) with links and support activities from ESTEC senior experts, and interactions with colleagues in member states, academia and industries .

The workshop finalized with some hands-on experiments, organized with some students demonstrating their work on a lunar lander with tele-operated instruments and systems, and on the measuring spectra of Moon-Mars analogue minerals. The day ended with a refreshing lunar music session, and a networking event on ESTEC ESCAPE where the last informal conversations marked a great wrap up of such exciting day.

Follow up Moon Village events are planned in 2016 at ESTEC, EAC and at international community venues. New means of outreach, communications and social media must be developed. You can follow Moon Village tweets, using #MoonVillage, and contribute to the virtual discussions. ESA is really looking forward to engage all stakeholders into the discussion, no matter of their background, nationality or interest. Just let us know your views!

Highlights and recommendations can be found on <https://ildwg.wordpress.com/>

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