

# IAA Study Group SG 5.12: Dynamics of space exploration strategies and future outlook

Status report, Paris, 21 March 2016

Chair: Serge Plattard

Co-Chair: Pascale Ehrenfreund

Secretary: Nicolas Peter

Henry Herzfeld, Gerda Horneck, John Logsdon, Mark Lupisella, Steve Mackwell,  
Jacques Masson, Tanja Masson-Zwaan, Patrick Michel, Mazlan Othman, Cheryl  
Reel, Giorgio Saccoccia, Kazuto Suzuki, Stephan Ulamec, Oleg Ventskovsky,  
Frances Westall

# Study Objective

- Compile a comprehensive space policy report on the current state and evolution of the domain of space exploration
- Pursuing alliances → interests and involvement of major stakeholders have to be well balanced → stakeholders have to engage together in the decision-making process and converge toward agreed-upon objectives
- Report: i) surveys on-going plans of major space actors, discussions in technical fora (IAA, COSPAR, ISECG, ILEWG, IMEWG, IPEWG,...and newcomers in the field; ii) summarizes an up-to-date view of the international space context, and; iii) identifies drivers and trends of various individual space stakeholders
- A common integrated vision for space exploration is proposed which has to be bold, collective, holistic, paved with realistic milestones shared by the stakeholders and thought *ab initio* in a sustainable manner

# Status Reports and Presentations

- February 2013, registration of proposal for forming an IAA SG 5.12
- January 2014, presentation (John Logsdon) of a preliminary report at the Heads of Space Agencies Summit, Washington DC, 9-10 January 2014
- March 2014, SG status report
- September 2014, SG status report
- October 2014, presentation (Serge Plattard) at the 65<sup>th</sup> IAC of preliminary results of the Cosmic Study perspectives
- March 2015, SG status report
- October 2015, presentation (Serge Plattard) at the 66<sup>th</sup> IAC of updated and quasi final results

# Report Outline 1/2

1. Introduction: Space exploration stakeholder landscape, political situation of space powers, changing exploration scene, main endeavours with timeline
2. Changing space exploration context. History, [John Logsdon](#). Geopolitics, [Nicolas Peter](#), [Kazuto Suzuki](#), [Serge Plattard](#)
3. Science drivers for exploration (per destination)  
General intro: [Pascale Ehrenfreund](#)  
Moon, [Steve Mackwell](#)  
Mars: [Frances Westall](#)  
Asteroids, [Patrick Michel](#)  
Martian Moons, [Cheryl Reed](#)  
ISS, [Gerda Horneck](#)  
L2 destinations, [Mark Lupisella](#)

# Report Outline 2/2

## 4. Dynamics in pillars of exploration

Human spaceflight, [Jacques Masson](#)

Robotic exploration, [Stephan Ulamec](#)

Technology roadmaps, [Giorgio Saccoccia](#)

Access to space,, [Nicolas Peter](#), [Oleg Ventskovsky](#)

## 5. Legal issue (legal regime for exploration)

IISL activities, [Tanja Masson-Zwaan](#)

Planetary protection and stewardship, [Henry Hertzfeld](#)

## 6. Emerging challenges and opportunities

Support and cross-interaction of national and international bodies,

[Pascale Ehrenfreund](#)

Political decision-makers, [Nicolas Peter](#)

UN support for space exploration, [Mazlan Othman](#)

## 7. Conclusion and recommendations, [Serge Plattard](#),, [Nicolas Peter](#), [Pascale Ehrenfreund](#) and others

# Completed updates and contributions 1/5

- Request for new updates and contributions made in February 2015. First entries expected second half of April, but stretched until end 2015

- Requests per section:

## **2. Changing space exploration context**

2.1 *History of space exploration*: estimate costs of early years of space exploration and compare to R&D budgets and/or big science equipments.

2.2 *Changing space exploration context*: Expansions on China, India and Japan provided together with how space exploration supports geopolitical stance.

## **3. Science drivers for exploration (per destination)**

3.1 *The Moon*: Details on 2015-2020 planned missions. Chinese and Russian plans beyond 2020 presented. X-Prize revisited.

## Completed updates and contributions 2/5

3.2 *Mars*: Updates with latest results of Curiosity, MAVEN and MOM. More details about the Mars missions planned by 2020.

3.3 *The Martian Moons Phobos and Deimos*: Reflight of Phobos-Grunt scheduled?

3.4 *NEOs*: Updates on NASA's ARM project, as much as possible; Hayabusa 2. First results of Rosetta Philae. New Horizons mission.

3.5 *LEO*: ISS experimental programme up to 2024, with a focus on the next 5 years, planned 2024 Russian split from the Station. Expand on Shenzou and Tiangong and future Chinese plans for human LEO activities up to 2030. ESA astronauts on the Chinese Space Station?

3.6. *Other Destinations – Cis-lunar Space*: among listed areas of potential activities, need to expand on concrete projects and associated time-lines.

# Completed updates and contributions 3/5

## 4. Dynamics of Exploration

4.1 *Robotic exploration*: technological challenges central for enhancing space exploration are explained in more details to the reader. A couple of case studies introduced.

4.2 *Human Spaceflight*: Developments and achievements obtained with the ISS are detailed. More on Chinese LEO human activities. Private initiatives taken into account. The very substance of the June 2014 NRC Human Spaceflight Committee report is included (Pascale Ehrenfreund).

4.3 *Technology Roadmaps*: This part has been significantly re-written and is completed



# On-going updates and contributions 4/5

*4.4 Access to Space:* Updates on China, Europe, India, Japan, Russian and US launcher programmes and their specificities for human and robotic exploration missions. Role of the private sector. Consequences on space exploration of Europe's long-term launcher programme choice.

This part has been substantially and significantly re-written by Nicolas Peter with the contribution of Oleg Ventskovsky

## **5. Legal and policy regime for exploration**

*5.1 International Space Treaties:* Issues such as liability, ownership of space assets, use of the Moon and celestial bodies for both scientific and other purposes closely related to space exploration missions put in perspective within existing treaties.

*5.2 Multilateral non-binding initiatives in space sustainability:* An update on the three non-binding initiatives under consideration and their impact on space exploration is provided.

*5.3 Legal Issues: Planetary protection and stewardship. Modus operandi completed*

# On-going updates and contributions 5/5

## **6. Emerging challenges and opportunities**

6.1 *United Nations support for space exploration*: The Human Space Technology Initiative (HSTI), aiming to engage more countries in activities related to human spaceflight and space exploration: completed

6.2 *Support and cross-interaction of national and international bodies*: completed by Pascale Ehrenfreund

6.3 *Political decision-makers*: written by Nicolas Peter

## **7. Conclusion and recommendations**

Expanding on the proposed multi-criteria common integrated space vision- International Space Exploration Council , and Common space transportation policy for exploration: essentially based on contributions from Serge Plattard, Nicolas Peter, Pascale Ehrenfreund and inputs from some other contributors. Needs still a bit of polishing.