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Multi-stakeholder forum on science, technology and innovation for the Sustainable Development Goals

Note by the Secretariat

The President of the Economic and Social Council has the honour to transmit to the high-level political forum on sustainable development the Co-Chairs' summary of the multi-stakeholder forum on science, technology and innovation for the Sustainable Development Goals, held in New York on 14 and 15 May 2019. The Co-Chairs of the forum, the Permanent Representative of Barbados to the United Nations, H. Elizabeth Thompson, and the Permanent Representative of Czechia to the United Nations, Marie Chatardová, were appointed by the President of the Council. The summary is being circulated pursuant to paragraph 123 of the Addis Ababa Action Agenda of the Third International Conference on Financing for Development (General Assembly resolution 69/313) and paragraph 70 of the 2030 Agenda for Sustainable Development (Assembly resolution 70/1).

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Co-Chairs' summary of the multi-stakeholder forum on science, technology and innovation for the Sustainable Development Goals

I. Introduction

1. The present summary represents a reflection of the broad discussions that were held during the multi-stakeholder forum on science, technology and innovation for the Sustainable Development Goals. The summary brings together a diverse set of views articulated through both formal and informal statements provided by stakeholders. The views presented do not necessarily represent opinions held or endorsed by the Co-Chairs or the Governments that they represent.

2. Pursuant to General Assembly resolution 70/1, on 14 and 15 May 2019, the President of the Economic and Social Council, Inga Rhonda King, convened the fourth annual multi-stakeholder forum. As a component of the Technology Facilitation Mechanism, the forum is a venue to discuss cooperation in science, technology and innovation around thematic areas pertaining to the implementation of the Sustainable Development Goals, bringing together all relevant stakeholders to actively contribute in their areas of expertise. The forum provides a venue for facilitating interaction, matchmaking and the establishment of networks among relevant stakeholders and multi-stakeholder partnerships in order to identify and examine technology needs and gaps, including with respect to scientific cooperation, innovation and capacity-building, and to help to facilitate the development, transfer and dissemination of relevant technologies for the Goals and targets.

3. The Permanent Representative of Barbados to the United Nations, H. Elizabeth Thompson, and the Permanent Representative of Czechia to the United Nations, Marie Chatardová, co-chaired the forum. The forum was prepared by the United Nations inter-agency task team on science, technology and innovation for the Sustainable Development Goals, with assistance from the 10-member group to support the Technology Facilitation Mechanism, composed of representatives from civil society, the private sector and the scientific community.

4. The opening of the forum featured statements by the President of the Economic and Social Council and by the Under-Secretary-General for Economic and Social Affairs, Liu Zhenmin.

5. Two keynote speakers set the scene for the forum: the Executive Director of the World Academy of Sciences for the advancement of science in the developing world, Romain Murenzi, and the Chief Information Officer of the Bank of Montreal, Canada, Claudette McGowan.

6. Participants in the forum also watched a video message from the Chair of the Commission on Science and Technology for Development, A Min Tjoa, who presented an overview of the Commission's deliberations at its twenty-second session, held concurrently in Geneva from 13 to 17 May 2019, including a response to General Assembly resolution 73/17, which are presented in detail in the report of the Commission (E/2019/31-E/CN.16/2019/1).

7. The forum was well attended, with an estimated 700 participants, representing Governments and scientists, innovators, technology specialists, entrepreneurs and civil society representatives. The forum comprised interactive sessions that engaged all stakeholders in the deliberations. In line with its mandate, the forum promoted networking and matchmaking, including through presentations by innovators; exhibitions of innovative solutions for the Sustainable Development Goals and on gender and science, technology and innovation that featured prominent women

scientists from around the world; special events to launch the exhibitions; a special round table on science, technology and innovation road maps to achieve the Goals; and 29 side events. The forum immediately followed the Global Solutions Summit, a special event of the Global Sustainable Technology and Innovation Conference, and several other events during the week. The forum also included a ministerial segment on strengthening capacity and policy for the development of science, technology and innovation road maps.

II. Highlights of the discussions held at the forum

8. Participants in the forum deliberated on the challenges to the achievement of, and technology solutions with a transformative impact on, each of the Sustainable Development Goals to be reviewed at the high-level political forum in 2019: Goals 4, 8, 10, 13 and 16. The following matters, in particular, were discussed: the status of existing and new technologies; the potential of science, technology and innovation to support the achievement of quality education and lifelong learning (Goal 4); the ways in which science, technology and innovation have an impact on economic growth and perspectives for full and productive employment and decent work for all (Goal 8); the interrelations between technology change and inequality within and among countries (Goal 10); the main challenges to developing, adopting, disseminating or scaling up clean technologies for mitigating and adapting to climate change (Goal 13); and the ways in which science, technology and innovation can promote peaceful and inclusive societies and access to justice for all and build effective, accountable and inclusive institutions (Goal 16). Good practices and policy recommendations, as well as challenges, were identified, with a view to facilitating the development and scaling up of the adoption and dissemination of relevant technologies for sustainable development.

