

Training Workshop on Science, Technology and Innovation Policies for Sustainable Development in the Fourth Industrial Revolution

19-22 March 2019

Incheon City and Sejong City, Republic of Korea

MEETING REPORT

The Training Workshop of the United Nations Economic and Social Commission for Asia and the Pacific East and North-East Office (UNESCAP-ENEA) and the Science and Technology Policy Institute (STEPI) of the Republic of Korea, in partnership with the Asia Pacific Research and Training Network on STI Policy (ARTNET on STI Policy), was held in Incheon and Sejong, Republic of Korea, from 19-22 March 2019. The workshop comprised of nine sessions dedicated to building the capacity of countries in the Asia-Pacific region to respond to the changing STI policy landscape, particularly with regards to a) the shift towards an integrated sustainable development approach to STI policy, b) the emergence of frontier technologies and the 4th Industrial Revolution, and c) innovations within the public sector to enhance policy making and service delivery. Two site visits to K-City (testing site for autonomous vehicles) and Pangyo Technovalley (the tech and startup hub of the Republic of Korea) were also organised for the participants.

The Workshop was attended by official representatives from the following Member States: Cambodia, China, Indonesia, Lao People's Democratic Republic, Indonesia, Malaysia, Mongolia, Myanmar, Philippines, Sri Lanka, and Viet Nam.

A. Opening Remarks

1. The Head of the UNESCAP-ENEA Subregional Office, Mr. Ganbold Baasanjav, delivered opening remarks. In his address, he warmly welcomed all delegates to the first training workshop of the Subregional Office of East and North-East Asia and expressed his hope that the discussions to take place during the workshop would contribute to the further development of the capacity of UNESCAP member states to develop and implement science, technology and innovation policies that benefits all of society, grounded in the 2030 Agenda for Sustainable Development framework, and to promote the fostering of innovation within the public sector. He also announced the launch of the report, [*Evolution of Science, Technology, and Innovation Policies for Sustainable Development: the Experiences of China, Japan, Republic of Korea and Singapore*](#), which served as a principle reference informing the development of the training workshop to build the capacity of government itself to be able to develop effective STI policies.

2. The President of STEPI, Mr. Hwang-Hee Cho, delivered congratulatory remarks. In his address, he underscored the importance of STI policy and strategic technology management in socio-economic development. He further emphasized that the workshop served as a platform to identify and develop more tangible projects to collaborate and tackle new and unprecedented challenges in the era of the Fourth Industrial Revolution.

B. Science, Technology and Innovation Policy in the 4th Industrial Revolution

3. Ms. Marta Pérez Cusó, Economic Affairs Officer, UN ESCAP, gave a presentation on **STI Policy and the SDGs** in which she highlighted how the establishment of STI policies served as a means to not only support national development goals such as productivity and the creation of jobs, but also to tackle social and environmental challenges. She expressed that, following the spirit of the SDGs to leave no one behind, the next generation of STI policies should be mission-driven while being time-bound and addressing the interlinking economic, social and environmental spheres. In addition to covering how the Fourth Industrial Revolution offered an opportunity to address issues of ethics and the creation of jobs, she also underscored that the priority should be placed on the promotion of inclusive innovation – particularly its accessibility, appropriateness, and affordability – so that ‘innovations for the poor’ and ‘innovation by the poor’ can be developed to cut across multiple social (marginalized groups), economic (smaller firms, inclusive business), and geographical (rural, landlocked, least developed) dimensions. Ms. Pérez Cusó recommended a four-part process for the way forward to achieve inclusive innovation in Asia-Pacific. Firstly, leadership must work on generating alliances that support long-term inclusive innovation policies and foster inclusive technology & inclusive business models. Secondly, understanding Inclusive innovation is needed to further analyze and share the variety of Asia-Pacific experiences in addressing the socio-economic impact of technologies in different groups and contexts, including indirect or unintended impact. Thirdly, the coordination of efforts should be encouraged to explore new approaches to align action (co-design, co-implementation etc.) and to create structures and incentives that facilitate whole-of-government and multi-stakeholder approaches. Finally, capacity-building is needed (a) to encourage the understanding of systemic and inclusive STI approaches among STI policymakers and non-tech policy makers, (b) to collect inclusive STI data and capacity analyses, and (c) to assess the impact of STI policies.

