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Committee on the Peaceful Uses of Outer Space

Report on the United Nations Expert Meeting on Human Space Technology on the theme "Providing access to space"

(Vienna, 4–6 December 2018)

I. Introduction

1. The United Nations Expert Meeting on Human Space Technology on the theme "Providing access to space" was held in Vienna from 4 to 6 December 2018. The Expert Meeting was part of the Human Space Technology Initiative (HSTI), which is implemented by the Office for Outer Space Affairs of the Secretariat within the framework of the United Nations Programme on Space Applications (see www.unoosa.org/oosa/en/ourwork/psa/hsti/index.html).

2. The Expert Meeting was organized and hosted by the Office for Outer Space Affairs, supported by the China Manned Space Agency (CMSA) and the Japan Aerospace Exploration Agency (JAXA), and attended by senior experts, professionals and decision makers from national and regional space agencies, research institutes, academia, industry and the private sector, as well as regional and international organizations.

3. The Expert Meeting was the eighth event held within the framework of HSTI and the first event of its kind to be organized pursuant to the recommendation of the Committee on the Peaceful Uses of Outer Space at its sixtieth session that the Office for Outer Space Affairs should pursue greater engagement with industry and private sector entities so that they can support and contribute to the overall work of the Office.

4. The present report contains a description of the background, objectives and programme of the Expert Meeting, and provides a summary of the observations and recommendations made by the participants. It has been prepared for consideration by the Committee on the Peaceful Uses of Outer Space at its sixty-second session and its Scientific and Technical Subcommittee at its fifty-sixth session, both to be held in 2019.

A. Background and objectives

5. The Committee on the Peaceful Uses of Outer Space and its Scientific and Technical Subcommittee and Legal Subcommittee were established contemporaneously with the launch of Sputnik I in 1957, and the first human space flight by Yuri Gagarin in 1961, to promote international cooperation in the peaceful uses of outer space.

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6. The Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III), held in 1999, recognized that large human space exploration missions exceeded the capacity of a single country, and therefore recommended the development of future space science programmes through international cooperation. One year later, in 2000, the first long-duration crew went on board the International Space Station (ISS). In 2009, ISS attained full crew capability of six astronauts.

7. In 2010, the Office for Outer Space Affairs launched HSTI to promote international cooperation in human space flight and space exploration-related activities, create awareness among countries of the benefits of utilizing human space technology and its applications, and build capacity in microgravity education and research.

8. Within the framework of HSTI, a series of events and activities have been carried out, including outreach seminars, expert meetings and workshops on human space technology, in which it has been acknowledged that human space exploration can be regarded as a common goal of humanity to unite the world and that all countries, in particular emerging countries, should be encouraged to become involved in human space exploration-related activities and to derive benefits from its outcomes.

9. Moreover, the Office for Outer Space Affairs has been carrying out a number of substantial projects in cooperation with spacefaring nations, thereby providing opportunities for Member States to physically gain access to space by means of a wide range of modalities, including space experiments, space flights and small satellites, thus continuing to bring the benefits of human space technology to humanity, while taking into account the particular needs of developing countries.

10. Building on the progress made within the framework of HSTI, the Expert Meeting was aimed at providing optimal opportunities for access to space through the achievement of the following meeting objectives:

(a) To exchange information on the latest developments and future plans relating to human space flight, space exploration and their commercial applications;

(b) To exchange information on progress made, achievements, lessons learned and potential improvements in relation to past and ongoing cooperation projects within the framework of HSTI;

(c) To increase awareness of the benefits of human space technology and its multiple applications, including their important role in achieving the Sustainable Development Goals;

(d) To strengthen capacity in relation to scientific research, experiments, payload development and space education, as well as small satellites, utilizing space and ground facilities and space environment and microgravity conditions;

(e) To identify new and potential opportunities for newly spacefaring countries and emerging countries, as well as for industry and the private sector, to participate in activities within the framework of HSTI;

(f) To discuss and solicit recommendations on how to further provide access to space within the framework of HSTI and on the way forward in international cooperation on potential activities.

11. The Expert Meeting was advertised and promoted on the website of the Office for Outer Space Affairs (www.unoosa.org), through permanent missions of Member States in Vienna and on social media platforms such as Facebook and Twitter.

B. Attendance

12. Preparations for the Expert Meeting, including the selection of participants, were carried out by a programme committee and an organizing committee composed of selected experts and officials from the Office for Outer Space Affairs. The

participants were selected on the basis of the relevance of their background and their experience in the development, promotion and implementation of the use of human space technology and its applications.