9. Participants in the forum also addressed global trends and cross-cutting issues, including in relation to: emerging technology clusters and the impact of rapid technological change on the achievement of the Goals, pursuant to General Assembly resolutions 73/17 and 72/242; the strengthening of capacity and policy for the development of science, technology and innovation road maps; gender and science, technology and innovation in the context of the Goals; the role of young people in relation to innovation ecosystems and development; the linking of the science, technology and innovation of indigenous peoples, cultures and traditional knowledge with the achievement of the Goals; and next steps for the Technology Facilitation Mechanism. The 10-member group, which was appointed by the Secretary-General for the period 2018–2019, moderated the sessions and provided its vision for the Mechanism.

10. Selected messages and highlights of the forum are presented in the remainder of the present summary. Statements and presentations in the opening session laid out broad views of key issues, principles and policy responses, many of which were further elaborated on in later sessions.

Impact of rapid technological change on the achievement of the Sustainable Development Goals

11. Pursuant to General Assembly resolution 73/17, the Officer-in-Charge of the Division for Sustainable Development Goals of the Department of Economic and Social Affairs of the Secretariat, Alexander Trepelkov, presented an update on the findings of the Technology Facilitation Mechanism regarding the impact of rapid technological change on the achievement of the Goals. The findings, documented by the inter-agency task team, represented a collaborative, multi-stakeholder effort with

contributions from well over 100 experts. Key contributions to the process were also made by staff of the Department of Economic and Social Affairs, the Economic Commission for Latin America and the Caribbean, the Economic and Social Commission for Asia and the Pacific, the Economic and Social Commission for Western Asia, the International Labour Organization, the International Telecommunication Union, the United Nations Conference on Trade and Development, the United Nations University, the World Bank and the World Intellectual Property Organization, and by the International Council for Science and the children and youth major group. The findings synthesized the evidence and conclusions from eight meetings and sessions held under the umbrella of the Mechanism,[1] 10 recent reports and publications of the United Nations system, written inputs from the 10-member group and from the inter-agency task team, and 50 science-policy briefs.

12. Digital technologies, robotics, artificial intelligence and automation, biotechnology and nanotechnology all have far-reaching impacts and present opportunities and challenges in respect of the economy, society and the environment that can already be felt in all countries. They require society to engage actively with a number of issues identified by experts of the Mechanism and set out below.

13. **Great potential**. The potential benefits of new and rapidly changing technology clusters are so great for the achievement of the Sustainable Development Goals and beyond that society cannot afford to ignore such technology.

14. **Technology risks and gaps**. Technology change has never been neutral, creating winners and losers, involving risks and potentially exacerbating gaps and inequalities. The United Nations has an important role in promoting action on those issues.

15. **Impacts of cheap automation and artificial intelligence on development**. The rapidly declining costs of new technologies can broaden access to the benefits of technology and enable much more rapid development, but they also present extraordinary policy challenges that call for an extraordinary level of international cooperation. Many countries may need to find new development pathways that incorporate those technologies and to rethink employment and income distribution issues.

16. **Impact on employment**. The overall effects on employment will depend on the specific circumstances within sectors and on the various local contexts. Computers and robots could replace as many as half of all human jobs in the coming decades, essentially precluding traditional routes to achieving economic development in some countries, but they could also create many new jobs. It is unclear how job losses and job creation will compare and how they will be distributed; however, society needs to be prepared for different scenarios to unfold.

17. **Preparation for the impact**. Governments will need to rethink and reorganize how they match the supply of skills to the rapidly evolving needs of the job market in formal and informal education systems. Some experts of the Mechanism called for the testing of proposals for technological unemployment insurance, for policies on guaranteed income and for a range of other compensatory social policies.

[1] See, in particular, the first and second expert group meetings on rapid technological change, artificial intelligence, automation and their policy implications for sustainable development targets, organized by the Department of Economic and Social Affairs, the Economic Commission for Latin America and the Caribbean and the United Nations Conference on Trade and Development, held in Mexico City from 6 to 8 December 2016 and on 26 and 27 April 2018, respectively.

18. **Impact on the natural environment**. New materials, digital technologies, biotechnologies and nanotechnologies and artificial intelligence hold great promise for a range of high-efficiency water supply and renewable energy systems that could be deployed in all countries and catalyse the global move towards sustainability. However, despite efficiency increases, artificial intelligence and all the other emerging technology clusters will require ever-increasing electricity, with its associated pollution and wastes (e.g., e-waste, waste from nanomaterials and chemical waste), which means that it will be necessary to incorporate environmental considerations into the design of those technology systems from the start.

19. **Strengthening of the science-policy interface**. Society's knowledge and understanding of new technology trends, especially in developing countries, need to be expanded and serve as the basis for well-founded actions and policies. Experts of the Mechanism proposed building partnerships and interfaces with universities, laboratories, innovation incubators and private sector entities that are at the forefront of the technological change, potentially in the form of a discovery laboratory or a network of science, technology and innovation centres to serve as an interface between policymakers and technologists at the frontier of technological change, facilitating the exchange of real-time information, engagement and policy insights.

20. **Norms and ethics**. Calls for a more responsible and ethical deployment of new technologies have to be balanced against concerns that excessive restraints on innovations may deprive humanity of many benefits. Ethical and normative considerations that should guide the thought process on those issues have to spring from a shared vision, namely, the values contained in the Charter of the United Nations, the Universal Declaration of Human Rights, the outcome document of the United Nations Conference on Sustainable Development entitled "The future we want" (General Assembly resolution 66/288, annex) and, most recently, the 2030 Agenda for Sustainable Development.

