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Contribution of Space Activities to Solving Global Societal Issues (2)

Author: Mr. Klaus Bockstahler

Airbus Defence & Space, Space Systems, Germany, Klaus.Bockstahler@airbus.com

Mr. Marc Peter Hess

Airbus Defence and Space, Germany, marc-peter.hess@airbus.com

Dr. Willigert Raatschen

EADS Astrium Space Transportation, Germany, Willigert.Raatschen@airbus.com

Mr. Norbert Henn

Germany, norbert.henn@space-exploration-henn.com

SPACE EXPLORATION IN VIEW OF TERRESTRIAL CHALLENGES; PROTECTION OF
RESOURCES BY CLOSE-LOOP PROCESSES

Abstract

The scope and objectives of space exploration are composed of the preparation and realization of robotic and manned space missions aiming for an extension of human presence beyond our planet. Such aim requires the development of new technologies and infrastructures. Sustaining humans for an extended presence beyond and far away from Earth requires research in the fields of life science, physico-chemical and biological processes. Achieving a mature picture on the interaction of the related processes serves for both, the preparation of future manned space missions plus the future-proof and enhancement of our living conditions on Earth. Since living on Earth, mankind is aspired to explore its environment and to extend its boundaries to the benefit of the comfort and safety of its living conditions. Unmanned space systems i.e. satellites for communication and earth observation and spacecraft for exploration of our solar system are developed and applied. Manned space systems are put in place on fundamental research with significant results achieved throughout a broad range of scientific fields e.g. material science and life science. The desire of mankind to consolidate and even enhance its comfort and safety, coincidental with the ongoing increase in population and consumption of limited resources, does comprise a future challenge in several areas. An analysis of today's megatrends allows for the deduction of impacts and consequential solutions and sociopolitical actions. Similar challenges apply on future manned space exploration missions. Accordingly, besides its ordinary objective, manned space exploration may contribute to the resolution of terrestrial challenges. Exemplary: human space exploration must apply efficient concepts wrt the consumption and regeneration of consumables i.e. wrt sustainable systems at reduction of re-supply needs. The space habitat's closed humansphere allows for an early determination of the impacts and the suitability of countermeasures wrt the accumulation of waste and contaminants, including bio-contaminants, in such small ecosystem. Regenerative energy systems i.e. regenerative fuel cell systems apply e.g. in planetary surface systems granting planetary protection. Man-machine interfaces are being optimized including its further support by robotics. The paper compares the challenges derived from the ecosphere's megatrends with those applying on space habitats' humansphere and outlines the envisaged contribution of manned space exploration developments and missions. Emphasis is put on energy and life support systems including crew health in terms of minimized consumption of energy and consumables i.e. of maximized recycling and loop closure respecting human and environmental impact parameters.