THE ROLE OF DESIGN FOR HUMAN MISSIONS IN OUTER SPACES A. Dominoni[1] and I. L. Schlacht[2],
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Introduction: The rapid expansion of manned missions in Space exploration, and the gradual increase in the length of the uninterrupted periods of time spent by the crewmembers onboard the ISS, have multiplied the studies on habitability in microgravity conditions and confined environments, in order to guarantee now and in the near future, looking at Lunar and Mars missions, a way of living and working more comfortable and functional, and consequently more efficient [1].

One of the task of design is to mediate innovation technology, space requirements and wellbeing of the "people" involved in the mission (not only "crew members") designing equipment that can facilitate human movements and improve the performances of the various activities, to the advantage of greater productivity and a higher level of the quality of life.

Design of Usage and Gesture Interaction in Space: This methodology was developed by the author, who was Principal Investigator in ESA Space Missions [2], considering the different conditions and parameters verified such as a designer and researcher working on Space, instead on Earth.

Designing for Space means starting anew, applying a different logic for a different environment, conceiving new instruments for uses and activities that Earth dwellers have difficulty in envisaging, but which on the whole presuppose a different relationship between our bodies, the objects and the surrounding space. When we design for extreme environments, as microgravity and confinement, we have "to be able to foresee the way in which an object will be used", to imagine, for example, the actions and the movements of the crew in relationship to the new NBP, Neutral Body Posture that is assumed in microgravity, and "to anticipate" the physiological, perceptive, ergonomic, psychological and motorial requirements that will arise in the astronauts in environmental conditions that are completely new and unknown to the human being [3].

How to Imagine and Design the Experience: A way used by the designer/researcher to support the capacity of prevision in order to facilitate the "Design of Usage and Gesture Interaction in Space" is to act mission's operations during campaigns simulation on Earth, such as those carried at Mars Desert Research Center. The photo shows a simulation of geological EVA activity at MDRS in 2010 where the design practice is fundamental to optimize tools in relation to behaviours and movements of the human being during exploration in situ. The research of comfort is indeed one of the essential elements of the design discipline which implies to investigate all the possible factors involving the human interaction with tools and activities, and overall, the environmental constraints generated by extreme conditions.

Geological EVA at MDRS (2010 © I. L. Schlacht).

Astronauts work in difficult contexts and under life-threatening situations as radiations, adaptation to microgravity, isolation, and user-system interaction are some of the many challenges that strongly affect human performance, safety and comfort and, as a consequence, the mission success [4].

The main difficulties during the EVA simulation at MDRS was to use instruments that were not designed for the mission, such as a monitor, that was not readable through those specific light condition and the filter generated by the helmet glass, or a keybord of another instrument that was not possible to use with glows. The interaction with unsuitable instruments increase the time necessary to carry on activities, the oxygen consumption, and, as a consequence, the stress of the operators involved: all factors which cause the decreasing of performances and results.

For these reasons Design contribution is fundamental in Space missions: it makes easy human activities led in Outer Spaces, translating the needs of the people into requirements, use and gestures, which will be the base to create new objects and tools specific for the environment and the conditions in which the crew live and work.

References:

[1] A. Dominoni (2002) *Industrial Design for Space, SilvanaEditoriale,* Milano.

[2] A. Dominoni (2002) Principal Investigator of the Experiment *VEST. Clothing Support System for Crew IVA Activities on-board the ISS,* Marco Polo Mission, ASI, ESA

A. Dominoni, (2005) Principal Investigator of the Experiment *GOAL. Garment for Orbital Activities in weightLessness,* Eneide Mission, ESA.

[3] A. Dominoni (2010) *Cosmic Space as a Key for Creative Design. How Industrial DesigniIn Cosmic Space is Useful to Exemplify an Innovative Methodology for Design Process in Education,* INTED Conference Proceedings, International Technology, Education and Development Conference, Valencia, Spain.

[4] I. L. Schlacht, (2012) *SPACE HABITABILITY: Integrating Human Factors into the Design Process to Enhance Habitability in Long Duration Mission*, Doctoral Dissertation, Technische Universität Berlin, Germany, Published by TU-Berlin.