21. **Multisectoral and multi-stakeholder engagement**. It is now more important than ever to foster coherence across policies on macroeconomics, science and technology, industrial development, human development and sustainability, and to foster multi-stakeholder dialogue in order to present different perspectives, arrive at a shared understanding and establish trust.

22. The aforementioned issues are, by design, complemented by those contained in the recent report of the Secretary-General on the impact of rapid technological change on sustainable development (E/CN.16/2019/2).

23. In the discussions that followed the presentation, private sector representatives offered their support to work with Governments to keep pace with technological breakthroughs and find ways to leverage them in order to achieve the common aspirations of the Sustainable Development Goals. Many case studies from the private sector and of partnerships are available in that regard. An idea of common table was presented as a means to bring all actors together. The online platform of the Mechanism was highlighted as an important tool that should be engaging and interactive, allowing participants to learn and partner with others.

24. Notably, resistance to antibiotics was identified as an emerging global health crisis. Commensurate support for efforts in academia and the business sector towards reducing, or even eliminating, antibiotic resistance is urgently needed.

25. Participants in the forum were briefed on progress and consultation processes undertaken by the Secretary-General's High-level Panel on Digital Cooperation. The Panel has focused on the issues of digital commons for the Goals, metrics for digital inclusion, economic policy coordination and regulation. The Panel had indicated the importance of values and principles, workable mechanisms and illustrative actions. It

was found that high-tech solutions can be used to tackle low-tech challenges, and low-tech solutions can be delivered through high-tech mechanisms, hence, both are intricately linked to one another. Governments should thus build partnerships with universities, innovation incubators and the private sector, linking stakeholders at the frontier of technological change with policymakers.

26. The discussions on new and emerging technologies have been ongoing at the forum since 2016 and are likely to continue at the forum, the meetings of the Commission on Science and Technology for Development and other forums at the regional and national levels. Not all policymakers are aware of the far-reaching potential effects of accelerated technology change and how to strategically respond to those trends. Against that background, the inter-agency task team was encouraged to identify and facilitate the implementation of good practices and public policy responses related to the Goals, including through a repository of good practices and salient empirical data.

Strengthening of capacity and policy for the development of science, technology and innovation road maps (ministerial segment and technical round table)

27. The challenge is to design science, technology and innovation policies and instruments for the Sustainable Development Goals that translate the universality principle of the Goals into action, while respecting national science, technology and innovation priorities and realities. Science, technology and innovation road maps to achieve the Goals, together with measures for tracking progress, can be important strategic tools for ensuring policy coherence and for finding solutions to development challenges.

28. In the ministerial segment, the following countries and political groups shared their experiences, emphasizing the role of science, technology and innovation as a central element of national development strategies, policies and programmes: the Group of 77 and China, the European Union, Barbados, Ecuador, Egypt, Ethiopia, Hungary, Japan, the Philippines and Serbia. Their submitted statements are available on the website of the forum at https://sustainabledevelopment.un.org/index.php?page=view&type=20000&nr=5519&menu=2993.

29. Speakers suggested the establishment of an international funding mechanism to support small and medium-sized start-ups in technology and bright and creative young people, as well to support the development of human skills through new fabrication laboratories and technological learning centres in which innovators could pilot and commercialize their products and services.

30. Speakers encouraged addressing the needs of small island developing States and other small developing countries and working on solutions for those countries to better leverage technologies for development and to become technology creators themselves.

31. A number of lessons have been learned from national plans, policies and road maps on science, technology and innovation, many of which were already discussed at the forum in 2018. On the basis of those findings and further expert consultations, the inter-agency task team has produced a technical guidebook on science, technology and innovation road maps to achieve the Goals. The 2019 forum also included a technical round table dedicated to the road maps.

32. The cross-cutting nature of the Goals requires holistic approaches and strategies that are multidisciplinary and take into account different sources of knowledge. Global partnerships are essential. Science ecosystems and advisory systems need to be improved and relevant stakeholders need to be involved in the design, adaptation and application of science, technology and innovation policies. Collaboration should

be fostered among scientists, engineers, companies, public research and government institutions and the end users of technological products.

33. Participants in the round table explored how to integrate the range of issues related to frontier technologies into science, technology and innovation road maps. Market-ready, integrated frontier technology solutions exist to support developing countries in achieving specific Goals. The role of Governments is to build the infrastructure and education systems. In order to identify appropriate technology solutions, the entire value chain, business models and potential impacts need to be considered.

34. It is important to balance policy coherence across sectors, including through in-depth analysis of goal-specific road maps. Affordability, economics, technical efficiencies and people's needs should be considered. Close collaboration between Governments and the private sector is essential for the development and implementation of the road maps. Different groups of countries will have different needs.

35. Participants in the round table also assessed the various partnership models for the road maps. They found certain types of public-private partnerships promising, but acknowledged great regional and national differences. Globally, official development assistance for science, technology and innovation amounts to about $20 billion per year, but it is highly fragmented and should be provided in response to the prioritized needs of countries. It is important to note that even a simple replication of successful existing technology in other countries is risky, local human talent being a critical factor.

