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Report on the United Nations/United Arab Emirates/International Astronautical Federation Workshop on Space Technology for Socioeconomic Benefits: "Space exploration: a source of inspiration, innovation and discovery"

(Dubai, United Arab Emirates, 22–24 October 2021)

I. Introduction

1. The Office for Outer Space Affairs of the Secretariat, the Government of the United Arab Emirates and the International Astronautical Federation (IAF) jointly organized the United Nations/United Arab Emirates/IAF Workshop on Space Technology for Socioeconomic Benefits, on the theme "Space exploration: a source of inspiration, innovation and discovery". The Workshop is one of the long-standing activities of the Office and is held in the three days prior to the start of the International Astronautical Congress (IAC). Thanks to the collaboration with IAF, the Workshop offers sponsored participants the possibility of attending the Congress.

2. The Workshop has traditionally aimed at providing emerging space nations with capacity-building opportunities in using space science, technologies and applications for space exploration in support of sustainable economic, social and environmental development. The 2021 Workshop was the twenty-eighth in the series and was organized as part of the education component of the space exploration track of the Access to Space for All initiative.

3. The present report contains a description of the background, objectives and programme of activities of the Workshop, as well as its various segments. It also contains recommendations stemming from the discussions held during the event.

II. Background and objectives

4. The previous 27 Workshops were focused on innovative themes, with a view to responding to societal needs, and showcased the socioeconomic benefits of space in a wide range of subject areas, enabling cooperation and interaction for more than 2,000 participants from different backgrounds.

5. In 2020, the series of workshops was interrupted owing to the coronavirus disease (COVID-19) pandemic. The previous workshop in the series was held in 2019, in Washington, D.C., on the theme "Ensuring inclusiveness through space-based

applications and space exploration", and participants discussed, among other matters, initiatives aimed at lowering the entry barriers to space exploration, including through the standardization of space exploration systems and international cooperation (see A/AC.105/1218). The 2021 Workshop expanded on the discussions of the previous one and had the following objectives:

(a) Raise awareness of international and national entities, space agencies and industry and civil society activities related to space exploration;

(b) Raise awareness of planetary protection concepts and guidelines;

(c) Raise awareness of capacity-building efforts relating to space exploration and discuss synergies and common areas of work;

(d) Promote and discuss inclusiveness in space exploration;

(e) Raise awareness of the efforts of the international space community relating to how space exploration and innovations can trigger inclusiveness through new partnerships involving emerging space nations and industries;

(f) Bring together policymakers, decision makers and the research and academic communities to help integrate space into policy and the decision-making process.

6. To achieve those objectives, the Workshop was organized as a mixture of presentations, a keynote speech, a panel discussion and breakout group discussions, which allowed the participants to express their views in various manners, contributing to lively discussions that extended into coffee breaks, thus also facilitating networking.

III. Attendance

7. The Workshop was attended by 90 participants, including 41 women. After the Workshop, the participants received an evaluation questionnaire and gave the event an average rating of 4.7 out of 5.

8. The participants included representatives of the following 20 space agencies: Algerian Space Agency, Angolan National Space Programme Management Office, Bolivarian Agency for Space Activities, Bolivian Space Agency, Brazilian Space Agency, Costa Rican Space Agency, Egyptian Space Agency, Ethiopian Space Science and Technology Institute, European Space Agency (ESA), Geo-Informatics and Space Technology Development Agency of Thailand, Italian Space Agency, Japan Aerospace Exploration Agency (JAXA), Kenya Space Agency, Korea Aerospace Research Institute, Mexican Space Agency, Mohammed Bin Rashid Space Centre, National Space Science Agency of Bahrain, Paraguay Space Agency, Portugal Space and South African National Space Agency. The International Space Exploration Coordination Group was also represented at the sessions and worked together with the Office for Outer Space Affairs to raise awareness of the Workshop and in the definition of one of the breakout scenarios.

9. The following countries were represented at the Workshop: Algeria, Angola, Austria, Bahrain, Belgium, Bolivia (Plurinational State of), Botswana, Brazil, Cameroon, Canada, Chile, Colombia, Costa Rica, Egypt, El Salvador, Ethiopia, France, Germany, Greece, Guatemala, India, Ireland, Italy, Japan, Kenya, Mauritius, Mexico, Nepal, Netherlands, Nigeria, Pakistan, Paraguay, Philippines, Portugal, Republic of Korea, Russian Federation, Sierra Leone, South Africa, Sweden, Switzerland, Thailand, Tunisia, United Arab Emirates, United Kingdom of Great Britain and Northern Ireland, United States of America, Venezuela (Bolivarian Republic of) and Zimbabwe.

IV. Programme of activities

10. The programme was structured around three sessions. Session 1 was entitled "Space exploration for all" and comprised three segments, on the national and international perspective, the industry perspective and the civil society perspective. Session 2 was devoted to the theme "Capacity-building for space exploration". Session 3, a panel discussion on opportunities for emerging space countries to join efforts in space exploration, was attended by heads of space agencies and Chairs of international panels. Prior to those three sessions, an opening ceremony was held, followed by a keynote speech and presentations by different members of the programme committee to set the scene. The Workshop was concluded with a closing ceremony involving representatives of the organizers at the highest level. In addition, for the breakout discussions between sessions 2 and 3, attendees were divided into four groups to discuss different scenarios related to the topic of the Workshop.