13. The Expert Meeting was attended by more than 73 participants, 28 per cent of whom were women. The following 35 Member States were represented: Australia, Austria, Bulgaria, Canada, China, Colombia, Costa Rica, Czechia, Dominica, Germany, Guatemala, India, Iran (Islamic Republic of), Iraq, Italy, Japan, Jordan, Kenya, Mauritius, Mexico, Myanmar, Netherlands, Nigeria, Norway, Pakistan, Peru, Poland, Russian Federation, Saudi Arabia, Singapore, Spain, Turkey, Ukraine, United Kingdom of Great Britain and Northern Ireland and United States of America.

14. Funds provided by the United Nations, CMSA and JAXA were used to defray the costs of air travel and to provide daily subsistence allowance for 23 of the participants. Hospitality was provided to all participants, the cost of which was defrayed from the funds provided to the Office of Outer Space Affairs by CMSA.

II. Programme

15. The programme of the Expert Meeting consisted of an opening session, a keynote session, four plenary technical sessions, two poster sessions, two breakout sessions, a special session and a closing plenary session for discussing and endorsing observations and recommendations resulting from the breakout sessions, which was followed by closing remarks by the organizer.

16. The plenary sessions and poster sessions were designed to facilitate the exchange of information on the latest developments and plans in the areas of human space flight and space exploration and their applications, as well as on the progress made, achievements, lessons learned and potential improvements in relation to past and ongoing cooperation projects within the framework of HSTI.

17. The keynote session was designed as an opportunity for the Office for Outer Space Affairs to brief participants on its Access to Space for All initiative, which was built largely on the outcomes of HSTI. At the special session, the Office for Outer Space Affairs and Airbus Defence and Space GmbH would announce a call for interest in utilizing the Airbus Bartolomeo facility, which would be attached to the Columbus module of ISS and was expected to provide opportunities for Member States to conduct space experiments and technology demonstrations.

18. The breakout sessions were devised as a forum to discuss and consolidate observations and recommendations by participants with a view to identifying potential opportunities and necessary improvements for newly spacefaring countries and emerging countries, as well as industry and the private sector, to participate in human space activities.

19. Sections A to G below provide summaries of the various sessions. Observations and recommendations are presented in section III.

A. Opening session

20. At the opening session, the Chief of the Space Applications Section of the Office for Outer Space Affairs welcomed participants to the Expert Meeting, extending gratitude to them for their active engagement in and continued support for the work of the Office. He recalled the reasons for the establishment of HSTI, emphasized the importance of strengthening its role as a meaningful platform to promote international cooperation and capacity-building in human space-related activities, and expressed the hope that discussions would lead to a successful outcome.

B. Keynote session

21. The representative of the Director of the Office for Outer Space Affairs gave a presentation on the Access to Space for All initiative, which provides opportunities in the areas of access to orbital facilities, satellite development, ground-based microgravity and hypergravity facilities, scientific data on space experiments and activities, space data on Earth observation and disaster risk reduction. Opportunities to expand the Access to Space for All portfolio through potential collaboration with a number of stakeholders from across the space sector and the plan to release a publication dedicated to the initiative in 2019 were also highlighted.

C. Plenary technical sessions

22. Plenary technical sessions were held on the following topics: (a) national and international space activities; (b) space- and ground-based facilities and their utilization; (c) small satellite-related capacity-building activities; and (d) human space and other capacity-building activities.

1. National and international space activities

23. This session on national and international space activities was designed for participants to report on progress and achievements on their human space-related activities at the national and international levels. The representative of the Office for Outer Space Affairs opened the session, providing detailed information about the overall work of the Office, events and activities under HSTI and the substantial achievements in providing opportunities for Member States to gain access to space.

24. Representatives from CMSA, JAXA, the Asociación Astronáutica Colombiana and the United Nations Children's Fund shared information about their ongoing human space technology-related activities and projects in capacity-building for access to space, and recalled the importance of space as a source of inspiration and fraternity among nations, contributing to international collaboration.

2. Space- and ground-based facilities and their utilization

25. The goal of the session on space- and ground-based facilities and their utilization was to exchange information on existing international cooperation initiatives and to propose, identify and discuss new and potential opportunities. Participants discussed their achievements relating to past and ongoing projects in the context of opportunities provided by the Office for Outer Space Affairs within the framework of HSTI, including the utilization of the China Space Station, the Dream Chaser of the Sierra Nevada Corporation, the Zero Gravity Instrument Distribution Project and the drop tower at ZARM in Bremen, Germany.

