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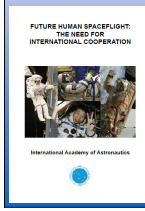
Human Spaceflight Study Group Report

17 November 2010



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Objectives

- The Human Spaceflight Study Group is truly international, with representatives from all major space faring nations, incl. 3 astronauts
- Leadership team is :
  - Chair: Prof. V. Soloviev
  - Co-chair: Prof S. Pace
  - Rapporteur: Mr G. Reibaldi
- The ultimate goal of space exploration is human exploration and as such Human Spaceflight is the main component
- The report is an end-to-end assessment of the Human Spaceflight issues, starting with basic exploration questions and concluding with possible international cooperation implementing schemes
- The report provides concrete proposals on how to move beyond the International Space Station taking into account ongoing efforts such as the Global Exploration Strategy

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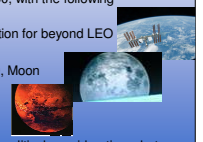
Boundary Conditions

- The Human Spaceflight Study Group has focused on Human Spaceflight exploration beyond Low Earth Orbit (LEO), identifying the required enabling technologies including robotic missions
- For reference, the Planetary/Lunar Exploration Study Group has focused mainly in science-driven robotic missions
- The horizon or the Human Spaceflight Study Group is 2050, with the following features:
  - 2010-2025: LEO exploitation and technology preparation for beyond LEO
  - 2020-2035: LEO capability supports missions to NEO, Moon
  - 2030-2050: missions beyond the Moon



- The time horizons were chosen to look beyond immediate political considerations, but to remain within the horizon of the next generation of the space community.

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Exploration Questions

- Fundamental questions:
  - Why should we invest the considerable resources necessary for Human Space Exploration, and risk human lives with this endeavour?
  - Where can humans go in the solar system?
  - What are they capable of?
  - Does humanity have a future beyond the Earth?
    - Can we live off the land (e.g., use local resources)?
    - Can we it make pay (e.g., commercial activities)?

- The answers are not yet available but considering the limitless benefit offered by Human Spaceflight and the concrete benefit generated by the required enabling technologies developed, it is reasonable that nations invest in their future, knowing that any investment presents risks

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Enabling Technologies

- Human Spaceflight is expensive and technologies to reduce mission cost are a priority and a prerequisite for a sustainable exploration programme
- Major enabling technologies to be developed /matured include:
  1. Human rating of launchers/spacecraft
  2. Propulsion
  3. Automated rendezvous, docking and capture
  4. Regenerative environmental control life support systems
  5. Entry and re-entry technologies
  6. Autonomous landing technology
  7. Surface infrastructure/non-terrestrial mining/surface habitation
  8. Robotics for in-space and planetary surface use
  9. Interplanetary data and information exchange
  10. Energy systems
  11. Space exposure and health care at remote locations
  12. Planetary protection/sterilization

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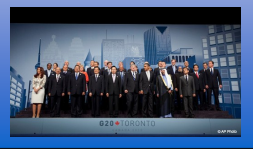
Potential Organization and Mechanisms for International Cooperation

- LEO Missions:
  - Present ISS mechanism is extended to non-Partner States taking into account the ISS "Lessons Learnt" defined by the ISS Partners
- Beyond LEO Missions:
  - Coordinated team of Space Agencies define an initial set of missions architecture and interfaces. This is what the ISECG is carrying out.
- In view of the political and global relevance of Space Exploration initiatives, it is proposed to hold Head of Space Agencies meetings in conjunction with G-20 meetings to review or initiate new programmes



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Sustainability

- Technical
  Orbital Debris is a major problem mainly in LEO; international guidelines exist but a more concerted international effort is required
- Programmatic
  Action plan for sustainable programmes must consider the following:
  - Define a clear and credible vision for a global space exploration program
  - Provide the necessary resources
  - Ensure information and open communication
  - Improve cross-cultural management
  - Strengthen the scientific context of space exploration
  - Prioritize space programs for the benefit of humanity
  - Optimize technical capacities and transnational cooperation
  - Foster creativity, entrepreneurship and entrepreneurial orientation
  - Provide appropriate legal frameworks for space cooperation
  - Raise public awareness and invest in educational programs
  - Apply strategic performance management measure