A. Opening ceremony

11. In her opening remarks, the Director of the Office for Outer Space Affairs highlighted the importance of space exploration and focused on inclusiveness and diversity, stressing the role of the Access to Space for All initiative, which facilitated opportunities through three tracks, namely, the hypergravity and microgravity track, the satellite development track, and the track most relevant to the Workshop, the space exploration track.

12. The Director of the Office also stressed the importance of the sustainability of outer space activities and the need for a collective approach to tackle sustainability challenges in order to avoid the worst-case scenario, in which even entire orbits would be rendered unusable for decades. She noted that multilateralism was at the core of the United Nations system and that outer space was one of the top priorities on the political agenda of the Secretary-General, placing the outer space dialogue among the high-level tracks of the Summit of the Future, to be held in September 2023.

13. The President of IAF highlighted the importance of the collaboration with the Office, which had made it possible to bring forward and discuss the relevance of space technology for socioeconomic benefits and to explore very diverse topics. The Workshops were organized back to back with IAC, which brought together several thousand attendees every year to discuss a range of topics, from technical to policy-related issues. The theme of IAC in 2021, "Inspire, innovate and discover for the benefit of humankind", was very much in line with the topic of the Workshop.

14. The Deputy Director General and Executive Director of the Mohammed Bin Rashid Space Centre welcomed the participants to the Workshop and gave an overview of the activities carried out at the Centre, highlighting the importance of space for the United Arab Emirates, which has a vision for space exploration to build a permanent settlement on Mars by 2117.

B. Keynote speech

15. The opening ceremony was followed by a keynote speech entitled "The importance of space in society", held on behalf of the Secretary General for Telecommunications and Post of Greece, who presented the wider context of space in Europe, including three flagship projects of the European Commission, namely, European Union drone technologies, the European Union strategy for space traffic management and the European Union space-based global secure communications system. In addition, concerning connectivity, the speaker presented the European Quantum Communication Infrastructure initiative, aimed at building secure quantum communication infrastructure serving States members of the European Union.

16. The keynote speech also focused on national activities related to the "GreeConnect" architecture, which is based on ongoing discussions concerning the European secure connectivity initiative and blends satellite and terrestrial connectivity. The speaker also presented the Greek digital transformation strategy, aimed at ensuring connectivity anytime, anywhere, with the support of ground, wireless and satellite infrastructure.

C. Setting the scene

17. The "setting the scene" segment included presentations by programme committee members from the Office for Outer Space Affairs, IAF, the Mohammed Bin Rashid Space Centre, the IAF Committee for Liaison with International Organizations and Developing Nations, the IAF Committee on Developing Countries and Emerging Communities and the IAF Space Exploration Committee, and by the International Space Exploration Coordination Group.

18. A representative of the Office presented the agenda for the Workshop, together with the objectives and the connection with the activities carried out by the Office, in particular with the Access to Space for All initiative. The Office also expected to gather recommendations on how to improve the initiative with regard to the space exploration track.

19. The Executive Director of IAF emphasized the importance of the Workshop for developing countries and its connection to IAC, where different aspects of space exploration were covered. The presentation also highlighted the importance of face-to-face networking and the outcomes of the Global Space Exploration Conference held in person in Moscow in June 2021.

20. The representative of the Mohammed Bin Rashid Space Centre described the United Arab Emirates space programme, which was composed of several pillars:

(a) A satellite development programme, which had led to the development of indigenous capability and Earth observation satellites developed completely by engineers from the United Arab Emirates;

(b) The Emirates Mars Mission (Hope Probe), which had successfully entered Martian orbit in February 2021, with a view to studying the Martian atmosphere;

(c) The Mars 2117 project, with the objective of establishing a lasting colony on Mars by 2117. The preparatory work was based on research and development, collaboration, education and enabling activities with academia and industry. The alignment of Mars 2117 with the Global Exploration Roadmap was also presented. Other enabling activities for Mars 2117 included the Emirates Lunar Mission, the United Arab Emirates Analogue Programme, Mars Science City, the Space Ventures initiative and efforts relating to space sustainability, such as the World Space Sustainability Association;

(d) The United Arab Emirates Astronaut Programme, which had recently announced the first Arab female astronaut and incorporated two new astronauts into the Emirates astronaut corps.

21. The representative of the IAF Committee for Liaison with International Organizations and Developing Nations explained the work of the Committee and its role in providing advice to the President of IAF, in particular on opportunities to foster international cooperation in space programmes and relations with international organizations. Every year, the Committee works together with the Office for Outer Space Affairs in the preparation of the Workshop.

