

# Policy Considerations for New Human Space Exploration Strategies

## *The Space Generation Perspective*

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### **Abstract**

Human and robotic spaceflight has become a global enterprise with increasing entities from the government and non-governmental sectors, introducing new space exploration strategies. With these novel strategies, the need for modifications to existing regulations or policies, or the development of additional guidelines, must be considered. During the Space Generation Congress 2014 held in Toronto, Canada, students and young professionals representing 15 countries participated in the Ethics and Policy of New Human Space Exploration Strategies working group. The group conducted a review of the current field of human space exploration strategies, focusing on ethics, present policies, and future policies. As a result of these findings, the space generation proposed several recommendations. As we move into an age of manned-mission focus, ethical considerations surrounding exploration strategies are numerous and complex. As such, there is growing need for a guiding body to oversee the balance between ethical factors and mission objectives. In order to fill this gap, the group proposed the establishment of a

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UN-ethics board to formulate ethical guidelines and monitor mission proposals of entities pursuing human spaceflight initiatives. Furthermore, we suggest the extension of existing policies to foster cooperation and diversify risk with regards to multinational, multi-party, commercial, and long-duration human missions.

## **I. Introduction**

Spaceflight (and space exploration), with or without humans, has become a global enterprise with more and more entities, both governmental and non-governmental. With one to two launches per week, Earth orbit is becoming very populated and collisions with space debris have already been reported. Such events have resulted in the development of regulations for Geostationary Earth Orbit (GEO) and active discussions on orbital debris (removal) and regulations for Low Earth Orbit (LEO).

With human spaceflight and deep space exploration now becoming the goal of multiple countries and companies, it becomes a valid question if space flight regulations or policies are needed for this as well. The relevance is emphasized by the recent failure of Orbital Science's mission to the International Space Station and fatal loss of Virgin Galactic's SpaceShipTwo.

Furthermore, the fundamental objectives of government entities and commercial stakeholders in industry are not necessarily aligned. Commercial entities have a financial responsibility to their investors, whereas government entities have a social responsibility to conduct activities for the betterment of society. So while the sustainability of the industry and its activities is in the best interest of all stakeholders, discrepancies in ethical standards, which arise from individual stakeholder strategies and policies, shall need to be addressed.

The Space Generation Congress (SGC), the annual conference of the Space Generation Advisory Council (SGAC), was hosted in Toronto, Canada from September 24 to 26, 2014. During the congress, students and young professionals representing 15 countries participated in the Ethics and Policy of New Human Space Exploration Strategies working group. The group conducted a review of the current field of human space exploration strategies, focusing on ethics, present policies, and future policies. The results of this working group discussion are discussed in the following.

## **II. Current Policy: Environments and Considerations**

As related to human exploration, UN Space Policy is primarily dictated by three declarations:

- The 1967 Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (referred to as the “Outer Space Treaty”),<sup>1</sup>
- The 1968 Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space (the “Rescue Agreement”),<sup>2</sup>
- The 1972 Convention on International Liability for Damage Caused by Space Objects (the “Liability Convention”).<sup>3</sup>

The Outer Space Treaty is the foundational document which currently dictate current UN Space Policy. This treaty was created during the Cold War to alleviate tensions between space faring nations, limiting military activity in space, and preventing sovereign claim over celestial objects. The treaty restricts the use of outer space to activities that are peaceful, and beneficial to humankind. Additionally, the treaty sets guidelines for the ownership and responsibility of objects in space. A state which launches an object into space has judicial control over it, and is liable for damage or interference caused by said object.

The Rescue Agreement and the Liability Convention are modifications to the Outer Space Treaty. This agreement outlines the responsibility of all states to assist and support astronauts or “space personnel” that land on, or near, their territory. The Liability Convention makes specific the intent of the Outer Space Treaty that the responsibility for any damages caused by a space launch rest with the state where the launch originated.

The current policy environment for cooperation in space exploration is largely dictated by the activities of the United States, particularly with relation to the International Space Station. The International Space Station (ISS) Agreement,<sup>4</sup> signed in 1998, puts forth a comprehensive plan for managing one of the greatest technological achievements of our time: an orbiting laboratory. While this is impressive in its own right, the construction and use of the ISS was/is complex, necessitating the use of equipment from many countries with language, technical, and social barriers. The ISS Agreement sets forth a detailed plan for the construction, operation, and use for the space station as

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1 Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, Jan. 27, 1967.

2 Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space, Dec. 3, 1968.

