

Using the ISS to Prepare for Exploration (01)
ISS as the Foundation for Exploration (1)

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IDEAS FOR DEMONSTRATION OF EXPLORATION ENABLING TECHNOLOGIES ON THE
INTERNATIONAL SPACE STATION

Abstract

The International Space Station (ISS) has now entered the full exploitation after the 3 final years of assembly, with expansion of its volume and capabilities: Node 2 has been on-orbit since October 2007, the European Columbus and Japanese Kibo laboratories are operative since early 2008, Node 3 and Cupola were launched in March 2010. The Italian Permanent Multipurpose Module, obtained by the enhancement of Leonardo, has been attached to the Node 1 Nadir Port since March 2011. Now, with assembly complete, the ISS horizon is widening: its lifetime has been extended at least to 2020 and talks are on-going to extend it till 2028, in order to expand its original mission objective (a microgravity facility for experiments and basic research in life and material sciences, fluid physics and human physiology) to become a human outpost in preparation to the Deep Space Exploration, for testing enabling technologies and demonstrating specific operations. The ISS will become the stepping stone for exploration beyond LEO. In preparation to this, ESA has released a call for Ideas to exploit ISS for experiments for exploration: the present configuration of the ISS can easily accommodate and support technological demonstrations, as a preparatory test bed for applications to be exploited in the frame of long duration exploration missions. Various subjects could be considered potential fields for technological enhancement. Some of them appear particularly interesting for their implications, and are addressed in this paper. Several technological areas have been identified as good candidates for demonstration on ISS. Rapid Prototyping can be considered in long duration autonomous missions as a viable alternative to storage of maintenance and repair parts; Collaborative Robotics is essential in the exploration both in tele-presence mode, in the conditions typical of a “human imminent arrival scenario”, and in sharing IVA-EVA tasks with the human crew; Power Generation can benefit for testing in zero-G new types of electrolyzers and fuel cells. Inflatable technologies may be adopted to improve the ergonomics and habitation standards as well as for equipment applications, like deployable antennas, booms, radiators; Bio-regenerative Life Support is mandatory to cope with the limitation of resources imposed by a long exploration journey, Environmental (e.g. Radiation) Protections will have to be adapted to safeguard the crew health while leaving the benign LEO environment. The paper describes the ISS inherent capabilities to act as test bed and provides details on the demonstration opportunities for these technological areas.