4. Mr. Young Rak Choi, Professor at Korea University and adviser to the Minister of Science and Technology of Ethiopia gave a presentation on **Policy Design and Evaluation**, in which he discussed the critical role of government and political leadership in the early stage of STI development. Using the Republic of Korea as a case study, he underscored the key role that the Korean Government played in cultivating an R&D sector that allowed the country to develop and advocated for aggressive long-term investment in R&D, the cultivation of human resources and globally open networks, the selection and focus on strategic areas, the improvement of implementation capabilities (resource concentration, infrastructure, ecosystem), building consensus, and fostering strong leadership in the STI community. While discussing major STI policy instruments, he emphasized the need for a comprehensive STI technology roadmap to establish long-term and short-term forecasting and planning, to continually evaluate projects in order to change target goals accordingly, to follow through with policy ideas with real terms for actual implementation, and to identify gaps between STI plans and execution. This was complemented with advice for developing countries to create linkages between the public and private sectors, and to carefully assess the capabilities of each sector in supporting international STI competitiveness so as to create local agile strategies that help the country meet - and potentially surpass - global standards. Mr. Choi also expressed the need for accountability and transparency in the monitoring and evaluation process, not only to get objective information to guide resource allocation and strategic decision-making, but also to encourage organizational change and innovative behavior. In order to assess policy, he recommended looking at

input, process, output, and outcome while keeping in mind relevance, effectiveness, efficiency, impact and sustainability as evaluating criteria. He also recommended the implementation of evaluations on large-scale R&D programs, return on investments, fiscal incentives, institutions, technology transfer measures, and foresight.

5. Mr. Jun-seok Hwang, Professor at the Department of Industrial Engineering of Seoul National University, gave a presentation on **Frontier Technologies**, in which he examined STI strategy implementation and steps taken for AI preparation in the context of the Republic of Korea. He focused on introducing the following frontier technologies: (i) Artificial intelligence/AI (ability of machines and systems to apply knowledge and to carry out intelligent behavior); (ii) big data (extremely large data sets that may be analyzed computationally to reveal patterns, trends, and associations, especially relating to human behavior and interactions); and Internet of Things/IoT (when network connectivity and computing capability extends to objects, sensors and everyday items not normally considered computers, allowing these devices to generate, exchange and consume data with minimal human intervention). He then presented examples from key sectors, including healthcare, education, transportation, farming, and energy, to showcase real applications of these frontier technologies in government strategies. He noted that public reception tended to be more positive in supporting innovation R&D when the implemented technology benefited the public good. Mr. Hwang also stressed that in order for technology to serve as a useful tool in solving social problems (linked to education, medical healthcare, transportation, environment, etc.), the monopoly of emerging technologies must be prevented to mitigate issues of inequality linked to the digital divide.

6. Ms. Sabrina Luk, Assistant Professor at Singapore Nanyang Technological University, gave a presentation on **Frontier Technologies**, in which she presented an overview of emerging technologies and policy responses. She underscored that no singular definition of frontier technology exists and that socio-cultural contexts played a role in determining whether a technology would be considered conventional or frontier for different countries. After showcasing a number of applications, she looked at the national Fourth Industrial Revolution (4IR) strategies developed by Japan, the Republic of Korea and Singapore, focusing particularly on how governments utilised frontier technologies to address challenges around ageing populations, sustainability, inclusion, and cyber safety. She urged caution with regards to the risks of 4IR including impacts on employment and inequality, ethical issues concerning the digital divide and AI bias, big data privacy and security issues. Ms. Luk highlighted six key policy priorities for STI development: (i) inclusive ICT infrastructure; (ii) the development of a workforce fit for a 4IR future (upskilling, education reform promoting soft skills, problem-solving and creativity); (iii) innovative regulatory frameworks (such as regulatory sandboxes, driverless car legislation); (iv) the incentivization of responsible frontier technologies development in the private sector; (v) the role of government in the evolution of frontier technologies; (vi) the creation of a platform for multi-stakeholder and regional cooperation. She noted that the role of government was central in facilitating open data through public investment and legislation so that the general public can make use of it.