3 Convention on International Liability for Damage Caused by Space Objects, Sep. 1, 1972.

4 Agreement among the Government of Canada, Governments of Member States of the European Space Agency, the Government of Japan, the Government of the Russian Federation, and the Government of the United States of America concerning Cooperation on the Civil International Space Station, Jan. 29, 1998.

well as the division of cost, risk liability, and ownership of any breakthroughs obtained through the research conducted.

With the increasing presence of private and government entities in the space sector, these existing policies must be extended so as to address new mission types and strategies in future human spaceflight. Future missions will likely involve multiple parties and/or states, and as humanity pushes further into the Solar System, long-duration missions (in excess of six months) will become far more common. With the current growth of the commercial space industry, commercial human spaceflight must also be addressed as a possible future strategy.

Two key areas of existing policy were identified as the focus of the new extension: future multiparty cooperation, and diversification of risk.

### **II.1. Multiparty Co-Operation**

Current and future human space exploration strategies do, and will, encompass more than a single entity actor. Current United Nations policy does not reflect this growing multiparty space environment. As stated above, the Outer Space Treaty, currently signed and ratified by 102 countries including the United States, Russia and China, was created at the height of the Cold War with a focus on responsible and peaceful use of space. This international treaty forms the cornerstone of current space policy, and yet addresses solely single state-operated space missions. At the time it was written, there was no precedent for commercial or multilateral manned space missions. With the rapid growth of the current space environment, this is a major omission in part of the Treaty. It is crucial that cooperation between states and commercial enterprises be encouraged, to ensure future growth in the manned space industry, and thus a recommendation regarding multiparty missions should be made by the United Nations.

### **II.2. Diversification of Risk**

It is crucial that any extensions made to existing policy not be prohibitive. Cooperation between parties and states is essential for furthering the manned space industry. New strategies in human space exploration, particularly with regards to long-duration missions, will likely involve higher levels of risk. Under the existing policies, it is the launching state which remains liable for any damage caused by a spacecraft during its mission. This policy has the potential to stifle future collaboration between commercial entities and states. Placing risk and liability solely on the launching state discourages the state from allowing high-risk ventures by commercial parties. Liability needs to be shared between the launching state and any commercial parties involved, and thus the articles within the Outer Space Treaty and the Liability Convention addressing liability of states should be amended or revised.

### **II.3. Recommendations**

- 1) Current and future space exploration encompasses more than a sole State actor. Current UN policy does not reflect this growing multi-party space environment. Therefore, it is our suggestion that the UN recommend to countries to examine the Multilateral ISS Agreement and use it as a model for cooperation and accessibility agreements in future multi-party missions.
- 2) Future exploration will likely involve higher risk missions. Current policy places the majority of the responsibility on the launching nation. Therefore, it is our suggestion that the UN should recommend countries adopt risk-sharing policies, similar to the US Launch Indemnification.

### **III. Long-Term Strategy for Space Exploration**

Possible policies for future exploration missions are hard to assess due to contradicting scenarios and expectations, particularly when human lives are involved. There are many factors that need to be taken into account when deciding on new, long term policies for space exploration. These factors will be outlined in this section.

#### **III.1. The Roles of Government and Commercial Initiatives**

Although recent events such as the Orbital Science's launch failure and SpaceShip 2 crash have cast some doubt on the viability of commercial space exploration efforts, we believe commercial initiatives are positive efforts that facilitate new developments. The successes of companies such as SpaceX is evidence for this belief. As such, these activities should be supported in the long term, and not be held back by strict regulations or prohibitions. Future long term space policies should consider both, commercial and state-supported endeavours and, more importantly, respect the different drivers and requirements of such programmes.

#### **III.2. The Extent of Regulations**

Regulations can block development as they might impose such tight restrictions that commercial endeavours become unattractive. Lack of regulations, on the other hand, can lead to loss of human life, damage to the space environment or damage to infrastructure on earth. Damage to space assets due to space debris (which gave rise to development of space debris mitigation guidelines<sup>5</sup> and the reentry of the Kosmos 954 satellite over Canada are examples highlight the importance of proper regulations. A balance should be sought, taking into account the risk of mission failure or loss of life.

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<sup>5</sup> IADC space debris mitigation guidelines. Inter-Agency Space Debris Coordination Committee, 2002.