22. The representative of the IAF Committee on Developing Countries and Emerging Communities explained its close ties with the IAF Committee for Liaison with International Organizations and Developing Nations. However, in contrast to the latter Committee, the Committee on Developing Countries and Emerging

Communities focused on promoting the participation of developing countries and emerging nations in IAF activities. He explained that the Committee provided knowledge and expertise to support those countries and nations, aiming at tangible benefits. Moreover, the Committee acted through interventions of a different nature. Its successes included the meeting of heads of emerging agencies, held on the margins of IAC, and its involvement in the Global Conference on Space for Emerging Countries to be held in Quito in 2022.

23. The representative of the IAF Space Exploration Committee presented the drivers making space exploration a commercial endeavour, such as the reduction of costs and the attractiveness of being associated with or co-branding space exploration activities for investors. A comparison between the budgets of space agencies and the advertising budgets of private companies was presented, showing that in some cases the advertising budgets of individual companies were larger than the budgets of entire space agencies. The speaker mentioned that although Governments and national agencies were still the main drivers, there was a trend towards partnering with private industry and the privatization of space activities.

24. The presentation by the International Space Exploration Coordination Group included a description of the activities of the Group, which was set up in 2007 by 14 space agencies to advance the Global Exploration Strategy through the coordination of their mutual efforts in space exploration. At the time of the presentation, the Group was composed of 27 space agencies, of which 13 had joined the group in the past three years, showing the increased interest in space exploration. Currently the Group was chaired by the Canadian Space Agency. The Group regularly published the Global Exploration Roadmap, with the most recent edition dating from 2018 and reflecting a coordinated international effort to prepare for space exploration missions. In August 2020, the Group had published the Global Exploration Map Supplement, which contained an update to the Lunar Surface Exploration Scenario. To engage emerging agencies in space exploration and contribute to the formulation of the Global Exploration Roadmap and other outputs of the Group, the Emerging Space Agencies Working Group had been established in April 2021 as a permanent working group within the International Space Exploration Coordination Group.

25. The presentations conveyed to the audience not only the objectives of the Workshop, but also a global vision of space exploration activities to be considered in the discussions during the event.

26. It is important to note that, owing to the COVID-19 pandemic, it was necessary to readjust the programme on site and the timing of some presentations did not correspond to their thematic allocation. The summary provided below is organized not chronologically, but by theme. It is also worth noting that the sections below contain summaries of the key aspects, observations and recommendations from the presentations. The final programme, including the final chronology of events and the associated presentations, is available on the website of the Office for Outer Space Affairs.

D. Session 1a: Space exploration for all – the national and international perspective

27. This segment was devoted to the national and international perspective on space exploration and included presentations by space agencies or government entities leading space-related activities in their respective countries.

28. The speaker from the Bolivarian Agency for Space Activities presented national efforts in the Bolivarian Republic of Venezuela with regard to space exploration and integration with Latin America and the Caribbean. She also presented the structure and different programmes of her organization and how its national and international relationships were structured, and she noted that her country was a party to the convention establishing the Latin American and Caribbean Space Agency.

29. The speaker from the Bolivian Space Agency described the organization of the space programme in the Plurinational State of Bolivia with a presentation entitled “A decade after entering space”. He described the mission, vision and strategic goals of his organization, including social programmes and benefits stemming from space activities.

30. The speaker from the Brazilian Space Agency described the national space programme of Brazil, focusing on the impact of space exploration activities on the Alcântara region and the development plans for that region, with an emphasis on collaboration with the private sector, the development of local infrastructure and awareness-raising. He also noted that his organization welcomed collaborations.

31. The speaker from the Board of the Costa Rican Space Agency presented the economic evolution of Costa Rica in terms of exports and how the country had become an exporter of technology. The Costa Rica Aerospace Cluster had been created in 2016 and, in 2021, the Costa Rican Space Agency had been established with the objective of catalysing space activities, promoting existing infrastructure and fostering local development by capitalizing on existing activities and resources. Research teams from Costa Rica had taken part in several opportunities offered by the Office for Outer Space Affairs, in particular in the provision of clinostats through the Zero-Gravity Instrument Project, the Drop Tower Experiment Series and the International Space Station Japanese Experiment Module (Kibo), known as “KiboCUBE”, which had contributed to the development of the space sector. The speaker invited cooperation, collaboration and funding.

32. The speaker from the Paraguay Space Agency introduced the organization of the space programme in Paraguay with a presentation entitled “Socioeconomic benefits of aerospace development from an emerging country perspective: the case of Paraguay”. He highlighted national challenges arising from climate change, flooding and fires during the COVID-19 pandemic. Despite those difficulties, the country had been able to put its first satellite into orbit and was collaborating with other entities and countries to strengthen national capabilities. The speaker also stressed the importance of and the need for capacity-building in Paraguay.

33. The speaker from the Algerian Space Agency presented the activities carried out in Algeria in support of the Sustainable Development Goals, in particular with regard to food security, climate change and disaster management. At the same time, he noted a lack of adequately trained personnel, which was also associated with a lack of funding, and invited other space agencies to partner with his organization.