26. Information about new opportunities, including the utilization of the Bartolomeo platform of Airbus Defence and Space GmbH, the large diameter centrifuge of the European Space Research and Technology Centre, the multiple facilities of the Space Institute of Southern China and the first Latin American suborbital mission, "ESAA-01", was presented. Comprehensive analysis on utilizing different types of simulated microgravity devices and progress on constructing and using homemade clinostats was also presented.

27. The need to expand international cooperation among different entities, such as space agencies, universities and research institutes and private companies, was emphasized during the half-hour discussion. It was proposed – and generally agreed – that the Office for Outer Space Affairs should play a major facilitating role in such cooperation.

3. Small satellite-related capacity-building activities

28. The purpose of the session on small satellite-related capacity-building activities was to exchange information on small satellite projects, either within the framework of the United Nations/Japan Cooperation Programme on CubeSat deployment from ISS Japanese Kibo Experiment Module (KiboCUBE) or in the context of the national development strategies of the presenting countries.

29. Participants from Kenya, Guatemala and Mauritius gave presentations on progress in the development and deployment of their first small satellite projects under KiboCUBE, as well as on their next steps relating to small satellites and education. Participants from Costa Rica explained that in 2018 their country had deployed its own small satellite – for the first time in its history – from the Japanese Kibo Module of ISS in bilateral cooperation with JAXA, and they also spoke about national plans for the future in that regard. Participants from Myanmar described the history of Myanmar space exploration and future plans relating to small satellites. Representatives from Pakistan shared their experiences in using low-cost facilities for small satellite development and technical education.

30. The presentations made at the session demonstrated that KiboCUBE had provided tangible opportunities for some developing countries to enter into space development for the first time, and those countries were highly motivated to take the next steps by themselves. The recommendation to form a regional CubeSat team in Latin America, proposed by the presenter from Guatemala, was an example of that motivation.

4. Human space and other capacity-building activities

31. The session on human space and other capacity-building activities provided opportunities for participants to share their practices, experiences and views on international cooperation, space programme development, long-term human space missions, commercial space missions, habitats for humans on other planets and space law-related matters. The participant from the Netherlands made a presentation on Europe's experience in utilizing ISS and provided an overview of the development of the space programme of China, as well as emphasizing the importance of international cooperation and the need to define long-term goals with regard to space programme development.

32. The participant from Kyoto University highlighted the university's educational and research programme on human spaceology, that is, the study of human space activities, the aim of which was to provide young scholars with a high level of expertise and a long-term vision regarding the possibility of establishing a space society on other planets. The participant from CEPT University, India, introduced a multi-level educational framework aimed at building capacity, and provided details relating to its purposes, as well as to resources, curriculum development, education methodology, topics covered and impacts at different levels. The participant from the Costa Rica Institute of Technology highlighted the evolution of the space programme in Costa Rica and the advantages that the unique biodiversity of the country provided for experiments.

33. The effects of long-term space missions on humans and the importance of strong mental preparedness for such missions were stressed by the participant from the Universidad de Ciencias y Humanidades, Peru. The correlation between appropriate nutrition and the psychological situation of people adapting to harsh environments was explained by the participant from the University of Oslo. The presenter from the University of Bremen introduced plans for the design of habitats for humans on Mars and the Moon, including the challenge of protecting astronauts from space radiation.

34. The participant representing the China Aerospace Science and Technology Consulting Company, Ltd., focused attention on the prospects for and value of commercial cooperation in low Earth orbit, especially in terms of possibilities for commercial utilization through payloads, transportation and space tourism, and

stressed that it was necessary to abide by international space law, using space for peaceful purposes and making human space flight more accessible.

35. The obstacles to transporting more people to space, including the cost of missions and the limited budgets of national agencies, were stressed by the presenter from the Space Generation Advisory Council. The participant representing McGill University, Canada, stressed the importance of updating the current space law treaties with a view to governing private spacecraft and private space travellers. The view was expressed that it was important to include human rights considerations in international space law.

