

IAA Study Group Status Report

Responsible Commission: 3

**Study Number and Title: SG3.16 - Global Human Mars System Missions
Exploration – Goals, Requirements and Technologies**

Short Study Description (repeat from Study Group Proposal):

Human Missions to Mars have been studied individually by several Space Agencies over the past decades. However, a cooperative Human Mars mission framework – including, but not limited to requirements and technologies, is missing.

ISECG is not dealing with the above subject since it is limiting the coordination of the activities to the Mars Sample Return Mission.

Overall Goal:

Identify, assess and synthesize a global set of goals with its related criteria requirements for future human exploration of the Mars system and establish technology opportunities and roadmaps in the context of promising cooperative exploration scenarios. The Study should aim to identify means to minimize the risks at global level

Intermediate Goals:

The study will consider, but not limited to, the following aspects:

- 1) Mission rationale definition goals with its related criteria: – Political, Scientific, Economical, Cultural
- 2) Questions to be answered with the relevant time lining
- 3) Global set of requirements
- 4) Enabling Technologies required with the required time lining
- 5) Human Factors aspects
- 6) Mission Architecture Options
- 7) Sustainability
- 8) Outreach aspects
- 9) Cooperative Framework
- 10) Decision Roadmap
- 11) Recommendations
- 12) Conclusions

Progress in past six months:

The fourth meeting was held at the 64th IAC in Beijing in September 2013.

After the meeting the 25 pages White Cosmic Study (Previously referred to as 25-page special synthesis document) was prepared and delivered to the IAA so that it was available for the Heads of Space Agencies Summit held in Washington D.C. in January 2014.

A short version (about 6 pages) of the White Cosmic Study was presented at the IAA Space Exploration Conference held in Washington on 9 January 2014.

The study contained a set of recommendation which are here reported in detail:

- 1) Define an International Mars reference mission scenario, with the involvement of Space Agencies/Industries, to agree on a preliminary technical baseline and the required technological decision milestones, for instance:
 - a. Nuclear thermal and nuclear electric propulsion

- b. Zero-boil off technology for cryogenic propellant storage.
 - c. Nuclear power generator systems for both space and on-planet usage.
 - d. Passive or active radiation shielding technology.
 - e. Artificial gravity in space.
 - f. Effects of Mars gravity using large centrifuges or tethered spacecraft in orbit.
 - g. Aerocapture technologies for large payloads.
 - h. Life support systems, in particular regenerative ones.
 - i. In Situ Resources Utilization (ISRU) systems.
 - j. Exploration technologies, in particular astronaut robotic assistants, rovers, drillers, etc.
- 2) Set up a joint working group, IAA(SG3.6)/ISECG, to define in which of the Human Missions beyond Earth, defined in the ISECG roadmap, the technologies defined in the Mars reference mission (see recommendations 1) should be demonstrated, in order to reduce the risk and cost of the Global Mission to Mars. Demonstration projects, to be carried out by a variable group of countries will be defined to this end.
 - 3) Foster the global involvement of countries, in particular of the emerging and developing countries, through existing bodies like ISECG, UNOOSA-HSTI, IAA, etc.
 - 4) Improve the common knowledge of the human factors, as the most critical issue for the Mars mission.
 - 5) Set-up a Human Spaceflight Virtual Institute, by IAA and with the participation of Space Agencies/Industries, to foster the exploitation of existing technologies, facilities and know-how available world-wide. This Institute will also facilitate the engagement of new and developing countries by identifying technological niches existing in these countries, as well as facilitating the exchange of information in many critical areas, such as human factors.

Out of the two deliverables

A. The main report

B. The 25-page special synthesis document

the second was delivered on time, while the preparation of the first is on schedule.

.Website Study Information up to date? (Study Group Membership, Study Plan and Schedule):

Chair: Giancarlo Genta

Co-Chairs: Alain Dupas
Hideto Yamazaki

Secretary: Jean-Marc Salotti

Study group **Membership** (in alphabetic order):

Mauro Augelli (CNES, France)
Andrew Aldrin (ULA, USA)
Nicolas Bérend (ONERA, France)

Giovanni Bignami (COSPAR)
 Claudio Bruno (University of Rome, Italy)
 John B. Charles (NASA, USA)
 Lin Chen (Lockheed Martin, USA)
 Elisa Cliquet Moreno (CNES, France)
 Gabriel G. De la Torre (Univ. of Cadiz, Spain)
 Nadeem Ghafoor (MDA, Canada)
 Alexey Grushevski (Keldish Institute, Russia)
 Richard. Heidmann (Planet Mars Ass., France)
 Bernhard Hufenbach (ESA, Europe)
 Les Johnson (NASA, USA)
 Nick Kanas (U. of California, S. Francisco, USA)
 David Kendall (Canadian Space Agency, Canada)
 Anatoly Koroteev (Keldish Research Center, Russia)
 Andrey A. Kuricyn (Russia)
 Julien-Alexandre Lamamy (Orb. Sc. Corp. USA)
 John Logsdon (George Washington Univ., USA)
 Kohtaro Matsumoto (JAXA, Japan)
 Chris McKay (NASA, USA)
 Susan McKenna-Lawlor (Ireland Nat. U., Ireland)
 Ernst Messerschmid (Stuttgart U., Germany)
 Gian Gabriele Ori (Univ. G. d'Annunzio, Italy)
 Natalia Nikolaeva (Skobeltsyn Institute of Nuclear Physics, Russia)
 Michael Panasyuk (Skobeltsyn Institute of Nuclear Physics, Russia)
 Maria Antonietta Perino (TASI, Italy)
 Viacheslav Petukhov (Moscow Aviation Institute, Russia)
 Yury Razoumny (Russia)
 Pascal Renten (University of Stuttgart, Germany)
 Stephen C. Ringler (SGAC, USA)
 Andreas Rittweger (Astrium, France)
 Christian Sallaberger (MDA, Canada)
 Klaus Schilling (Univ. of Würzburg, Germany)
 Alexander Semenkin (Keldish Research Center, Russia)
 Carol R. Stoker (NASA, USA)
 Lin Wei (China)
 Luo Wencheng (China)
 Alan Wilhite (Georgia Tech, USA)
 Cao Xiaohui (China)
 Lu Yu (China)
 Tatiana Zenchenko (Space Research Institute, Academy of Sciences, Russia)

New members have been added, see list below.

- Study plan: see previous section
- Schedule:
 1. A paper will be presented at the 65th IAC, Toronto, Sept. 2014
 2. The Study will be completed for the 65th IAC in Sept. 2015

Issues requiring resolution? (recommend approach):

None

Product Deliveries on Schedule? (If modified explain rationale):

YES

Study Team Member Changes? (List any Study Team Members that you wish to discontinue, and provide names plus contact coordinates of any Members you wish to add on the second page of this Study Update form.) Note: Complete contact information including email, tel. and fax must be provided for all additions. Only Members with complete contact information will be listed and receive formal appointment letters from the IAA Secretariat.)

See below

Name of person providing Study Group Status (Study Group Chair or Co-Chair):

Giancarlo Genta
Study Group Chair

Status Report Date:

20 Feb. 2014

Study Team Membership Changes

Effectivity Date: 20 Feb. 2014

Discontinue:

Name: Christophe Bonnal (CNES, France)
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Name Stephane Gres
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