34. The speaker from the Italian Space Agency described the organization of the space programme in Italy, stressing three pillars: (a) the consolidation of the science community; (b) the improvement of technology; and (c) international cooperation. Concerning space exploration, he noted that the Italian Space Agency had signed an agreement with the National Aeronautics and Space Administration (NASA) to cooperate in the Artemis programme.

35. The speaker from the Egyptian Space Agency presented the space programme in Egypt and space technology and applications for sustainable development. In addition, she highlighted the development of scientific and technological capacities and the importance of international collaboration and regional collaboration through the African Space Agency.

36. The speaker from ESA presented his organization’s space exploration activities, in particular its Terrae Novae exploration programme and opportunities for an inclusive space exploration journey, placing emphasis on the benefits of space exploration for society, including stimulating the economy and inspiration. He highlighted that the vision of ESA was to have European-led capabilities in space exploration after 2030. He also underlined the importance of education and outreach and presented different ESA activities in those areas.

37. The speaker from the Ethiopian Space Science and Technology Institute presented the organization of the space programme in Ethiopia and described the

available facilities, as well as the Institute's activities for human capacity development and research and development activities. He underlined the importance of the space policy and strategy of Ethiopia and noted that cooperation was an important element of space activities in the country. The speaker presented several examples of existing cooperation and welcomed interested potential partners.

38. The speaker from the Geo-Informatics and Space Technology Development Agency of Thailand explained the work, mission and vision of the Agency with regard to space-related activities in his country. He noted that the main activities of his organization were in the field of space technology development, Earth observation, in particular activities related to sustainability, education and training, and activities related to international cooperation with a diverse group of stakeholders. In addition, the Agency played an active role in monitoring the COVID-19 pandemic.

39. The speaker from JAXA presented the organization of the space programme in Japan, including a description of past, present and future space exploration activities. In addition, she highlighted the participation of JAXA in the International Space Exploration Coordination Group and in the Artemis programme.

40. The speaker from the Korea Aerospace Research Institute gave a presentation entitled "Joining the journey of space exploration: the Korea Aerospace Research Institute (KARI) case" and highlighted space exploration activities in the Republic of Korea, including enabling elements such as the country's lunar exploration plan, and preparations for future exploration through domestic and international partnerships.

41. The speaker from the Kenya Space Agency presented the organization of the space programme in Kenya. She began with a summary of the country's involvement in space activities, which had started in 1962. The Agency had been established in March 2017. In addition, she presented the elements of the Agency's strategic plan (2020–2025) and highlighted the importance of education and outreach in space technologies to realize that plan.

42. The speaker from the Mohammed Bin Rashid Space Centre described the organization of the space programme in the United Arab Emirates, focusing on the Emirates Mars Mission (Hope Probe). He highlighted the complexity of going into deep space and the results provided by the mission with regard to the Martian atmosphere.

43. The speaker from the Mauritius Research and Innovation Council opened his presentation with a description of how Mauritius was exploring space through astronomy, after which he presented his country's space programme and its plan of future activities. He highlighted the development of the first Mauritian satellite, MIRSAT-1, which was deployed in June 2021 through KiboCUBE in partnership with JAXA under the Access to Space for All initiative, and its relevance in stimulating and inspiring students. He concluded his presentation by showing his country's space road map until 2030, which would focus on the use of space for national priorities.

44. The speaker from the National Space Science Agency of Bahrain gave a presentation entitled "A bright vision to a bright future", with a description of the space programme in Bahrain and its achievements. He laid particular emphasis on the participation of women in the Agency, where women accounted for 66 per cent of the active workforce and 60 per cent of leadership positions.

45. The speaker from the Office for Outer Space Affairs presented the Access to Space for All initiative, a joint initiative of the Office and space agencies, research institutions and industry to offer access to space research facilities, infrastructure and information with the aim of developing technical know-how, engineering processes and infrastructure in the areas of hypergravity and microgravity, satellite development and space exploration, and promoting international cooperation in the peaceful uses of outer space. She also noted that the initiative welcomed new partners and contributions.

E. Session 1b: Space exploration for all – the industry perspective

46. The speakers described their respective organizations and the different activities carried out by them. All of the speakers reaffirmed the need for investment in science, technology and innovation to drive entrepreneurship.

47. The presentation by the Mohammed Bin Rashid Space Centre was focused on the strategic plan for the centennial anniversary of United Arab Emirates in 2071, which was aimed at increasing the productivity of the national economy through innovation and partnership with the public and private sectors to carry out the different activities envisaged by the Centre. The speaker also described the outreach programmes that had been developed to inspire and attract talent and thus create a future workforce.

48. The speaker from the Swedish Space Corporation provided an overview of the company and its activities, in particular the Rocket Experiments for University Students and the Balloon Experiments for University Students programmes, and noted that the Swedish Space Corporation was continuously working to build partnerships with emerging space nations for student programmes.

49. The speaker from Surrey Satellite Technology Limited presented the company's capacity-building projects and the lessons learned from more than 20 projects carried out in collaboration with different education programmes around the world.