7. Mr. Joshua Chambers, Founder and Managing Director at GovInsider, gave a presentation on **Public Service Innovation**, in which he presented an overview of how to spur public sector innovation through

process, service and governance innovation. Supported by a number of case studies from around the world, he discussed the need to enable innovation within the public sector, to integrate innovation from outside the public sector, to engage citizens in policy responses and to engage end-users to co-design services. On process innovation, he highlighted the importance of creating formal structures to drive innovation by incentivizing good ideas, sharing best practices, and integrating tools within processes to increase efficiency and reach. On service innovation, he examined the role of user experience design to ensure services are optimized for the needs of users, and the collection of real-time citizen data available government-wide to inform the creation of tailored services. He underscored that innovation does not have to be cutting-edge, but rather can be a method that enables a particular type of service user to have a better engagement. On governance innovation, Mr. Chambers encouraged governments to have an open approach to idea generation, to reform procurement systems so that the private sector can contribute to providing better services, and to increase democratic participation and streamlining policy to suit citizen needs by proactively engaging citizens in policy processes with the use of technology (e.g. citizen juries, challenge tenders, co-design, crowdsourcing opinions, hackathons).

C. Governmental Policy Areas

8. Ms. Jae-Yun, Research Associate at the Centre for Science, Technology & Innovation of Cambridge University, gave a presentation on the **Role of Government Overview**, in which she focused on the government's role in planning for the future using foresight to develop policies that address challenges related to economic growth, the 4th Industrial Revolution and sustainable development. She described foresight as a participatory process to collectively explore, anticipate and shape innovation policy by analysing the future potential of technologies. Its diverse roles range from strategic goal setting to consensus and network building with the aim to identify long-term opportunities and alternatives, to legitimate the process, and to embed knowledge into many stakeholders' planning and strategies. She used a number of examples to illustrate how foresight can be used to analyse the future potential of technologies, support policy or strategy development, build networks and their capacity, identify priorities for S&T, and encourage public engagement, among other things. Ms. Ho stressed that for effective results, parties sponsoring and/or implementing the foresight exercise should have strong links to key stakeholders and policymakers working on innovation policy, and be able to identify and address emerging policy requirements. She also added that foresight offers opportunities for prioritizing appropriate research and innovation programmes, setting the agenda for standards and regulations, identifying skills and education needed, and fostering linkages and public-private partnerships for national competitive advantages. Ms. Ho highlighted roadmapping as an effective tool for supporting the participatory process of foresight, which enables governments to map out future activities by identifying key future needs or gaps and developing appropriate responses based on consensus-building.

9. Mr. Satoru Ohtake, Deputy Director of Tokyo College and Visiting Professor at the Institute for Future Initiatives of the University of Tokyo, gave a presentation on the **Role of Government Overview**, in which he discussed how to make STI policy effective using Japan's STI policies as an example, particularly the use of national level strategies reviewed every 5 years. Mr. Ohtake explained that these strategies are set by the Cabinet Office for Science, Technology and Innovation, which is also responsible for leading and

coordinating STI policy across various ministries and influencing private sector behavior. Mr. Ohtake linked Japan's success to the use of foresight and horizon scanning to set policy priorities. He emphasised the importance of using evidence from across a range of actors, from the "hard" sciences (engineering, chemistry, physics, etc.) to the social sciences, provided through think tanks, academia and public sector knowledge for Japan's current infrastructure for innovation. He added that the linkage provided references for strategy-building, such as the necessary interlinkages between the SDGs, as global and societal issues are similarly interlinked. From this, a distinction was drawn between 'policy *for* science', of which the main purpose is advancing the fields of science (e.g. through promoting/funding academic research), 'science *and* policy', which advances the integration of science for economic or social development, and finally 'science *for* policy,' which aims to serve society with scientific outputs rather than to promote research as the end goal. With regards to the latter, Mr. Ohtake stressed the importance of the capacity building of persons with both a scientific and policy background and strong networks with various actors. Furthermore, Mr. Ohtake argued there are two distinct cultures within these fields, where policymakers are action-based, time-bound workers who drive towards economic or social development, whereas scientists often take years to develop research, mainly based on ideas of truth and understanding. Overall, this distinction was used to demonstrate the ability of the SDGs to bridge society and economics, but also highlighted the need to integrate scientific solutions to achieve a more innovative relationship between society and policy. Mr. Ohtake concluded by highlighting the importance of the imbuing of scientific personnel with an understanding of policy, in particular the Sustainable Development Goals, including through collaboration with other disciplines. This is essential in ensuring that future innovations work towards achieving the SDGs.