36. Science, technology and innovation road maps to achieve the Goals need to be customized to fit the circumstances within countries and, at the same time, be harmonized worldwide as a means to structure the necessary knowledge and match problems with solutions. National innovation systems, governance, regulatory environments and, ultimately, the precise value proposition of the technology solutions need to be considered in the road maps. Attention should be paid to market-ready technology solutions, and efforts should be made to build strong linkages with stakeholders and outline the potential wider impacts of proposed science, technology and innovation policies.

37. Main elements of the implementation of the road maps include the localizing, mobilizing, prioritizing and customizing of science, technology and innovation. The inter-agency task team's guidebook on the road maps can also serve as a tool for communicating with stakeholders and citizens. Raising social awareness and increasing inclusion are essential. In view of the complexity of the challenge, capacity-building is critical in order to bring everyone to a minimum knowledge level before engaging in the development of the road maps. Such capacity-building has been the focus of the inter-agency task team subgroup on capacity-building.

38. Sociocultural sensitivities need to be considered, institutional issues need to be included and science and technology communities need to be fully involved in the road map development and implementation process. The positive and negative effects of the implementation of the road maps should be clearly predicted and monitored. The sustainability of infrastructure construction is key. Governments should stimulate cross-sector cooperation and carefully examine the social, economic and environmental impact of frontier technology and react to the findings with fine-tuned policies.

39. Further international support, Member State engagement and partnerships with donors and the private sector will be needed to fill the critical gaps in data, finance and effective implementation. The United Nations system, through the inter-agency

task team, is encouraged to design an international road map of science, technology and innovation for the Goals as a communication tool, on the basis of expert input and the contents of national or local road maps. International organizations need to mobilize funding to support road map implementation, enable policy learning, improve capacity for monitoring and analysis and inform international efforts.

40. National road maps can be a significant output of the Technology Facilitation Mechanism. They can help decision makers in Government and civil society, as well as members of the public, from Heads of State and finance ministers to citizens at the local level, to evaluate whether a nation's policies, investments and actions are achieving the intended outcomes efficiently and effectively. United Nations experts in the inter-agency task team, the 10-member group and partners of the Mechanism constitute an important source of expertise and financial support, which should be effectively mobilized. Members of the inter-agency task team subgroup on science, technology and innovation road maps, most notably the World Bank, are currently exploring national pilot applications.

Science, technology and innovation to support education and decent work for the future (Goals 4 and 8)

41. Science, technology and innovation have strongly shaped and changed the worlds of work and education, and that trend is expected to accelerate in the next 10 to 20 years. Digitalization continues to create new types of jobs, even as its disruptive nature continues to be a matter of great concern. New and emerging technologies will continue to increase efficiencies and may benefit workers (e.g., by promoting part-time work and online learning). The recommendations on artificial intelligence and the policy toolkit of the Organization for Economic Cooperation and Development were highlighted as useful guidance in that regard.

42. Science, technology and innovation can support efforts towards Goals 4 and 8 through proactive, lifelong learning and skills development of workers. At the same time, high-quality university education in science and engineering remains crucial.

43. A paradigm shift in action and practices in the field of education is needed to prepare for a rapidly changing future of work. In the context of national development processes, formal and informal education systems need to be continuously adapted to prepare students, researchers and workers for disruptive technologies. Concerted efforts are needed for a greatly expanded and interconnected, worldwide education system in the fields of science, technology, engineering and mathematics that is open and accessible to talented people around the globe. Comprehensive learning strategies should also be targeted at learning in families, social networks and enterprise networks. Engineering education needs to be geared towards addressing challenges in the context of the Goals and be focused on human-centred design. Similarly, policymakers need to negotiate a delicate balance so that jobs are not lost as a result of technology change in a way that causes social dislocations in societies in which the unemployed are not easily reabsorbed into the job market.

44. There are strong links between access to capital and education as enablers of science- and technology-driven development. Financial resources are dedicated to achieving higher education levels, and higher education levels help to attract investment, reflecting a virtuous cycle that drives development. Hence, adequate public and private investment in education is paramount for sustainable development.

45. National innovation systems should be geared towards supporting new employment opportunities and inclusive growth, reflecting innovation goals, technology direction and capacity. Basic research and its close connection with applied research are important. A global infrastructure needs to be built to allow all countries to benefit from frontier technologies. Stakeholders should jointly develop

international standards for frontier technologies. The number of science, technology and innovation researchers needs to be increased significantly in many countries, and elements of science, technology, engineering and mathematics need to be expanded in school curricula, including through the development of global educational qualifications. In that regard, the leading scientific nations should provide capacity support and tools to other countries, including the transfer of educational technology through official development assistance.

Gender and science, technology and innovation in the context of the Goals

46. Globally, women spend twice as much time on unpaid work as men. According to the International Labour Organization, women's unpaid work amounts to 12 billion hours per day, which equals about 2.1 billion jobs. Those vital unpaid contributions are typically ignored in official statistics and estimates of gross domestic product, and in economic policies in general. It is important to recognize those economic contributions and to address the significant data gap.

47. Technology access for women in lower social strata remains varied. However, mobile technologies have proven to be particularly useful enablers of financial transactions in the informal sector. Political leadership can address the existing divide and ensure that women's issues are included in science, technology and innovation and labour policies. In particular, Governments could showcase the usefulness of technology in the daily activities undertaken by women.