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Public Engagement

- In the 1950's and 1960's the "Space Race" brought excitement to the general public, culminating with the live broadcast of the Moon landing in 1969
- Today Space missions *appear* to have become almost routine
- The Public is the ultimate beneficiary and support of Human Spaceflight and effective means of communication must therefore be found
- "Participatory Exploration" could be an answer. It describes the active involvement of individuals. It encourages individuals to contribute their creativity and capability to Space Exploration missions with advanced communication technologies and use of commercial orbital and suborbital capabilities beside the national space capabilities


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Recommendations (1/2)

- Human Space Exploration can and should be guided by questions that promote international cooperation and collaboration.
- The priority areas for global cooperation are the following:

1. Mechanisms for cooperation :
Develop an integrated architecture for LEO and beyond including all human space faring nations

2. Programmatic Priorities:
Define/develop a common transportation policy for LEO and beyond

3. Infrastructure Standards:
Define/implement common interoperable standards for human spaceflight missions

4. Enabling Technologies:
Define/coordinate roles for specific technologies among Human Spaceflight nations

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Recommendations (2/2)

5. Sustainability
Define/develop an integrated Human Spaceflight Space Situational Awareness system

6. Public Engagement
Define/develop an integrated Public engagement Plan for Human Spaceflight

7. Human Factors
Coordinate research on Human factors

8. Global Involvement
Foster involvement of all space faring countries in Human Spaceflight in view of the long-term benefits for humankind

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Conclusions

- Human Space exploration is now the best example of global cooperation as indicated by the ISS. It is desirable to expand the opportunities for other countries to utilize the ISS in addition to the current ISS partners

- All space faring States agree on the necessity and desirability of maintaining human space activity in LEO and extending human missions beyond LEO in coordination with precursor missions
- Global exploration strategy is the basis for the cooperation in Human Spaceflight beyond the ISS, building on the many existing mechanisms already in use
- Considering the strategic and societal importance of Human Spaceflight, this topic should be discussed at the highest political level (e.g. G-20)

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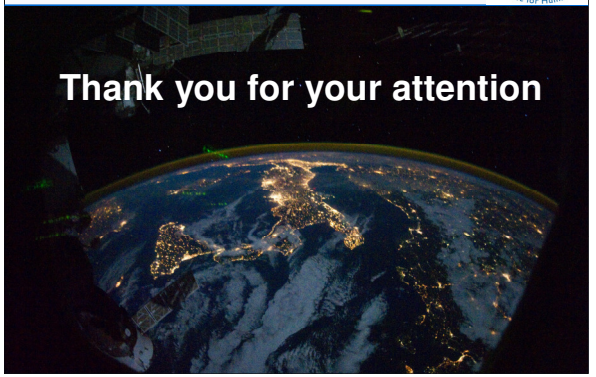

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Global Political Context (1/2)

- General
  Human Spaceflight is the most interdisciplinary of Human activities and it is considered strategic by a growing number of countries worldwide.
- Per country:
  - CNSA/China : Human launch capabilities Shenzhou spacecraft with Long March 2F launcher
  - CSA/Canada: active ISS Partner with main skills in robotics
  - ESA/Europe: Active ISS partners with Columbus, ATV development
  - ISRO/India: Technologies studies in Human Spaceflight could lead to first manned mission after2015
  - JAXA/Japan: Active ISS participation with KIBO laboratory and HTV development

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Global Political Context (2/2)

- KARI/South Korea: Important investment to develop launchers; first Korean Astronaut went to the ISS in 2008
- NASA/U.S.: decided to extend ISS operations until 2020. Major shift tin Human Spaceflight programme with the halt of STS launches and with the development of commercial cargo service to ISS
- Roskosmos/ Russia: decided to extend ISS operations until 2020. Currently the only ISS partner with the capability to deliver crew to the ISS after retirement of the Space Shuttle