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Report on the Workshop on Space Technology for Socioeconomic Benefits: “Ensuring inclusiveness through space-based applications and space exploration”

(Washington, D.C., United States of America, 18–20 October 2019)

I. Introduction

1. With the support of the Office for Outer Space Affairs of the Secretariat, the International Astronautical Federation organized the twenty-seventh Workshop on Space Technology for Socioeconomic Benefits, on the theme “Ensuring inclusiveness through space-based applications and space exploration”, to provide emerging space nations with opportunities to build capacity in the use of space science, technology, applications and exploration in support of sustainable economic, social and environmental development and the role of industry.
2. The Workshop was held in Washington, D.C., United States of America, from 18 to 20 October 2019, in conjunction with the 70th International Astronautical Congress and was co-sponsored by the American Institute of Aeronautics and Astronautics.
3. The present report contains a description of the background, objectives and programme of the Workshop and provides a summary of the recommendations and observations made by the participants.

A. Background and objectives

4. The role of space applications and exploration is increasing and is fostering cooperation across all sectors related to sustainable development, in particular in the context of developing countries. Space is becoming more and more accessible to everyone. For example, the development of CubeSats has opened the door to new actors in low Earth orbit; recently, CubeSats have even been launched towards Mars, and amateur radio operators have had the opportunity to receive transmissions from the Longjiang-2 satellite, weighing only 47 kg, orbiting the Moon.
5. The Office for Outer Space Affairs addresses topics relating to applications of space technology in various workshops and conferences organized at the request of Member States. Such events provide a platform for Member States to exchange knowledge, and extend access to the benefits of space to all humankind.



6. The Workshop was aimed at facilitating exchanges on space science, technology, applications and exploration in support of economic, social and environmental development, with a focus on inclusiveness as an underlying factor in sustainable development. It provided opportunities for emerging space nations to perceive space as a contributor to the inclusive growth of countries, in particular by serving as a catalyst for empowering people and ensuring inclusiveness and equality.

7. In view of the relevance, whether direct or indirect, of space to all 17 Sustainable Development Goals, the Workshop focused on specific elements of Goal 4 (quality education), Goal 8 (decent work and economic growth), Goal 10 (reduced inequality), Goal 13 (climate action) and Goal 16 (peace, justice and inclusive institutions), as well as Goal 17 (partnerships for the Goals). The Workshop built on the high-level political forum on sustainable development that was held at United Nations Headquarters in New York from 9 to 18 July 2019.

8. In addition, the Workshop served as a platform for ensuring inclusive development in the area of space technology. It also served to demonstrate the relevance of space applications and exploration in promoting inclusiveness, and the linkages between space-related matters and the 2030 Agenda for Sustainable Development, and provided a forum for discussing global solutions to common challenges, with a view to promoting prosperity for all and endeavouring to leave no one behind.

9. The Workshop had the following objectives:

(a) To provide insights on how space applications contribute to empowering people and ensuring inclusiveness and equality;

(b) To share success stories of space applications that support the Sustainable Development Goals focused on inclusiveness and equality;

(c) To promote and discuss inclusiveness in space exploration;

(d) To raise awareness of how the international space community is promoting inclusiveness through new partnerships involving emerging space nations and industries;

(e) To bring together policy and decision makers and the research and academic communities to help integrate space into policy and the decision-making process.

B. Attendance

10. The Workshop was attended by 105 participants, of which 44 per cent were women.

11. Representatives of the following 46 countries attended the Workshop: Australia, Austria, Botswana, Brazil, Canada, Costa Rica, Dominican Republic, Egypt, France, Germany, Ghana, Greece, Guatemala, India, Israel, Italy, Jamaica, Japan, Kazakhstan, Kenya, Malaysia, Mauritius, Mexico, Morocco, Nepal, Netherlands, Nigeria, Pakistan, Paraguay, Philippines, Poland, Republic of Korea, Romania, Russian Federation, Saudi Arabia, Serbia, Singapore, Slovenia, South Africa, Spain, Sri Lanka, Thailand, Turkey, Ukraine, United Kingdom of Great Britain and Northern Ireland and United States of America.

II. Programme of activities

12. The Workshop programme comprised an opening session that included opening remarks by seven high-level participants and a presentation to set the scene; a high-level keynote speech; five other keynote speeches; five plenary sessions; an interactive session; a concluding session that included a high-level panel involving six panellists and concluding remarks; and two poster sessions involving a total of

25 poster presentations. Overall, 38 presentations were given during the plenary sessions, and five focus group discussions were held during the interactive session, on the following topics:

- (a) Space for inclusiveness: leaving no one behind (plenary session 1);
- (b) Mobilizing everyone: innovative space applications for socioeconomic development (plenary session 2);
- (c) Opportunities for emerging space nations and industries to join efforts involving space science and technology (plenary session 3);
- (d) Space exploration for everyone (plenary session 4);
- (e) Developing collaborations on space applications and education (plenary session 5);
- (f) Inclusiveness in space science and technology (interactive session).