48. Continued efforts are needed to improve the representation of women in technical fields. However, approaches to gender and science, technology and innovation have dramatically changed in the past few years. It is now recognized that it is not simply a matter of increasing the number of women, but of promoting structural change in science, technology and innovation institutions. In particular, girls should be engaged in technology early on during schooling, and top talents could be identified in order to provide them with mentorship and role models, connect them with others in the field and inspire them. Ultimately, increased representation of women will improve science, innovation and problem-solving. Hence, women and girls are essential as both beneficiaries and creators of science, technology and innovation.

49. Some countries face a shortage of science, technology and innovation workers. Yet, excellent minds can be found anywhere – they simply have to be matched with opportunities. Boot camps can be cost-effective tools for providing technology training to women. Government policies and flexible, culturally sensitive arrangements in corporations can improve the recruitment and retainment of women in technology industries. Direct support for placements in companies can also be useful. International science organizations should continue advocating gender equality in science.

50. Software coding could be taught in different ways in order to make it accessible to everyone. For example, teaching coding more like a language rather than a complex set of algorithms can make it less daunting and thereby attract greater interest among the wider population, including among girls and women.

51. Following the session, a special exhibition on gender and science, technology and innovation prepared by the inter-agency task team was launched. It celebrated prominent women scientists from around the world and their contributions.

A brighter future: the role of young people in relation to innovation ecosystems and development

52. Young people are a force for development. They tend to be pioneers and first adopters of new ideas and technologies. Most importantly, young people are the leaders of tomorrow. Decisions made today will have long-term implications, often with consequences that will only be recognized in the long term.

53. Participants in the forum heard the views of younger generations on the kind of science, technology and innovation policies and solutions they would like to see. A large number of side events were organized by younger people, many of the initiatives spearheaded by the children and youth major group.

54. Intergenerational equity is a core principle of the Rio process. It is essential to ensure that science, technology and innovation policies and solutions designed today do not jeopardize the capabilities of future generations to deal with emerging challenges because of technology lock-in and path dependence. This can be achieved in numerous ways, for example, by enabling young scientists to become involved in science advisory systems, community-based technology assessments and simulations to forecast short- and long-term consequences of science, technology and innovation policies and solutions, and by providing opportunities for peer learning and mentorship.

55. Young scientists, engineers and entrepreneurs should be fully involved in the decision-making process on matters of science, technology and innovation, especially with regard to the impact of rapid technological change. Science literacy and modern science education for youth are important. From the earliest stages of their careers, scientists, engineers and innovators need to be systematically supported, in particular as a means to retain top talent in relevant areas in order to address challenges relating to science, technology and innovation in the context of the Goals. Similarly, providing young people with access to seed funding and continued resources for their science, technology and innovation ventures is worthwhile.

56. In the least developed countries, science literacy levels need to be raised. All technological means should be considered in efforts to achieve universal access to affordable education. That need is especially important given the comparatively large proportion of the population in poorer countries made up of young people.

57. Science, technology and innovation policies should be continuously and critically assessed, informed and inspired by younger people so as to shape the visions for the future. Such an approach is essential to elicit multiple perspectives, allow for comparisons and enable co-designing with communities to ensure relevance.

58. Similarly, effective science communication is important to bridge the gap between science and society and to ensure that science addresses societal needs and concerns, and that ethical considerations are taken into account.

Science, technology and innovation for inclusive and equitable societies (Goals 10 and 16)

59. In the past, science, technology and innovation have been both a cause of and a solution to the issue of inequalities within and among countries. Progress in science, technology and innovation does not necessarily lead to extreme forms of technology divides. Rather, institutions play a decisive role in determining the ultimate direction of science, technology and innovation. International cooperation on matters relating to science, technology and innovation is essential in that regard.

60. Partnerships between Governments and the private sector can be useful for leveraging technology to deliver social protection programmes and enhance digital opportunities for citizens.

61. Persons with disabilities should be involved in all stages of the technology development cycle. Ethical considerations and the principle of universal design can help to ensure that technology is available, affordable and accessible. It is important to involve persons with disabilities since they have typically been excluded from the technology development process despite being key users of artificial intelligence and robotics.

62. Various international programmes are important supporters of efforts in science, technology and innovation to achieve Goals 10 and 16. For example, the European Union project known as "Horizon Europe" is a €100 billion research, development and demonstration programme that will also support the Goals through co-creation and dialogues with citizens. The approach of the World Bank to mitigating technology risks combines building the infrastructure for technology, boosting users' capacities and brokering infrastructure access, in particular for poorer countries.

63. Digitalization can play an important role in improving private sector productivity and governance. It can enhance the participation of citizens and improve access to health care and financial transparency. Examples showcased included the use by the World Food Programme of blockchain technology to deliver aid to refugees and the e-governance portals of Armenia and Georgia.

64. As the application of technology becomes ever more useful and ubiquitous, or precisely because of those trends, it is important not to lose sight of the potential risk of technology becoming all-consuming to the point that it erodes rather than improves the quality of life.

65. There are a number of science, technology and innovation solutions that have demonstrably helped to reduce corruption. Online platforms limit interactions between civil servants and contractors or service providers. It is especially important to eliminate cases of corruption in the construction sector, and such efforts can be supported by innovative technology solutions.