10. Mr. Xielin Liu, Professor at the University of Chinese Academy of Sciences, gave a presentation on **Catch-up and Leapfrog**, in which he focused on the processes of technological advance, specifically catching up, or skipping a stage of development through innovation (leapfrogging). An emphasis was put on the 'four windows of opportunity for late comers' during the Fourth Industrial Revolution: (1) new techno-economic paradigm, (2) business cycle downturns, (3) changes in demand condition, and (4) industrial policy and government regulation. These four categories were elucidated throughout the presentation, detailing how previously successful countries can be overtaken by countries in the "catch up" process, as evidenced by the growth of the Republic of Korea and the People's Republic of China. Mr. Liu described this through the framework of 'catch up cycles' whereby 'windows of opportunity' are presented that provoke a response from incumbent STI leaders, which can be either advantageous or disadvantageous to countries/industries attempting to challenge them. Countries attempting to catch up, or leapfrog were advised to develop according to their specific capacities, rather than to replace/copy leading countries methods or technologies. Moreover, Mr. Liu noted the dangers of industrial complacency with technological advantage seeing as being ahead of competitors can lead to a lack of innovation, leaving companies vulnerable to being replaced by newcomers or more innovative competitors. He similarly highlighted the potential loss that can result from being reliant on older manufacturing processes, noting that countries such as China have shown an ability to integrate new technology and processes into their entrepreneurial culture, and that many Chinese entrepreneurs have repatriated the skills learnt working abroad for foreign multinationals and adapted them for local markets.

11. Mr. Xudong Gao, Professor at the Tsinghua University Research Center for Technological Innovation, gave a presentation on **Catch-up and Leapfrog**, in which he focused on the rapid trajectory of the People's Republic of China from developing nation to technological and economic leader. Three basic strategies for achieving this were outlined: (1) a technology transfer strategy whereby technologies are shared between countries and industries leading to an advancement in progress; (2) R&D strategies for pursuing emerging technologies; (3) Mature technology reinvention strategy to foster innovative solutions for old problems in technology. Mr. Gao referenced the advantages of being a latecomer, noting how companies in the PRC are able to capitalise on lower quality products through their ability to produce at a significantly lower price than competitors. He recommended that countries use their own unique strengths as a competitive advantage to become industry leaders, which can be facilitated at two levels. At the macro-level, the process involves government policy, a high-quality education system, the repatriation of overseas talent, and the existence of both private firms and state-owned enterprises (SOEs). At the micro-level, the process involves boosting technology capability through talent and R&D investment, clear assessment of advantages and disadvantages, focusing on early globalization, and competing against multinational enterprises (MNEs). Mr. Gao further emphasized the needs to create many opportunities for people to support bottom-up innovation.

12. Mr. Jin Chen, Professor at the Tsinghua University Department of Innovation, Entrepreneurship and Strategy, gave a presentation on **Law and Regulation**, in which he discussed the current 'National Innovation Strategy (NIS)' of the People's Republic of China where the emphasis is on the use of law, regulation and policy to foster indigenous innovation and steer the country towards becoming a world-class science and technology power by 2050. Mr. Chen said that to realise this strategy, the PRC is working on achieving: (i) high-level research with more investment in R&D; (ii) high quality of intellectual property (technology and engineering); (iii) high value-added products and services (entrepreneurship and innovation); (iv) high speed of innovation diffusion (technology transfer); and (v) better design of inclusive public policy to support innovation. He further clarified that these constituent elements are part of an 'innovation ecosystem' that evolved through the adoption of: Firstly, an internal R&D-oriented innovation system. Secondly, a collaboration innovation system with internal technology strategies involving data and HR and external collaborations with academics and research institutes. Thirdly, a strategy-oriented innovation system to vertically integrate innovation and assist in the strategic management of enterprise innovation. Finally, a holistic innovation ecosystem in which innovation ecosystems exist on the micro and macro scales. He further explained that an important element of this final phase is that micro-scale innovation systems should have modes of operation that are not wholly reliant on the national innovation system. Mr. Chen suggested that this ecosystem allows for more connectivity and cooperation ranging from grassroots/crowdsourcing, to maker platforms and crowdfunding.