50. The speaker from Head Aerospace Group presented the company's portfolio, in particular concerning Earth observation and ground station capabilities, and noted that the company also provided services to countries other than China.

F. Session 1c: Space exploration for all – the civil society perspective

51. The third segment of session 1 was aimed at giving the civil society perspective on space exploration and comprised eight presentations.

52. The speaker from the International Lunar Exploration Working Group presented a report on the activities carried out by the Working Group in recent years, providing an overview of the results achieved during the period and presenting the Working Group's road map and future plans. The report also highlighted several data analysis activities for different space exploration application areas, including data from the Working Group's EuroMoonMars analogue field campaigns. The speaker underlined that there was room for collaboration for those who were interested in Moon missions and that the Working Group was open to collaboration.

53. The speaker from the Methuselah Foundation presented the activities carried out under the NASA/Canadian Space Agency Deep Space Food Challenge. The Foundation administers competitions on behalf of NASA. The presentation included insights on the importance of understanding the nutritional needs of personnel involved in deep space missions in order to provide sufficient nutritional elements to support healthy human life. During the presentation, it was highlighted that more than 200 proposals for the Deep Space Food Challenge had been received and the top 10 had been selected. There was also a plan to put in place financial support for the second phase of the Challenge so that the selected proposals could be implemented for further evaluation.

54. The speaker from the Federal University of Rio Grande do Norte in Brazil gave a presentation about a network established to promote space education focusing on the fields of science, technology, engineering and mathematics in Brazil. The presentation highlighted the importance of quality education, which was at the root of a sustainable space programme. The need to ensure inclusiveness and increase the participation of women in the fields of science, technology, engineering and mathematics, from high school to university level, was also part of the work carried out by the network.

55. The speakers from the University of Rome Tor Vergata presented a multidisciplinary approach to space sustainability and colonization. They emphasized the significance of a sustainable space programme through such a multidisciplinary approach and presented the activities of the Space Sustainability Centre housed at the University. Social and cultural aspects, such as the influence of different religions and a review of the legal framework, were also highlighted as significant contributors to the sustainability of national space programmes. The presenters concluded by inviting new collaborations.

56. The speaker from the National Autonomous University of Mexico presented the possibilities and advantages of adopting the use of blockchain technology and the cryptoeconomy for space exploration. After describing the need to plan for the space economy, the speaker highlighted the possibility of adopting various cryptocurrencies for different celestial bodies to facilitate transactions. With regard to limitations, Internet availability was highlighted as one of the factors that limited the adoption of such currencies in many sectors on Earth, but they could still be adopted for the celestial economy. It was highlighted that two blockchain projects were proposed to test the implementation of such initiatives.

57. The speaker from the IAF Committee on Near-Earth Objects presented an educational approach to planetary defence during COVID-19. The presentation provided an overview of several communities involved in the planetary defence arena and how they actively participated virtually during the pandemic, including work with the United Nations Platform for Space-based Information for Disaster Management and Emergency Response (UN-SPIDER) programme of the Office for Outer Space Affairs.

58. The speaker from El Salvador presented the activities of the El Salvador Aerospace Institute and how that institution was fostering space education in the country.

59. The speaker for the Mars Society in Brazil gave a presentation entitled “Space and sustainable development: the inclusive and inspiring actions of Habitat Marte”. The speaker provided a scientific overview and highlighted the challenges arising from COVID-19 in the country, and discussed the engagement of students in a virtual analogue mission. The presentation concluded with strategies to expand the participation of girls and young women in missions focusing on the fields of science, technology, engineering and mathematics in the Habitat Marte project.

G. Session 2: Capacity-building for space exploration

60. The second session covered activities to develop capacity in space exploration, showcasing national, regional and international projects and initiatives supporting the development of skills, infrastructure and capabilities related to space exploration.

61. The speaker from the African Regional Centre for Space Science and Technology Education – in English Language gave an overview of the Regional Centre, affiliated to the United Nations, and how it was implementing different activities at the regional level, including tackling the Sustainable Development Goals. He noted that the Regional Centre had different academic programmes and served as an implementation hub for the achievement of most of the targets set out in the 2030 Agenda for Sustainable Development. The speaker also noted that the Centre had established relationships with national and international institutions to deliver its mandate and remained available for cooperation with other entities.

62. The speaker from the Apollo Foundation outlined the activities of the Foundation, which provided financial support, guidance, awareness-raising and opportunities for access to space education. The presenter requested support from international organizations with regard to space education.

63. The speaker from the Centre of Applied Space Technology and Microgravity introduced the activities and facilities of the Centre, including its Bremen Drop

Tower. In addition to the Drop Tower, the Centre's facilities made it possible to perform additional tests for space exploration, including generating microgravity, partial gravity and hypergravity environments.

64. The speaker for the International Space University gave a brief overview of the institution, its different academic programmes and its activities concerning space exploration. For example, he noted that the University was working on "moon soils" with a special clay to understand how the soil could be used for in situ resource utilization.