### **III.3. Liability and Accountability**

There are pros and cons in implementing liability and accountability for missions. While harsh accountability requirements will dissuade companies from venturing into space, lack of accountability could possibly lead to recklessness. What is clear, with increasing international collaboration and involvement of commercial stakeholders in space activities, the current scheme of liability based on taking the launching states liable needs to be revised.

### **III.4. Ownership of Resources or Scientific Achievements**

The UN Outer Space Treaty states that no sovereignty can be claimed by nations on celestial object, and that outer space shall be free for exploration [3]. While it is desirable to keep this principle, it might lead to fierce competition for space resources. This can be detrimental to the space environment, leading to rapid harvest of resources and destruction of sites of scientific or sentimental value. As such, a policy framework to safeguard important sites in space seems necessary.

### **III.5. International Regulations**

As discussed in the current policies section, current regulations are mainly nationally focused. Due to the likely international nature of future space exploration endeavours, involving both government and commercial entities, new regulations with an international focus seem necessarily for long term sustainability of space activities. There are good examples of developing international guidelines or inter-entity communication frameworks in space, such as the guidelines developed for space debris mitigation by the Inter-Agency Space Debris Coordination Committee (IADC),<sup>6</sup> or the development of the Global Space Exploration Roadmap by the International Space Exploration Coordination Group (ISECG).<sup>7</sup> Such activities should, in the long run, be expanded to other areas of space exploration to help create relevant international regulations.

### **III.6. Dependence of Policies on Mission Type**

The need for regulations, guidelines or policies is highly dependant on mission type. End of life operations, which are currently focused on LEO, will be highly relevant for future exploration missions to protect the space environment from debris created during missions. However, the type of debris created in long duration missions, and equipment required for end of life operations might be entirely different. Rescue agreements might become complicated for Lunar missions and impossible (or undesired) for Mars missions, and, as such, need to be assessed. All these factors need to be taken into account,

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6 IADC space debris mitigation guidelines. Inter-Agency Space Debris Coordination Committee, 2002.

7 The global space exploration roadmap. International Space exploration coordination group, 2013.

highlighting the importance of proper categorization of missions and development of specific policies for different mission classes.

### **III.7. Recommended Actions**

Upon reviewing the factors outlined in III.1 to III.6, the group concluded that specific regulations on technical and medical aspects are not desired as this will likely block developments. Instead, it is recommended that the UN establishes an internationally agreed set of guidelines and recommendations encompassing the following aspects of human space exploration missions:

- Astronaut selection criteria (physical, psychological, genetic screening, family relations, education)
- Medical care (pre-emptive, immediate, end of life, post mortem)
- Personal care (personal items, privacy, family contact, mission management contact)
- Spaceship design (consumable reserves, system redundancy/spares)
- Rescue missions (LEO rescue, reentry rescue, resupply missions)
- These aspects shall be defined for different classes of missions (unmanned or involving humans):
  - Suborbital
  - LEO (days or weeks up to long term (more than 6 months))
  - Earth vicinity (Lunar missions or Lagrange points)
  - Deep space (asteroid, Mars, etc.) (both one-way/settlement mission and return missions)

These international guidelines can be used as recommendations for state or commercial entities planning and implementing such missions. These entities shall, however, be obligated to provide transparency on whether these guidelines are met or not, and to communicate this information to the relevant UN bodies and eventually to spaceflight participants. Eventually, the UN can publish quality labels for different missions.

To address the question of liability and accountability, we recommend to include outer space affairs under the International Court of Justice jurisdiction. In cases where one mission impacts another or inhabitants of Earth, this court should be able to assess if accountability applies due to negligence.

In addition, the UN is recommended to extend the UNESCO World Heritage sites to outer space to protect sites of scientific value (potential sites for life), restrict resource harvest at specific sites (lunar polar ice) and preserve historic landmarks (lunar landing sites) from contamination. Access to these sites shall either be forbidden or closely regulated.

To set up the guidelines matrix, support the International Court of Justice and extend the UNESCO World Heritage sites to outer space, the workgroup recommends the UN to task this to the UNCOPUOS Technical and Law Commit-

tees and, in addition, set up an Ethics Committee and a Space Science Committee with representatives from all involved parties to avoid biased policies.

#### **IV. Ethics of Space Exploration**

##### **IV.1. The Importance of Ethics in Space Exploration**

The fundamental objectives of government entities and commercial stakeholders in an industry are not necessarily aligned. Commercial entities have a financial responsibility to their investors, whereas government entities have responsibility to conduct activities for the betterment of society. So while the sustainability of the industry and its activities is in the best interest of all stakeholders, discrepancies in ethical standards which arise from individual stakeholder strategies and policies shall need to be addressed.