D. Poster sessions

36. Poster presentations were made by seven participants from Austria, Germany, Iran (Islamic Republic of), Mexico, Myanmar, Spain and the United Kingdom. The posters were presented during two coffee breaks over two days. They covered capacity-building, scientific and technological research on space exploration and adaptation to space missions, effects on microgravity conditions, the utilization of space facilities for experiment and Earth observation, and small satellite activities.

E. Special session

37. The Office for Outer Space Affairs had been partnering with Airbus Defence and Space GmbH in order to offer States Members of the United Nations the opportunity to accommodate a payload on the Airbus Bartolomeo external platform on ISS. The mission would be open to all Member States, and developing countries in particular were encouraged to participate. The platform would accommodate and operate payloads provided by institutions in participating countries.

38. The special session was specifically designed for the Office for Outer Space Affairs and Airbus to open the call for interest in utilizing the Airbus Bartolomeo platform. Representatives of Airbus and the Office provided a summary of the proposed mission opportunity and announced the call for soliciting information from Member State entities interested in providing payloads that could be flown on that mission. The call for interest included the objective of gathering information on the interested countries for the sake of better understanding the demand for that type of mission.

F. Breakout sessions

39. Two breakout sessions, on the themes “HSTI lessons learned, benefits and improvements” and “Current and future needs on access to space”, were conducted twice, in parallel, in order to provide enough time for all participants to engage in discussions, exchange information on lessons learned, discuss observations and propose suggestions and recommendations.

40. The aim of the first breakout session was to gather lessons learned that could help others, to share the benefits that the HSTI programmes generated and to make suggestions and recommendations for improvements at both the participant and Office levels.

41. The aim of the second breakout session was to brainstorm on needs relating to access to space from the perspective of current and future applicants, in the context of HSTI activities and linked to institutional or country priorities that could be supported by such activities.

42. Participants attended the breakout sessions of their own accord. The moderators steered the discussion through participatory questions. Observations and

recommendations were captured and summarized by the rapporteurs and endorsed by the participants.

G. Plenary summary session

43. During the plenary summary session, the observations and recommendations resulting from the breakout sessions were presented to, shared with and further discussed by all participants, resulting in final observations and recommendations (see sect. III below).

III. Observations and recommendations

44. Participants at the Expert Meeting expressed their appreciation for the fruitful information exchange at the Meeting on a range of subjects that were important for the advancement of human space technology and its applications. At the final session, participants reached agreement on the observations and recommendations set out below, which will pave the way for further activities.

A. Observations

45. Access to space is a matter of opportunity and a matter of survival for humankind, and it is important for developing countries to be independent and autonomous in this regard. It was generally agreed that developing countries needed access to space, owing to the fact that it was becoming a significant global economic sector and could contribute to the attainment of the Sustainable Development Goals. Access was also a matter of national priority, as it helped such countries to develop niche activities, stimulated innovation and served as a source of inspiration.

46. It was observed that ground-based infrastructure could support microgravity-related experiments, while in-orbit experiments utilizing space facilities were desirable. It was recognized that countries were benefiting from the access to space programmes provided by the Office for Outer Space Affairs under HSTI. It was also observed that with the help of HSTI, countries had increased opportunities to go directly into space to conduct their experiments. Meanwhile, the view was expressed that there were gaps to be covered by HSTI, in particular parabolic flights and sounding rockets.

47. KiboCUBE was a successful example of an international cooperation programme under HSTI, through which a number of space emerging countries had embarked on space development activities, and positive results had been achieved by participants in the programme. Sincere gratitude was extended by participants to JAXA for the opportunities provided through the programme.

48. It was observed that United Nations/China cooperation on the utilization of the China Space Station was a forward-looking initiative that provided Member States with opportunities to fly their scientific experiments on board the station. It was noted that interesting projects, in which high school students had been involved, had been conducted at the drop tower at ZARM.

49. It was also observed that ISS was currently operating at the governmental level and would continue to do so until 2024. One of the possible scenarios after 2024 would be for ISS to be operated jointly by Governments and industry. The view was expressed that the United Nations, represented by the Office for Outer Space Affairs, could play a role in the coordination of ISS operations, in cooperation with, and with support from, its Member States.

50. The view was expressed that if those who had benefited by participating in HSTI activities spoke up and shared their experiences with the Governments of the HSTI

partner entities collaborating with the Office for Outer Space Affairs, it would greatly help increase and maintain government support for the partner entities.

51. It was mentioned that the localization of space capabilities in developing countries was important. In order to increase awareness of user needs in developing countries in the area of capacity-building and to share available space solutions, an efficient platform or mechanism (for example, the Space Solutions Compendium) for raising awareness was deemed necessary.