65. The speaker from the Kyushu Institute of Technology provided an overview of the BIRDS satellite project and its latest development, an open-source BIRDS satellite bus. He explained the different features of the bus, which was expected to further encourage the development of CubeSats at the national level.

66. The speaker from the Nepal Astronomical Society introduced the Society's activities in the field of science, technology, engineering, arts and mathematics in Nepal, noting that the activities followed a "from classroom to community" approach, with emphasis on hands-on activities that increase engagement and stimulate collaboration, curiosity and the development of critical thinking. Several competitions had been organized, including a space art online competition to stimulate the use of information technologies, and the Government of Nepal had provided financial support to organize a space day in Nepal.

67. The speaker from the Space Generation Advisory Council gave an overview of its activities. The Advisory Council was present in six regions of the world, and every year a workshop was organized in one of those regions. She presented on behalf of the African branch of the Advisory Council, noting that Africa was considered to have the largest population of young people. The speaker also gave a general description of the difficulties in the African region. Currently, the Advisory Council was looking into strategies to engage Africans to pursue education in space-related fields and was working on an African space education programme.

68. The speaker from the Science, Technology, Engineering, Arts and Development Society in Sierra Leone provided an overview of the history of the Society, its organizational structure and its activities. He noted that the Society was engaged in several activities, including training efforts in various space-related areas and awareness-raising events such as local activities in connection with World Space Week, with a view to promoting space exploration.

69. The speaker from the Swiss Federal Institute of Technology in Lausanne presented two analogue space missions for educational purposes and scientific development. The missions were carried out by children from several schools. The first mission, named Vivalys, was conducted by children in relative isolation in a Swiss shelter. The second one, Asclepios, was carried out in total isolation 500 m underground, where 15 experiments were conducted. The results were still being analysed in order to understand the impact of the activities.

70. The speaker from Universidad del Valle of Guatemala provided an overview of Quetzal-1, the first satellite of Guatemala. The satellite was deployed through KiboCUBE in April 2020 under the umbrella of the Access to Space for All initiative, the cooperation arrangement between the Office for Outer Space Affairs and JAXA that allows the deployment of CubeSats from the International Space Station. The first proof of concept was developed in 2014, and the design was developed further by undergraduate students from 2014 to 2016. Guatemala was selected in the second round of the KiboCUBE programme. Most of the team members on the project were students under 25 years of age with limited or no aerospace background. Additionally, owing to a lack of funding, several parts were manufactured locally. Thanks to that first step, Guatemala was planning to establish an aerospace facility and was working to develop a 3U satellite. The Universidad del Valle of Guatemala had been very active in raising awareness of the benefits of space, inspiring very young students, and was preparing two books and a documentary on the topic.

H. Breakout groups

71. Between sessions 2 and 3, four breakout groups were established. Each participant was randomly assigned to one of the four groups. The random allocation method was used to ensure that a mix of academia, space agencies, industry and civil society was represented in each group.

72. Each group was provided with four scenarios for discussion. The scenarios were formulated in such a way as to engage participation, providing hypothetical situations and tasks that the group would need to discuss. All groups were expected to discuss the four scenarios; however, owing to the time limit, some groups were able to discuss only a subset of the scenarios provided. Nevertheless, each scenario was discussed by at least one breakout group, as the order of discussion of the scenarios was different for each group.

73. The topics covered by each scenario are as follows:

(a) Scenario 1, entitled “Creation of a space programme”, was focused on the development of a national space programme from zero and on understanding different national realities and difficulties in pursuing space development. In discussing this scenario, participants were also expected to draw on the discussions from previous sessions concerning national development plans and how they are linked to the development of space activities;

(b) Scenario 2, entitled “Accessing space”, was focused on international programmes to develop access to space capacity and their goal-setting and adaptation to national realities. It was expected that synergies between international programmes would also be covered in the discussions on this scenario;

(c) Scenario 3, entitled “Space exploration engagement”, was focused on international cooperation initiatives in space exploration and the relevance of space exploration for countries that have already developed space exploration programmes and those that do not have a space programme or are starting to develop one;

(d) Scenario 4, entitled “All having access to orbit”, was aimed at stimulating discussion on the long-term sustainability of outer space activities, space debris mitigation, planetary protection and international space law and their links with space accessibility.

74. The moderator of each group was provided with a facilitator’s guide. The guide contained “seed questions” to stimulate the discussions and to orient the groups in discussing the topics. The facilitator’s guide is available on the website of the Office for Outer Space Affairs, and the link was also included in the programme of the Workshop.