In the space industry, recent non-governmental human space activities and proposals have often been perceived as less risk-averse, and brings forth ethical questions regarding what is ethical for an individual, and its wider implications for the industry. This recent proliferation of commercial players in the space industry, in what is termed as “new space,” has adopted many of the principles and ethos of Silicon Valley. For business and operational strategies, new approaches such as lean methodology and vertical integration are already proving early success with companies such as SpaceX, which was once considered high-risk. But when applied to human space flight, the business strategies of proposals such as a one-way human mission to Mars may not adequately reduce the risk to human life. Although many of these high-risk proposals have volunteer spaceflight participants, there are wider ethical implications for the progress of the industry which need to be considered.

Many of the new proposals are exploratory in nature, and are therefore risky by definition. No attempt, however, is made in this report to distinguish between exploration and the non-exploration/routine, or to justify a threshold of risk which is deemed ethically acceptable. But as with basic human rights, there should be a minimum internationally agreed-upon ethical standard for human spaceflight activities.

##### **IV.2. Role of the International Community**

The international community is responsible to address ethical issues that will arise in new human exploration strategies. To deal with such ethical issues, it is proposed that entities pursuing human spaceflight initiatives must follow a set of ethical guidelines regarding their proposals. These will be reviewed by an UN-established ethics board, who will make public recommendations.

The ethical board could address typical questions, which can be grouped into four categories (Suborbital, Low Earth Orbit, Beyond LEO, One-way missions). The questions may not relevant for all types of missions, but can be used as guidelines.



- Suborbital: Pilot experience and training; Evaluation of health risk; Scientific and flight data transparency.
- Earth orbit: Level of spaceflight participant training; Staff welfare; Pre-flight health evaluation; Risk assessment; Contingency plan (in orbit and during launch and landing operations); Passenger security.
- Beyond LEO: Death of passenger or crew; Major illness or injury; Medical facilities on-board; Privacy questions including the right to get information from ground; Physical care; Planetary protection; Property rights; Policy on scientific discoveries; Utilisation and exploitation of space resources; Outer space rescue obligations; Mission objectives vs. risk.
- One-way missions: Change of participation wish of crew-member; Responsibility for new-borns; Reasonable life expectancy; Burial plans; Responsibility for re-supply.

## **V. Recommendations**

This section will provide a brief overview of all recommendations by the working group, on the topics of ethics of long duration spaceflight, current policies and future long-term policies. The following are the recommendations made by the SGC 2014 exploration work group.

### **V.1. Ethics**

- Establishment of an ethical review board by the UNCOPUOS to review human spaceflight proposals.
- Consideration of mission specific ethical issues by all entities pursuing human spaceflight initiatives.
- Sharing of ethical review board recommendations with the public.

### **V.2. Policy**

- Use of the Multilateral ISS Agreement as a model for cooperation and accessibility agreements in future multi-party missions.
- Countries to adopt risk-sharing policies, similar to the US Launch Indemnification Policy, to share liability and reward in multi-party missions.
- Development of guidelines by the UN to be followed for different classes of space missions as outlined in section III.7.
- Extension of the UNESCO World Heritage sites to outer space and development of stricter planetary protection policies with future classes of missions in mind.
- Extension of the jurisdiction of The International Court of Justice to international space legal issues.
- Creation of a Space Science committee and Space Ethics Committee at the UNCOPUOS to support the International Court of Justice in the review of space legal cases and to review mission proposals.

- Involvement of the UNCOPUOS Technical, Legal, Ethics and Science Committees in space related cases presented at the International Court of Justice, determination of UNESCO World Heritage sites in outer space and development of guidelines mentioned above.

## **VI. Conclusions**

The Space Generation Congress Human Exploration and Ethics work group discussed key issues regarding current policy for the future of manned space exploration. The focus was on current space policies, long-term strategies for space exploration policy, and the ethics of space exploration.

These discussions addressed current policies and how it applies to the developing space sector, which now has both commercial and state entities. Recommendations on the long-term strategy for space exploration policy were made covering the role of government and commercial initiatives, the extent of regulations, liability and accountability of commercial and state entities, ownership of scientific resources or achievements, international regulations, and the dependence of policies on mission types.

The ethics of space exploration were also discussed, addressing the importance of ethics of space exploration, and the role of the international community in addressing ethical issues.

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