66. The science, technology and innovation sector and especially financial technologies require better regulation, which is only possible if Governments and society at large have a minimum understanding of the technology-related issues. At the same time, Governments should invest in data systems, following best practices in data privacy, transparency, openness and accountability. It was also suggested that the United Nations lead the creation of standardized national addressing systems in developing countries.

Role of science, technology and innovation in taking action to combat climate change and its impacts (Goal 13)

67. There are several technological pathways to achieving net zero greenhouse gas emissions into the atmosphere and to limiting global warming to less than 1.5°C in the twenty-first century. Effective technology solutions are available in principle, and political commitment has increased in many parts of the world. However, trade-offs between, on the one hand, the large-scale deployment of greenhouse gas mitigation and climate-altering technologies and, on the other hand, other policy objectives need to be better understood and quantified at various levels. Good governance, participatory approaches, business partnerships and international cooperation will be essential in that regard.

68. More than 9,000 cities worldwide are already addressing climate change. Most infrastructure and 80 per cent of global gross domestic product are concentrated in

urban areas, many of which face the double challenges of urbanization and the early impacts of climate change. Recently, the Global Covenant of Mayors for Climate and Energy established the "Innovate4cities" initiative to create partnerships between the scientific and academic community and cities and to use science as a basis for their decisions. Thousands of cities have signed the Edmonton Declaration, which calls for science-based decisions and climate action in line with the Paris Agreement.

69. More investments in science, technology and innovation are needed in almost all countries. International collaboration on the application of science, technology and innovation to climate change mitigation and adaptation is needed. International partnerships could promote increasing investments in research and development and in demonstration projects for climate technologies. Ultimately, regional adaptation plans will be needed, which may need to include relocating climate refugees and protecting their human rights.

70. Globally, an estimated 10 million new students are now engaged in multidisciplinary studies that are, in one way or another, related to climate change. Yet, no unified applied climate science and technology studies exist as an academic discipline.

Linking of science, technology and innovation of indigenous peoples, cultures and traditional knowledge with the achievement of the Sustainable Development Goals

71. The international community should not underestimate the practical knowledge of indigenous peoples. The development of science, technology and innovation at all levels could help to drive transformation towards sustainable development through a bottom-up process and encourage relevant actors to ensure that science, technology and innovation road maps fully respond to the needs of indigenous people.

72. Local and indigenous knowledge has an important role in addressing complex global issues, such as biodiversity loss, weather risks, climate change and desertification. However, conducive conditions and partnerships are needed to mobilize such knowledge.

73. Important synergies can be realized between, on the one hand, traditional, local and indigenous knowledge and grass-roots technologies and, on the other hand, modern scientific knowledge, leading to accelerated progress towards the Goals. To that end, policymakers and development practitioners should acknowledge the traditional knowledge systems and take into account the specific sociocultural contexts. That acknowledgement is especially important when new technologies, such as artificial intelligence, are introduced at the community level.

74. Governments should support dialogue among different knowledge systems so as to facilitate the innovation process at the national level. Funding is needed also for traditional knowledge systems in order to ensure that knowledge is passed on to the next generation.

75. International organizations should find new ways to reach out to indigenous communities through online platforms or similar forums focused on those communities. In its guidebook on science, technology and innovation road maps, the inter-agency task team should consider indigenous knowledge and communities.

Support for the implementation of the Technology Facilitation Mechanism: the way forward through joint action

76. The end of the four-year cycle of the high-level political forum on sustainable development is an opportune time to look back on what has been achieved, but also to look forward to an ever greater engagement of scientists, engineers and innovators

and the resulting forging of new partnerships for action. The forum on science, technology and innovation has matured and has firmly established discussions on science, technology and innovation at Headquarters. It is the primary United Nations entry point for scientists, innovators and researchers. In the words of a former Co-Chair of the forum, “there are great opportunities where great impact can be seen”.

77. Panellists and speakers not only reflected on lessons learned from the start-up phase of the Technology Facilitation Mechanism, since 2015, but also discussed ways for actors involved in the Mechanism to work closely with those involved in the Internet Governance Forum and the Technology Bank for the Least Developed Countries.

78. Interest in and demand for the Mechanism has continued to increase over the past year. Thus, renewed efforts should be made to involve a wider range of global science communities and civil society in the planning of and follow-up to the forum, building on existing mechanisms and intersessional dialogue conducted online and offline.

79. Participants in the forum commended recent progress in the work of the inter-agency task team and the 10-member group. The intersessional work of the Mechanism should involve building links to important events and initiatives related to science, technology and innovation in order to expand the scope of the forum and draw on knowledge from diverse stakeholder communities. Examples of such communities include the Global Solutions Summit, the Global Sustainable Technology and Innovation Conference, the Commission on Science and Technology for Development, the Internet Governance Forum, the Artificial Intelligence for Good Global Summit organized by the International Telecommunication Union, the World Science Forum organized by the International Council for Science and the United Nations Educational, Scientific and Cultural Organization, forums organized by the Organization for Economic Cooperation and Development and conferences of development banks.

80. Participants requested that the substantive work of the inter-agency task team be strengthened and systematized by fully engaging the 10-member group, science and engineering stakeholders, donors and interested Governments as political champions.