75. The results of the discussion of scenario 1, on the creation of a space programme, were as follows:

(a) A space programme needs to serve national priorities, and the identification of areas where space can support those priorities is essential. The Sustainable Development Goals have been adopted by all States Members of the United Nations, and therefore the space programme should also consider the Goals;

(b) The groups agreed about the need for specialized personnel to support the development of a national space programme. Therefore, they recommended searching for nationals with experience in the space sector, either internally, if the country had universities with space-related courses, or externally, by locating national students and professionals abroad and creating networks of expertise. It was also recommended that countries with programmes in early stages should facilitate the return of nationals with relevant experience;

(c) Concerning engagement with industry, there should be mechanisms to facilitate work with industry or the creation of new space-related companies;

(d) The groups agreed that the creation of education programmes in support of space activities and activities to inspire and attract students to those careers were very important;

(e) The creation of awareness-raising and communications campaigns for the general public and dedicated target groups, such as students and industry, was essential to generating engagement. Particular attention should be paid to raising awareness among policymakers and decision makers at the highest possible levels. Those campaigns should be aimed at explaining the benefits of activities under the space programme;

(f) Irrespective of the level of maturity of the space programme, participants regarded partnership and international cooperation as very important;

(g) Although it was among the topics to be discussed for this scenario, inclusiveness was discussed only marginally and only from the point of view of diversity, with emphasis on the need to include individuals with different cultural backgrounds in space programmes whenever possible.

76. The results of the discussion of scenario 2, on accessing space, were as follows:

(a) Participants found this scenario particularly difficult, and no clear outcomes or recommendations were provided;

(b) As a starting point, participants were requested to provide a definition of having access to space. Although there was no single definition, there was general consensus that being able to use space technology and data could be considered a form of accessing space, meaning that access to orbit should not be the only focus;

(c) Participants mentioned the need to encourage competition as a way to stimulate the development of capacity and access to space. The suggested way to generate competition was through enabling regulations that should guarantee a level playing field.

77. The results of the discussion of scenario 3, on space exploration engagement, were as follows:

(a) Participants recalled article I of the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, which reads: “The exploration and use of outer space, including the Moon and other celestial bodies, shall be carried out for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development, and shall be the province of all mankind”;

(b) The complexity of space exploration requires different technologies, skill sets and knowledge. For space exploration to be a successful endeavour, each country should contribute with different strengths;

(c) Participants also agreed that States members of the Committee on the Peaceful Uses of Outer Space could take advantage of the discussions under its agenda item entitled “Space exploration and innovation”;

(d) In addition, international discussions on the coordination of space exploration efforts among space agencies are being held within the framework of the International Space Exploration Coordination Group. Space agencies are encouraged to take part in the discussions on the Global Exploration Roadmap;

(e) Another step to involve students and professionals interested in the topic of space exploration is to share space exploration data and related training. Existing mechanisms such as the space exploration track of the Access to Space for All initiative could be used to increase the reach of data and training materials.

78. The results of the discussion of scenario 4, on all countries having access to orbit, were as follows:

(a) The groups explored the potential benefits and difficulties to be expected when all countries have access to orbit;

(b) Concerning the benefits, there was consensus that global access to orbit would generally bring economic growth and social benefits. In particular, it would lead to the creation of jobs and the development of spin-off technologies that could be used to tackle issues such as climate change. Participants noted that space also had an inspirational component that could stimulate studies and careers in science, technology, engineering and mathematics;

(c) Concerning drawbacks, the question was raised about how to ensure fair competition and access if some resources, such as orbital resources or landing sites, are scarce. Another point mentioned was the duplicity of space systems. While redundancy and resilience were considered essential in case of the failure of one system, the question was raised as to how to make optimal use of resources and ensure fair competition;

(d) The groups also discussed mitigation proposals, such as partnerships to reduce competition and share benefits. The use of internationally recognized forums, such as the Committee on the Peaceful Uses of Outer Space and the International Space Exploration Coordination Group, for the discussion and presentation of exploration plans could help to streamline and reduce the duplication of efforts, while fostering partnerships;

(e) The activities of the Office for Outer Space Affairs could help in establishing relationships between countries. Groups pointed to activities such as the Access to Space for All initiative, in which developed countries provide resources integrated into tracks that provide additional benefits instead of single opportunities alone;

(f) Another mitigation element mentioned was the Register of Objects Launched into Outer Space, as it can serve as a reference indicating which objects are in orbit. However, the participants mentioned that the lag between the launch of an object and its registration made it difficult to use the Register for that purpose.

I. Session 3: panel discussion on opportunities for emerging space countries to join efforts in space exploration

79. The objective of the panel discussion was to take stock of the discussions that had taken place during the breakout groups. The panellists were the Executive Director of the Bolivarian Agency for Space Activities, a member of the Board of Portugal Space, the Chief Executive Officer of the South African National Space Agency, the Deputy Director General of the Ethiopian Space Science and Technology Institute and the Chair of the Planetary Protection Panel of the Committee on Space Research. The summary below reflects the views expressed during the panel discussion.

80. The panel discussion was intended to be as interactive as possible, engaging the moderators of the breakout sessions and the rest of the audience. During the discussion, the Chair of the Planetary Protection Panel gave a presentation on planetary protection, including information on guidelines for the prevention of possible biological contamination by space objects returning to Earth and for the protection of celestial bodies from biological contamination from Earth.