A. Opening session

13. At the opening session, speakers provided an overview of the current efforts and commitments of the key space-related organizations to foster inclusiveness and leave no one behind.

14. Representatives of organizations and entities such as the International Astronautical Federation, the United States Department of State, the American Institute of Aeronautics and Astronautics and the Committee for Liaison with International Organizations and Developing Nations described their plans related to international cooperation specifically aimed at benefiting developing countries and specific segments of the population such as women and young people.

15. Speakers also emphasized the importance of space in achieving the 2030 Agenda for Sustainable Development and highlighted that inclusiveness in space exploration and applications was an important ingredient for success in that regard.

B. High-level panel

16. During the high-level panel, panellists highlighted efforts of the space community to ensure that no one is left behind.

17. The International Space Station was cited as an excellent example of a space activity with a high degree of inclusiveness, as it provided opportunities to several countries to access space and offered other benefits. The activities undertaken on board the International Space Station, as well as related activities, had direct relevance to the Sustainable Development Goals.

18. The world was undergoing changes resulting from megatrends related to climate, demography, urbanization, frontier technologies, conflicts and protracted crisis. Democratization of space was providing solutions by promoting inclusiveness and equal access to space science and technology. The Office of Outer Space Affairs was contributing to that process through initiatives such as Space for Sustainable Development Goals, Space for Women, Space for Youth and Access to Space for All.

19. Space activities were multidisciplinary in nature and inclusiveness enabled organizations to create research teams with members from diverse backgrounds and ensure gender balance.

20. In developing countries, space remained largely a matter for space scientists alone. In non-spacefaring countries, greater awareness was needed at the policy level of the potential of space to serve as an important instrument for national development.

21. Space agencies in spacefaring countries were providing opportunities to emerging space nations through bilateral or multilateral cooperation. The forums and

programmes offered through such cooperation brought benefits to developing countries, industries, academia and young people.

C. Plenary sessions

1. Space for inclusiveness: leaving no one behind

22. In plenary session 1, participants discussed initiatives aimed at utilizing space to ensure that no one was left behind. The participants described innovative projects and programmes and highlighted the impact that space-related projects had on national strategies. They also described space-related projects that targeted specific communities. The key points made in the session are summarized below.

23. Space is a global common with regard to all matters related to inclusiveness, including gender, disability and children, as well as social and economic matters in general.

24. The idea of creating a space sustainability rating should be implemented because a large number of mini-constellations of satellites are adding more space debris to the space environment. It is important to develop space technologies that support sustainable development and projects should be implemented in collaboration with Governments to ensure the sustainability of space activities.

25. Several initiatives are providing opportunities for children, adults, professionals, teachers and parents in order to stimulate their interest in space. These include a scientific tool for teaching astronomy and observing solar eclipses developed by the International Astronomical Union as part of an effort to reach a wider audience. The projects inspired by the Mars Desert Research Station missions are offering students the opportunity to practice Mars mission activities, control Mars rovers and understand the science of Mars through simulations, thus lowering the barriers to engagement in science, technology, engineering, art and mathematics through space-themed, hands-on technical learning and teamwork. An example from Africa is a partnership involving the Airbus Foundation and Travelling Telescope, a social outreach enterprise dedicated to promoting science, youth education and tourism, and in particular to empowering young girls. Such initiatives provide rare opportunities to students in non-spacefaring countries to view mobile planetariums and gain access to robotics kits, astronomy-related software, educational movies and hands-on science and virtual reality kits. These projects have also played a role in advising high-level government authorities and have provided opportunities for start-up companies in non-spacefaring countries to take part in the initiatives.

26. Technologies such as big data, the Internet of things, 3-D printing and virtual reality are integrating space data, ground-based data and other types of data, thus transforming the data into information relevant for the implementation of the Sustainable Development Goals and bringing information products such as 3-D models within reach of those wishing to learn.

27. There are several initiatives dedicated to facilitating access to space science and research for female students and researchers. Specific initiatives presented in the session, such as Space4Women, GirlsInSpace and She Space International, are contributing to the involvement of women in space activities.

