

IAF SPACE SYSTEMS SYMPOSIUM (D1)
Innovative Systems toward Future Architectures (1)

Author: Mr. Jonas Bahlmann
University of Luxembourg, Luxembourg

Dr. Michael Saidani
Luxembourg Institute of Science and Technology (LIST), Luxembourg

Dr. Vittorio Franzese
University of Luxembourg, Luxembourg

Prof. Enrico Stoll
TU Berlin, Germany

Prof. Andreas Hein
University of Luxembourg, Luxembourg

SPACE AND THE CIRCULAR ECONOMY: EXPLORING EXPERT PERCEPTIONS

Abstract

Space is facing significant sustainability issues such as space debris generation, light pollution, greenhouse gas emissions, and ozone layer depletion due to congestion of orbits, increase in rocket launches, and future mega constellations. Without including sustainability in the mission development framework, present and future space activities such as satellite internet networks, space resource utilization, solar power satellites, and space-based climate action will be compromised. To date, space endeavors exclusively rely on linear economy principles, following the “make, take, waste”-approach, and literature on how to transition to a circular space economy (CSE) remains limited. However, the implementation of circular economy (CE) principles in space activities requires a radical shift in the way mission concepts and space architectures are developed. A CSE may be crucial to ensuring the sustainable use of space and its resources, while an optimized use of existing and future space assets promises lower long-term costs, in addition to safeguarding sustainability on Earth and in space. The objective of this work is to gather, process, and synthesize qualitative and quantitative data on barriers, enablers, uncertainties, and challenges towards reaching the full circularity potential of the space ecosystem. To this aim, a diverse pool of global experts in CE, CSE, and space engineering from universities and research institutes, nongovernmental organizations, private sector including small businesses and prime contractors, space agencies, and civil society was included in a semi-structured interview. The investigation was done considering CSE in context of market interest, availability of funding, regulatory pressure, technological and social benefits, as recently suggested by the European Space Agency. The result is a large, first of its kind empirical dataset, which not only provides the ground for further, thorough research, but contributes to the discussion around space sustainability- and CSE-definition, lessons learned from terrestrial CE application, effects on the ecosystem, and best practices on implementing CE-principles in early design stages, where impact is the biggest. While the expert perceptions diverge in terms of time horizon and future grade of circularity implementation, they also fear short- and mid-term funding availability - but remain confident on a long time horizon. Broadly speaking, the views differ, depending on the organizational- and geographical background of the experts, while they align on CSE’s outstanding potential.