

## IAF SPACE HABITATS COMMITTEE (SHC)

### 1. Introduction/Summary

The IAF Space Habitats Committee (SHC) aims, in cooperation with other IAF committees and symposia, to foster interest in the importance of building an international and interdisciplinary understanding of the issues and stakes raised by future space habitats (e.g., settlements on celestial bodies and orbital infrastructures).

### 2. Summary

The past few months have highlighted how much human space exploration is a fast-evolving field, while commercial programmes and future Moon missions further take shape. Space habitats, including suits which are considered a form of habitability infrastructure by many experts, are a core dimension in these evolutions. While SpaceX continued launching NASA and international crews to the International Space Station (six missions as of October 2022) and prepares the first-ever commercial EVA for 2023 as part of its [Polaris Dawn programme](#), Axiom was officially granted by NASA in early September 2022 the agency's task order to build the generation of spacesuits to be used for Artemis missions (from Artemis III). From 8 to 25 April 2022, Axiom also realised the first all-private astronaut mission aboard the International Space Station (Axiom's Ax-1 mission), launched with SpaceX's Falcon 9. Except for the mission's Commander, former NASA astronaut Michael Lopez-Alegria, the Ax-1 crew was exclusively composed of philanthropists and investors, further highlighting the great evolution of astronauts' profiles and training. This evolution towards private missions relates to an increased need for renewing space habitation interior designs and capabilities to fit life in orbit beyond work. In the meantime, the future of the ISS has been extensively discussed among partnering agencies, while the utilization of the station has been extended to 2025 and thorough assessments of its technical reliability past this date are underway.

### 3. Highlights

The launch of NASA/SpaceX Crew-5 on 5 October 2022, as the first US-based commercial launch to the International Space Station including a Russian crew member, highlights the core importance of considering, and further developing, interoperability standards in future space habitability structures. In the continuity of the International Space Station, interoperability is expected to play a central role in future surface and orbital infrastructures to facilitate global partnerships and long-term adaptability (including in the Gateway and any future nationally led space station open to international cooperation). Commercial missions mentioned above (cf. section 2) also imply important technical developments, including the development of SpaceX Polaris EVA suits, Axiom's ongoing construction of the first commercial space station, ThinkOrbital [multimission platforms](#), and many other private initiatives fostering innovation, modularity, adaptability and sustainability. In addition, and after several delays, Boeing's CST-100 Starliner test flight scheduled for late 2022 will hopefully lead to the vehicle's validation and allow to further strengthen the diversity of transportation vehicles available for future crews.

Furthermore, many SHC members currently work on developing new technologies and techniques for future space habitats. These include a multi-disciplinary study investigating how pavement elements from lunar regolith can be laser sintered into infrastructures (e.g., roads and launch pads), research on mission and system requirements to allow compatibility and modularity of future infrastructures through standardization, and the further development of a ground test demonstrator for the EDEN ISS Mobile Test Facility (MTF) greenhouse for integration to ESA's LUNA facility. Some pedagogical developments by SHC members can also be emphasized, including the creation of the MBA Space Architecture at the Technical University in Vienna.

#### 4. Future Outlook

Lunar missions are currently an important focus in space habitats research, focusing on the challenges associated with long-term to permanent settlements on our natural satellite. Technologies and systems relevant to closed-loop habitats, infrastructure elements and power generation and storage are key research aspects. Furthermore, governance, standardization, and human factors in general, are also important fields for research. As illustrated by the previous sections, the Low Earth Orbit becomes increasingly interesting for future commercial space stations, with production, tourism, and science as core tasks, benefiting from the heritage of decades of ISS operation and utilization. For both areas, an economy and market are also researched, understanding how a market can be built to enable companies who have to operate profit-oriented, in supporting or even leading habitat operations. All aspects of this emerging space exploration ecosystem need to be further addressed through thorough research programs, i.e., not only the economic and technical feasibility of these programs but also their legal, cultural, ethical, and environmental dimensions. A minoritarian, yet growing, focus on indigenous design, technologies, and culture within the space field, highlights how diversifying our frameworks could lead to innovative and more sustainable approaches to space habitats in the coming years. This interest directly results from an increasingly diverse community of experts involved in space habitability projects around the world, both in terms of disciplines (anthropology, indigenous studies, etc.) and cultures.

#### 5. Committee activities

In addition to continuing developing a shared database via Google drive including resources of interest for SHC members (membership application supporting documents, collective work documents, ongoing project databases, interdisciplinary virtual library on space habitats-related topics, etc.), Committee's activities for the upcoming semester include:

- **Yearly online workshop.** Following the first iteration of a webinar, organized on Zoom in

January 2022 by the Committee's chairing team (Olga Bannova, Sandra Häuplik-Meusburger and Julie Patarin-Jossec), the SHC has decided to set up a yearly iteration of an online workshop allowing both current and prospective members to present their research and work. The organization of this event is to be handled by a team of rotating SHC members.

- **Yearly article in ROOM magazine.** Among its initiatives to foster cooperation between its members and the benefits of its activities, the SHC will be publishing each year an article in [ROOM magazine](#) focusing on some of the latest research conducted by its members. Forthcoming in December 2022, the first iteration of this publication will be edited by a team whose members will rotate every year.
- **Cross-committees initiatives** and technical activities. The SHC will continue its cooperation with other existing IAF symposia and technical committees, including the symposia E5 "Space and Society" and D3 on "Building blocks for future exploration and development" through joint Technical Sessions (E5.1, D3.2A). The SHC is also actively working with the Human Spaceflight Committee to organize a joint technical session and/or submit joint new session proposals for future IACs, including in the plenary format. The SHC will also continue the technical session it has implemented for the IAC 2022, E5.6, "Simulating space habitats", for the IAC 2023. Based on feedback collected at the IAC 2022 in Paris, the SHC has updated its call for proposals for the IAC 2023, including in encouraging increased cross-disciplinary research in submitted papers.

Considering a few SHC members are active members or chairs of the AIAA Space Architecture Technical Committee, both committees also maintain strong collaboration, as highlighted by both the IAC Space Habitats Sessions from 19 to 22<sup>nd</sup> September 2022, and the AIAA SATC symposium organized in Paris on 23<sup>rd</sup> September 2022.