52. Some participants expressed the view that human rights-related topics should be included in the programme of future events of the Office.

B. Recommendations

53. It was suggested that annual events continue to be held under HSTI, given that such events provided an excellent platform for stakeholders to exchange information on substantial projects and identify new cooperation initiatives in access to space. It was recommended that more countries, in particular those from South-East Asia, Latin America and the Caribbean and Africa, be encouraged to participate and/or co-organize such events. It was suggested that the presence of the media and journalists at such United Nations events, including those on HSTI, be encouraged. In order to make it easier to hold such events, it was suggested that OOSA collaborate with space entities at the agency level. Online events could be also considered.

54. In the light of the gaps identified during the discussions, it was suggested that the Office for Outer Space Affairs further foster HSTI projects by increasing opportunities in access to space, including moving forward to the space exploration area. To that end, the following activities were recommended: fostering and providing opportunities for selecting, training and flying international astronauts on board the China Space Station; utilizing hypergravity experiment facilities; distributing experiments at schools, especially for young children; utilizing parabolic flights and sounding rockets for microgravity experiments; deploying and launching small satellites through the China Space Station and private launchers; creating microbiology platform and CubeSat missions beyond the Van Allen radiation belt; opening a call for landing sites in developing countries under United Nations/Sierra Nevada Corporation cooperation on the utilization of the Dream Chaser.

55. It was recommended that the Office for Outer Space Affairs write reports on HSTI projects and activities and share them with Member States in order to raise awareness of HSTI and to share lessons learned, in which regard a report on the KiboCUBE project would be a good start. It was also recommended that the Office create a platform or network to collect and share user needs and solutions (for example, the Space Solutions Compendium), including access to data from microgravity experiments and course materials for outreach and awareness-raising, and that the Office share its previous experiences in such areas as fundraising and effective outreach activities with a view to benefiting countries in need.

56. It was recommended that a curriculum on human space activities be developed to help universities and regional centres on space science and technology education, affiliated to the United Nations, in their educational activities. Curriculums had to be maintained and kept up to date with the latest developments in technology and applications. To that end, an international expert group for developing the curriculum might be necessary. Such a curriculum would also contribute to exerting the leading role of the regional centres in promoting human space technology activities and in solving regional problems.

57. It was suggested that training opportunities on human space technology be provided for developing countries, in which regard technical training sessions on how to make good proposals on space experiments and how to prepare for experiments for readiness to fly on board a space station would be a good start. It was further

recommended that mentors and qualified volunteers be involved in preparing such proposals by applicants.

58. It was emphasized that education was the first step for developing countries in gaining access to space, and thus it was proposed to enhance space education activities and to ensure its continuity by concentrating on targeting the right group and the right generation and by focusing on students through practical education. It was also recommended that more outreach activities be carried out to inspire younger generations. Such activities could be implemented by cooperating more closely with the Space Generation Advisory Council (SGAC) and taking advantage of its huge global network. It was suggested that international cooperation among universities be enhanced with a view to providing opportunities to support students for space development, engineering, satellite designs, et cetera, taking as an example the University Space Engineering Consortium (UNISEC-Global).

59. In order to increase opportunities for developing countries to gain access to space, public-private partnerships should be encouraged in private commercial spaceflights and activities. It was recommended that HSTI activities be linked together in a chain with a view to providing continuous or successive opportunities to capture good candidates. It was also recommended that opportunities for cooperation be promoted, including announcements of opportunities and United Nations events, through influential media, including the BBC and CNN, in addition to social media.

IV. Conclusions

60. The United Nations Expert Meeting on Human Space Technology was held as a follow-up to the United Nations/Costa Rica Workshop on Human Space Technology held in 2016, with the intention of exchanging information and views on access to space by utilizing human space technology and its applications and identifying additional opportunities and approaches for further steps. The Expert Meeting was also aimed at engaging the private sector in activities to promote international cooperation in microgravity science, capacity-building and education, and human space exploration.

61. Building on previous achievements made through the platform of HSTI, the Expert Meeting showed that human space exploration and its related activities have become truly global undertakings and that human space exploration can be regarded as a common goal of humanity that can unite the world. HSTI has been bringing the benefits of human space activities to all and bringing nations together around that endeavour by providing access to space and creating new opportunities for international cooperation.