28. Space exploration and the presence of human beings in the solar system is for the benefit of all. National agencies and commercial partnerships are engaged in testing technologies to facilitate landing on the Moon that will lead to building capabilities for a future mission to Mars. Several initiatives leverage the full potential of space to advance humanity in space and on Earth. Protecting Earth from the threats of near-Earth objects is an ongoing effort of space agencies. The way to communicate such threats to the public is a subject of social science and predicting an asteroid impact may be easier than predicting the response of the public.

2. Mobilizing everyone: innovative space applications for socioeconomic development

29. In plenary session 2, participants presented innovative space applications and programmes in support of socioeconomic development at the national and regional levels. They described progress made in the development of space applications, tools, models and solutions that integrate space data and in-situ data. Experts presented operational programmes implemented by their organizations in support of mobilizing everyone through socioeconomic development and outreach.

30. Synthetic aperture radar satellites are widely used in monitoring disasters because the images they generate are clear and accessible, both by day and by night, regardless of atmospheric conditions. To enhance local capacities, developing countries can potentially obtain Earth observation data derived from such satellites, as well as relevant processing techniques and methodologies, by accessing the freely available geospatial information provided by the Copernicus Programme of the European Union.

31. High-resolution Earth observation radar data can be used to enhance early warning systems for disaster risk reduction through modelling, as cases relating to flooding in Ghana, Guatemala and Brazil have shown.

32. A significant number of events are held throughout the year to celebrate space science. To raise awareness of and increase participation in such events, the World Space Week Association uses World Space Week (4–10 October), established by the General Assembly, to focus attention on strengthening the links between space and society through public education, participation, and dialogue on the future of space activities.

33. Emerging space nations have access to a range of resources, such as the publication by the International Space University entitled *ARESS: A Roadmap for Emerging Space States*, which offers recommendations on how emerging space nations can support the space industry within their territory.

3. Opportunities for emerging space nations and industries to join efforts involving space science and technology

34. Plenary session 3 was focused on opportunities and collaboration offering access to space education, data and technology and research facilities, as well as direct access to space, in particular for emerging space nations. The session was aimed at reinforcing the vision of thematic priority 1, entitled “Global partnerships in space exploration and innovation”, of the fiftieth anniversary of the United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE+50).

35. Opportunities for the development of local capacities through education were among the issues discussed during the session. In that connection, presentations were made on the work of the African Regional Centre for Space Science and Technology Education in support of space science in the African context, and on fellowship opportunities in New Zealand, which were complemented by the launch of a “space challenge” to promote participation in the space sector.

36. Participants in the session stressed the importance of infrastructure, both hard and soft, as demonstrated by the development of a launch centre in Brazil to support the local economy, the evolution of the space programme of Paraguay as a result of international collaboration and the work of the European Space Agency to promote the Sustainable Development Goals through the provision of a set of tools to facilitate decision-making and monitor progress.

37. Disaster management and natural resource management were cited as examples of activities benefiting from capacity-building efforts and international collaboration to support the development of local capabilities, as was demonstrated in the case studies of Sri Lanka and the Philippines.

4. Space exploration for everyone

38. In plenary session 4, participants discussed initiatives aimed at lowering the entry barriers to space exploration, including through the standardization of space exploration systems and international cooperation. The key points made in the session are summarized below.

39. The commercial sector is contributing to space capacity-building efforts by offering emerging space nations end-to-end capabilities to manufacture, operate and utilize small satellites, and is promoting the learning of related science and technology through hands-on on-the-job training. Indicators of the success of a country's space programme are the resulting academic degrees, jobs, national infrastructure, international collaboration and improvement in the quality of life in those countries. Emerging space nations should have long-term space programmes with attainable short-term goals, designed to ensure their sustainability, and the programmes should have an impact on academic research and collaboration between industry and government, and stimulate the interest of everyone.

40. The growth of the aerospace market presents an opportunity to establish capital funding for space settlements. Effective tax policy incentives to direct capital investments towards space settlement could lead to long-term benefits for humankind, and the participation of individual investors could become a reality in the near future.

41. Researchers and students are benefiting from opportunities to carry out microgravity research. Such opportunities are offered within the framework of international collaboration, such as the fellowship programme of the Drop Tower Experiment Series of the Office for Outer Space Affairs, as well as by commercial companies through initiatives involving collaborative, educational life science experiments in space.

42. Gamification is a concrete tool for understanding the potential influence of future space missions and can be offered to younger generations in the form of virtual and augmented reality applications. Gamification scenarios may include Martian atmospheric and surface challenges, communication between Mars orbiter CubeSats and micro flying robots and/or rovers, plant and bacteria growth, medicine design during the journey to Mars and 3-D printing on Mars. Gamification techniques can also help in evaluating the cost of future Mars missions.