81. Science and technology are most needed in countries and places where such developments have been lacking. Hence, capacities need to be built, not only for research and development and for specific technology solutions, but also, most crucially, for the practical deployment of technology solutions on a large scale. Similarly, technology management capacities are essential for identifying economically affordable, environmentally sound and socially acceptable new technologies. Participants in the forum welcomed the inter-agency task team joint capacity-building initiative, through which training materials and staff expertise had been pooled to organize a training workshop in Panama, from 5 to 8 May 2019, with several more workshops planned in the coming months.

82. Political commitment and scientific leadership continue to be of paramount importance. Participants encouraged technical and financial support for the full operationalization of the online platform of the Mechanism. The prototype platform continues to be improved, with an increasing number of partnerships established for the further development, maintenance and operation of the platform.

Exhibition hub featuring the winning initiatives of a global call for innovations

83. As in previous years, an integral part of the forum was an exhibition hub that featured winning initiatives of a global call for innovations to achieve the Sustainable

Development Goals and a showcase with a selection of corporate solutions. Those innovations, selected from around the world, needed to meet the criteria of being transferable, inspiring and impactful.

84. The exhibition was launched through a special event. The innovations addressed technologies to improve education delivery (Goal 4), support skill building for work (Goal 8), promote cleaner cooking fuels (Goal 7), reduce greenhouse gas emissions (Goal 13), reduce waste (Goal 12) and improve transparency and accountability (Goal 16). The winning initiatives, which were presented at the forum, are the following:

(a) “A roof, a skill and a market for women” is an initiative that provides housing, builds skills and creates a market to end housing poverty in Africa, thereby enabling beneficiaries to participate in the $4.9 billion urban housing market of Uganda;

(b) “Biolite homestove” is an innovative, fan-assisted biomass stove that burns wood as if it were gas, turns fire into electricity and reduces smoke emissions by 90 per cent and fuel consumption by 50 per cent compared with traditional open-fire cooking;

(c) “Coliba recycling” is an initiative that makes use of mobile technology to create solutions for the massive problem of plastic waste in West Africa;

(d) “No food waste” is a youth- and technology-driven surplus food recovery network through which surplus food from weddings, restaurants and food industries are collected and redistributed to people in India, thereby combating both hunger and food waste together;

(e) “It’s our forest too” is a smartphone application used by indigenous communities to monitor and report on illegal logging and biodiversity loss;

(f) “We love reading” is a grass-roots community-based programme to encourage children to read for fun;

(g) “DIYlaw” is a one-stop hub for all legal matters in Africa, which provides access to legal and business support services, service providers and information for African entrepreneurs;

(h) “Broad class: listen to learn” is an interactive radio instruction programme that provides lessons and teacher training and reaches the poorest and remotest schools through the provision of interactive lessons on basic skills and English; measurable gains have been made in quality, equity and inclusiveness with regard to education;

(i) “Using unmanned aircraft to map, monitor and protect indigenous territories” is an initiative that uses unmanned aircraft as a low-cost, powerful and effective tool for indigenous communities to map, monitor and protect their territories; the aircraft help to collect important data and are an alternative to satellite images for precise photogrammetry and two-dimensional and three-dimensional mapping;

(j) “Can’t wait to learn” is a custom-made digital game-based learning programme to bridge the education gap for conflict-affected children;

(k) “Zelij invent” is a solution using green technology that transforms plastic waste into sustainable construction materials.

III. Key messages and general recommendations

85. Participants in the forum highlighted many practical examples and made proposals for action by the United Nations system, Governments, businesses, scientists, academia, civil society and others. The necessity of a multi-stakeholder approach was repeatedly underscored. The issues set out in paragraphs 86 to 98 below may be considered by decision-makers, in addition to the wider range of recommendations on how to address the challenges to achieving Sustainable Development Goals 4, 8, 10, 13 and 16 and a number of cross-cutting issues (see section II above).

86. The Technology Facilitation Mechanism constitutes a way of working that is entirely new within the United Nations system, especially in terms of engaging many communities and individual experts in the fields of science, technology and innovation that are not typically involved in the work of the United Nations.

Role of science, technology and innovation in achieving the Goals

87. Many insights have been gathered with regard to technology solutions aimed specifically at achieving the Sustainable Development Goals, including those that help to manage trade-offs and realize synergies. Attention should now move to identifying and assessing high-impact, integrated technology solutions for all of the Goals, their sociotechnical feasibility and potential impact. Such technologies should be discussed at the 2020 forum.

88. Similarly, every year since 2016 hundreds of innovators have responded to the call for technology innovations aimed at achieving the Goals. It is time to follow up on, support and create partnerships for supporting the scaling up of those and other similar innovations.

89. The Technology Facilitation Mechanism has become the premier multi-stakeholder mechanism in the United Nations system for advancing science, technology and innovation applications to achieve the Goals. Existing conferences and events within and outside the United Nations may become associated with the forum and consider presenting their science, technology and innovation findings at the forum. The online platform, as mandated by the 2030 Agenda, is almost operational, but requires further support from donors, the private sector, international organizations and others to reach that stage.

New and emerging technologies, frontier technologies and rapid technological change

90. While the Technology Facilitation Mechanism has made progress in documenting and analysing the wider societal impact of new technologies, far greater knowledge and quantitative insights are needed – in both developed and developing countries – in order to prepare for the different scenarios of how those effects might unfold in the coming years. Building the capacities of developing countries to assess and prepare for those effects and the exchange of experiences on public policies and good practices will be needed and should be systematically supported by the United Nations.