13. Ms. Eunjung Kim, Senior Research Fellow at the Korea Legislation Research institute, gave a presentation on **Law and Regulation**, in which she outlined that the Fourth Industrial Revolution introduces challenges not yet understood by governments, governments are attempting to create a regulatory framework that enables the development of the innovation ecosystem and to harness the positive potential of new technologies while at the same time mitigating its negative impacts. She highlighted that the national development programmes of the Republic of Korea have conceptually

transitioned from a policy emphasis on “economic growth and development” to one on a “wellbeing economy” with a human-centered approach. Ms. Kim discussed the introduction of “negative” legal frameworks alongside the existing “positive” law as a way for the law to be more agile in regulating fast moving technologies such as AI. Whereas positive regulatory frameworks enumerate what is explicitly allowed, negative regulatory frameworks enumerate what is prohibited. She underscored that to ensure the appropriate application of these instruments, the Korean Legislation Research Institute works with different ministries to analyse and enact legislation. Ms. Kim also noted the introduction of innovative legal arrangements, for example regulatory sandboxes. She further stressed the importance of recognising that there are fundamental rights (data privacy, human rights, research rights, environmental protection, health, etc.) that need to be considered for a myriad of parties ranging from producers, consumers and stakeholders, and that the potential conflicts between these stakeholders necessitate further analysis and constant consideration by policymakers. In doing so, Ms. Kim resolved that policymakers can ensure that the Fourth Industrial Revolution incentivises new technologies while leading to more equal cross-generational benefits.

14. Mr. Jian Xi Teng, Programme Officer in the Section for Educational Innovation and Skills Development at the UNESCO Bangkok Office, gave a presentation on **Human Capital**, in which he emphasized the role of education as a driver in national technological capacities and innovation. Mr. Teng posited that inequality will be a key characteristic of 4IR, but technology can uplift low income users as long as policymakers ensure disparities in educational opportunities are addressed and benefits are accessible to marginalized and excluded groups. To ensure a more equitable and accessible future, he explained that technology and big data can be used to facilitate increased access to education and monitor those who are at risk of being left behind. He recommended that technology can also be incorporated into primary education to develop technological competencies and foster creativity from a young age. In addition to ensuring children are in healthy, safe environments, Mr. Teng encouraged the integration of “soft” competencies (critical/analytical thinking, innovation, active learning and learning strategies, emotional intelligence, ideation, leadership and social influence, complex problem-solving) into curricula and developed alongside technical competencies. He further suggested that policymakers engage in cross-sector dialogues to identify the purpose of STI and create outputs with their colleagues in education while keeping the SDGs in mind.

15. Mr. Sunyang Chung, Professor at the Konkuk University – School of Business Department of Technology Management, gave a presentation on **Human Capital**, in which he talked about the importance of the Management of Technology (MOT) in the 4th Industrial Revolution, focusing on the best practices in the Republic of Korea’s development. Mr. Chung explained that the Republic of Korea was able to catapult itself to the forefront of R&D technology and innovation through nationwide mobilization of resources in science and technology, particularly through heavy government investment in industry, the public sector, academia and through the establishment of universities and government research institutes (GRIs). Mr. Chung expressed his belief that investment in S&T education and human capital is essential in expanding a country’s R&D capability and preparing for the 4IR and sustaining a country’s technology and innovation industry. In addition to pointing out the need to incentivize well-qualified researchers to work at small-medium enterprises (SMEs), he also pointed out the vast gender

gap and the need to increase the participation of women in technology and innovation fields. Mr. Chung further stated that effective management of technology and skilled human capital also includes understanding how to build effective, well-balanced teams composed of general specialists educated in the humanities, social sciences, and sciences.