43. A creative work inspired by the International Space Station, *International Space Station Suite* is an original multimedia music composition and education outreach project aimed at highlighting how the International Space Station has had an impact on humanity, scientific discovery and future exploration and how the Sustainable Development Goals have been directly and indirectly supported through activities connected with the International Space Station.

5. Developing collaborations on space applications and education

44. In plenary session 5, participants discussed various initiatives aimed at education and awareness-raising related to space applications and exploration in the context of the Sustainable Development Goals. Collaborations between various government agencies, non-governmental organizations and industries in promoting space education were presented, and tools and national and international programmes dedicated to space applications and education were demonstrated. The key points made in the session are summarized below.

45. A number of capacity-building efforts at the regional level serve as excellent examples of regional cooperation in promoting space education. The integral regional system of satellite information developed by the Mexican Space Agency is offering benefits in Latin America. Eurisy, a non-governmental organization, is encouraging governmental departments to take advantage of the investments made in space-related services. The National Institute for Space Research of Brazil is offering opportunities for space education at the graduate level in Brazil for international students.

46. The Office of Outer Space Affairs and the Space Generation Advisory Council are offering opportunities and fellowships to youth through programmes such as the Space for Youth competition and Space4Earth Hackathon.

47. The World Bank, through the Global Environmental Facility, is contributing to tracking the progress towards the Sustainable Development Goals and their 169 associated targets, which requires consistent data on the 232 related indicators. Such a challenge can be addressed through the application of geospatial approaches and the analysis of Earth observation data and big data, together with innovative methods for tracking the progress made towards the Goals.

D. Interactive session

48. In order to foster discussion on enhancing inclusiveness in the space community, five focus groups were created. The groups were invited to discuss the obstacles that limit participation and diversity in the space sector, as well as potential solutions or recommended actions to be taken by the space community to overcome the obstacles identified.

49. Each group focused on the specific entry barriers faced by a different group of stakeholders: women and girls; young people; persons with disabilities; people of colour; and indigenous communities.

50. Several commonalities were identified, including the existence of stereotypes in the way that those stakeholder groups' participation in the space sector is perceived. Furthermore, the important role of teachers and role models in inspiring and motivating young people was acknowledged.

51. The participants mentioned repeatedly that there was a need for change in the way that public perception shaped social behavioural patterns and choices, in order to open pathways to greater and more inclusive participation in the space community. Such change could be achieved through education, awareness-raising, and wider access to the space sector in general.

E. Keynote speeches

52. The keynote speeches focused on topics relevant to inclusiveness in the space community, presenting aspects to be considered by States when working towards the development of the space sector at the national level. Those aspects included the development of space law, local and regional initiatives and opportunities for international cooperation.

53. Space technology supports global efforts to achieve the Sustainable Development Goals, but the commitment of the space community is necessary in order to develop space technology that supports the Goals, and everyone must benefit from and have access to space-related capacities.

F. Poster presentations

54. A total of 25 posters were exhibited during two dedicated sessions. The posters examined a range of topics relevant to the theme of the Workshop and included assessments of regional and local circumstances through case studies, and presentations of innovative projects and ideas, and of new technologies and methodologies, all in the context of inclusiveness in the space sector.

III. Observations and recommendations

55. The Workshop reaffirmed the importance of inclusiveness in the space sector for fostering the evolution of space science and contributing to the achievement of

the Sustainable Development Goals, both directly, by reducing inequalities and promoting the empowerment of women and girls, and indirectly, by breaking down stereotypes and creating an enabling environment for scientific development.

56. Participants noted the need for cooperation, in particular international cooperation in support of the participation of developing countries, across sectors, involving actors from the public, private and non-governmental sectors, as well as across genders, with men supporting and fostering the participation of women and girls in space science.

IV. Conclusions

57. According to feedback given by participants, the Workshop was successful in generating ideas for developing opportunities for international cooperation and knowledge exchange to foster inclusiveness in the space community.

58. The Workshop induced participating space agencies, industries, start-ups and non-governmental organizations to adopt a new perspective of inclusiveness and highlighted the fact that inclusiveness is the key to implementing the Sustainable Development Goals. The way to promote inclusiveness and equality through space applications and exploration is intrinsically related to the Goals themselves.

59. The Workshop was considered an excellent environment for networking among the various stakeholder groups present, and the participants valued the fact that individuals from groups that traditionally have been less involved in such events were encouraged to participate and were offered an opportunity to discuss the issues they faced.

60. Furthermore, the Workshop was considered well balanced and very diverse in terms of gender, geographical and generational representation, in accordance with its theme. All the participants were encouraged to contribute to the discussions, and the interactive session was specially designed and conducted with the aim of giving voice to every participant.