91. The responsible and ethical deployment of technologies has to be balanced against concerns that “excessive” restraints on innovations might otherwise deprive humanity of many benefits. Finding such a balance requires pragmatic, evidence-based ethical assessments that must derive from the values contained in the Charter of the United Nations, the Universal Declaration of Human Rights, the outcome document of the United Nations Conference on Sustainable Development and the

2030 Agenda. The forthcoming report of the High-level Panel on Digital Cooperation is expected to provide guidance in that regard.

92. Holistic, integrated approaches and strategies are needed. They should draw on a wide range of forms of knowledge and perspectives, including those of young people and local, traditional and indigenous forms of knowledge, and be supported by new and emerging technologies.

93. Extraordinary levels of international cooperation on research, infrastructure, access and capacities are needed in order to overcome the technology gaps between and within countries, between men and women and across social groups, ultimately in order to avoid long-running, low-technology traps. Such cooperation requires multi-stakeholder approaches and support from the United Nations system.

94. A forward-looking perspective is needed to understand the potential opportunities and challenges associated with the impact of rapid technological change on the achievement of the Sustainable Development Goals.

95. In that regard, key emerging issues need to be systematically identified by the Mechanism. One such example was the call made at the forum in 2019 to fully support academic and business efforts towards reducing, or even eliminating, resistance to antibiotics.

Science, technology and innovation road maps and action plans to achieve the Goals

96. Science, technology and innovation road maps for achieving the Sustainable Development Goals and related action plans need to be developed at the national and subnational levels, ideally with measures for tracking progress and in line with national and global development strategies. The road maps and action plans are strategic tools for ensuring policy coherence, linking public and private actions and optimizing investments. They are also powerful communication tools.

97. The guidebook of the inter-agency task team provides an outline of the scope and nature of the road map development process. It was suggested that a group of Member States could lead the way by undertaking serious efforts over the coming year to develop their own versions of a road map and reporting on their experiences, in the coming years, at the science, technology and innovation forum and the high-level political forum on sustainable development.

98. The participation of science communities, funders, academia and the private sector needs to be further expanded and deepened, and partnerships are essential. Regardless of the model of involvement, a business case should be made for private sector investments in innovations aimed at achieving the Goals. Member States were also called upon to support the Technology Facilitation Mechanism, both politically and financially.

IV. Recommendations for the multi-stakeholder forum on science, technology and innovation for the Sustainable Development Goals

99. Going forward, the forum will continue to strengthen its convening power for dialogue between stakeholders and Governments and for the sharing of ideas and the catalysing of new initiatives and partnerships. It will continue to help to identify practical means and solutions to foster science, technology and innovation in all countries.

100. Continued real demand for the forum and its science-policy interface function in support of efforts towards the Sustainable Development Goals is apparent. Given the high expectations for the Technology Facilitation Mechanism, Member States and stakeholders should consider strengthening their political and financial support for the Mechanism.

101. The multi-stakeholder Mechanism should continue to facilitate the inclusion of stakeholders and associated related events and improve coordination with the United Nations system and other international organizations. Support is needed for even greater participation by government representatives and innovators from developing countries. Significant support is needed to fully operationalize and expand the online platform of the Mechanism into a veritable portal for partnerships on science, technology and innovation to achieve the Goals. Support is also needed for the expert work of the various inter-agency task team subgroups to better integrate the work streams of the subgroups and to disseminate and communicate the work of the inter-agency task team.

102. The task team's subgroup on new and emerging technologies, frontier technologies and rapid technology change should make a special effort to disseminate salient information on and support knowledge and understanding of the trends, impact, good practices, initiatives and public policies relating to science, technology and innovation for achieving the Goals. A forward-looking perspective, coherent and plausible scenarios and more robust quantitative approaches could help in that effort.

103. The Mechanism should build partnerships and interfaces with universities, innovation incubators and private sector entities that are at the forefront of technological change. In particular, the Mechanism may want to further pursue the idea of a discovery laboratory or a network of science, technology and innovation centres to serve as an interface between policymakers and technology pioneers, facilitating a two-way exchange of real-time information, engagement and policy insights.

104. The work of the task team's subgroup on science, technology and innovation road maps to achieve the Goals should continue to support the development of multi-stakeholder road maps in interested countries, on the basis of the conceptual approaches outlined in the recent guidebook produced by the task team. International support, Member State engagement and partnerships with civil society and the private sector will be needed to develop capacities and fill critical gaps in data, finance and effective implementation. United Nations experts in the inter-agency task team, in the 10-member group and among Mechanism stakeholders constitute an important source of technical expertise in that respect.

105. Similarly, the inter-agency task team subgroups on capacity-building and on gender and science, technology and innovation need full support and engagement.

106. In view of the demand for further work streams, the inter-agency task team and 10-member group are encouraged to take stock of the start-up phase of the Mechanism from 2015 to 2019 and to optimize its focus and working structures on the basis of the lessons learned.

107. Over the coming 11 years, the multi-stakeholder forum on science, technology and innovation should learn from and advance the achievements of the forum since 2016. The forum might become the outcome of an annual programme of results-oriented activities in the inter-agency task team subgroups, in close cooperation with the 10-member group.