81. The main topic of the panel discussion was scenario 1, on the creation of a space programme. The first area discussed by the panel was international collaboration and the creation of new regional space agencies. The panellists identified governance as one of the main challenges to overcome and noted that countries taking part in those efforts should focus on what unites them rather than what makes them different.

Maturity levels in terms of space capabilities might also pose challenges, as the potential benefits for each participating country would be different.

82. It was noted that the creation of regional space agencies could serve as a starting point for developing space industries and interest in space activities in countries where a national space agency did not exist. That could in turn lead to the creation of national space agencies. The case of Portugal Space and ESA was discussed, as the country's national space agency was created after Portugal had been a member of ESA for several years.

83. Panellists agreed that the focus of a newly created space agency did not necessarily have to be technology, but the oversight of space activities in the country, the establishment of partnerships and the promotion of space nationally, providing an integrated national vision to guide future activities.

84. The view was expressed that Governments should invest in infrastructure and human capacity in order to build space programmes. Education and capacity-building were key, and countries could benefit from initiatives such as the Access to Space for All initiative and its three tracks for developing specific capabilities.

85. There was consensus among the panellists that the development of a national space policy and law was also a cornerstone for the creation of a space programme.

J. Closing session

86. Closing remarks were provided by high-level representatives from the organizing institutions, namely, the Office for Outer Space Affairs, the Mohammed Bin Rashid Space Centre and IAF.

87. The Deputy Director General and Executive Director of the Mohammed Bin Rashid Space Centre expressed his satisfaction with the way the Workshop had been conducted and his hope that the discussions had been fruitful and participants had enjoyed the hospitality of Dubai. He invited participants to continue the relations established during the Workshop.

88. The President of IAF expressed satisfaction with the variety of topics covered by the Workshop and the fact that it had been possible to organize it in an in-person format.

89. The Director of the Office for Outer Space Affairs expressed satisfaction with the level of participation and noted that the representation of many countries and space agencies showed the relevance of the Workshop as a yearly activity. The Director expressed the view that the topic of space exploration was closely linked with many of the discussions taking place in the Committee on the Peaceful Uses of Outer Space and other forums and that it would become more and more important as time passed. The year 2021 had seen several missions to Mars, and the years to come would witness renewed interest in the Moon; therefore, it was more important than ever to continue discussions on the peaceful uses of outer space.

V. Conclusions and recommendations

90. Several speakers underlined the importance of space exploration activities for the sustainability of activities on Earth and for the achievement of the Sustainable Development Goals, including, in particular, benefits for food security, understanding climate change, and technologies related to disaster management. The development of science and technology associated with space exploration had applications on Earth. The view was expressed that space activities must support national activities and priorities. It was noted that raising awareness of space activities among decision makers and policymakers was crucial for understanding the relevance of space activities.

91. It was also noted that the sustained presence of humans on other celestial bodies, such as the Moon, would require adequate infrastructure and technology, which was only achievable through the long-term planning of space exploration activities and international cooperation.

92. It was stressed by all speakers that space exploration should be done in a cooperative manner, with a view to contributing to the development of science and maximizing the benefits of space exploration. Several speakers called for cooperation and support for activities involving countries without space exploration programmes.

93. Concerning drawbacks, the question was raised about how to ensure fair competition and access if some resources, such as orbital resources or landing sites, are scarce. Another point mentioned was the duplicity of space systems. While redundancy and resilience were considered essential in case of the failure of one system, the question was raised as to how to make optimal use of resources and ensure fair competition.

94. Several space agencies expressed the need for collaboration for the development of human resources and outreach to inspire and attract young students to space-related careers. Attracting and retaining skilled personnel were highlighted as issues by several speakers, and the Access to Space for All initiative of the Office for Outer Space Affairs was welcomed as a means of supporting the establishment of long-term plans through the gradual acquisition of know-how, by providing different tracks to develop specific capabilities. However, several speakers drew attention to the lack of adequate funding for training and infrastructure development.

95. The need for an enabling environment through national advocacy and through the development of adequate regulations was also noted by some speakers.

96. The following recommendations were made:

(a) The international mechanisms related to space exploration should be utilized as widely as possible, namely, the agenda item entitled “Space exploration and innovation” of the Committee on the Peaceful Uses of Outer Space, the International Space Exploration Coordination Group for discussions among space agencies on the coordination of exploration missions, and the space exploration track under the Access to Space for All initiative to support triangular cooperation on this matter. Raising awareness among policymakers and decision makers of how space can support national priorities is also regarded as very important;

(b) Space exploration data and associated training materials should be released as widely as possible to encourage the participation of a larger segment of the population, in particular in developing countries;

(c) Funding and international support should be devoted to capacity-building efforts relating to space exploration and space-related skills in general in order to ensure the availability of professionals in the near future;

(d) Awareness-raising efforts concerning inclusiveness and diversity should be increased;

(e) Awareness-raising efforts concerning planetary protection should be increased;

(f) The registration process in the Register of Objects Launched into Outer Space should be automated so that it can be used as a real-time source of information to raise awareness of the number of objects and as a transparency and confidence-building measure.