16. Mr. Masaru Yarime, Associate Professor at the Hong Kong University of Science and Technology - Division of Public Policy, gave a presentation on **Promoting Linkages and PPPs**, in which he presented an overview of the opportunities and challenges in stakeholder collaboration in innovation through the case study of data-driven innovation. Mr. Yarime explained that data-driven innovation has three components: data, data science and domain expertise. While data-driven innovation uses information exchanges to make the urban ecosystem more resource-efficient and sustainable, he highlighted several policy challenges with data-driven innovations: pacing issues (how to stimulate innovation while keeping up with the speed regulate it); the interconnection of technologies and the need to coordinate policies across different fields; and the potential of soft-law mechanisms (multi-stakeholder collaborations that require joint trials to be made in order to improve technologies). As such, he recommended that policymakers work on how to facilitate data collection, accessibility and sharing; how to enhance capacity for data analysis, human resources and investment; and how to link data to expertise in different sectors to leverage sector-specific knowledge and experience. Mr. Yarime also highlighted that the emergence of cyber-physical systems in housing, energy and manufacturing necessitates a deeper understanding of facilitating and regulating data-driven innovation. He explained that this is because cyber-physical systems require close monitoring and integration of different components of the business model based on data collection through platforms. He also emphasized that these systems have advanced to smart cities by connecting various urban aspects such as housing, energy and transportation. He pointed out that as the majority of populations migrate to cities, it becomes necessary to stimulate and implement innovative technologies to create sustainable and inclusive cities to resolve challenges such as poor infrastructure, population ageing and air pollution. He concluded that government must play an active role in facilitating innovation and addressing the challenges that come with emerging technologies by engaging necessary actors (government, academia, industry and NGOs), and implementing policy interventions that will incentivize stakeholders to seriously engage in innovation and sustainability from the early stages.

17. Mr. Johng-ihl Lee, Professor at the SUNY (State University of New York) Korea - Department of Technology and Society, gave a presentation on **Promoting Linkages and PPPs**, in which he talked about the role of government in supporting technology transfer. Mr. Lee emphasized the crucial role of the market seeing as superior technology alone does not guarantee market share. He suggested that policymakers and researchers should bear in mind the length of time it takes to develop and commercialize good technology; returns are not always immediate. Rather, the government can intervene in a market and mobilize government and taxpayer resources to facilitate technology development. Mr. Lee stated that successful technology transfer is contingent on a number of factors. For one, he urged policymakers to enact prudent policy, even if it means going against the majority. Mr. Lee also pointed out that technology should be practical and based on raw data, with information looked at objectively, and staff, researchers and professors relied on for expertise. He also warned that trust should not be placed entirely on human experience or entirely on technology. Finally, he explained that regulation must

at times be targeted to one sector or policy area; general policy is not always effective. Mr. Lee recommended developing countries to prioritize ICT development and foster industries with a comparative advantage. Culture, policy, innovation, innovative players, the domestic market and the world market must all be leveraged to facilitate growth, and consistent planning, policies and partnerships should be used to maintain growth.

D. Concluding Remarks

18. Mr. Li Zhou thanked the experts and official representatives for their participation in the Training Workshop. He summarized the speakers over the preceding days through the following points: frontier technologies are changing the way that governments, societies and economies operate, they offer developing countries a window of opportunity to leapfrog; however frontier technologies differ in national contexts, and the ability for governments to leverage it for good depends on the capacity of the public sector, infrastructure, human capital, regulatory frameworks and linkages between different sectors; he reiterated the use of foresight to identify advantages, disadvantages and gaps to link to strategies and objectives to be competitive, and linking foresight to policy agenda setting; he stressed the critical role of governments in the creation of markets, as well as standardisation and regulation to protect the interests of citizens; and he recapped the need to foster human capital through skills development and promoting networks across sectors for a prosperous and inclusive future in light of such rapid technological change.

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