Japan's Science and Technology Strategy for the SDGs

For Japan to achieve the seventeen Sustainable Development Goals by 2030 it must accelerate Science, Technology and Innovation. Japan should link this to its "Society 5.0" vision for the future of society and be at the fore of the international community's efforts.

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In order to achieve the seventeen Sustainable Development Goals (SDGs) included in the 2030 Agenda for Sustainable Development adopted at the 2015 General Assembly of the United Nations, Science, Technology and Innovation (STI) as well as social and economic reform, is essential. For this reason, a UN inter-agency task team (IATT) has been launched and STI is being accelerated at a global level in order to achieve the SDGs. The 10-member group to which I have been appointed was set up to provide advice to the IATT.

In this article, I would like to examine how STI can contribute to achieving the SDGs, what the considerations are regarding that, and my hopes for the G20 Osaka Summit.

Advances in modern science & technology and society's prosperity

Modern science was born following the Renaissance that began in Western Europe during the fourteenth century. From the seventeenth century, Galileo Galilei, Isaac Newton and others gave society new scientific knowledge through the discovery of various laws that govern nature, including classical mechanics, optics, thermodynamics and electromagnetism.

On the technology side of things meanwhile, during the eighteenth century there was a series of inventions that relied on past experience and traditional knowledge, including improvements to weaving and spinning machines, methods for producing coke, machining tools and steam engines, marking a huge social change known as the industrial revolution that preceded the birth of industrialized society. Then, technological innovation based on new scientific knowledge followed in the second half of the nineteenth century. Developments in heavy industry, such as steel, machinery and shipbuilding, and also the use of oil resources in chemical industries, resulted in great strides forward for industrialized society.

Around the beginning of the twentieth century, quantum mechanics and the theory of relativity appeared, while understanding in the natural sciences — from the micro-world to astronomical scale — moved forwards, leading to dramatic progress in electronics and materials technology. The discovery of DNA was also the start of today's life sciences and led to the development of biotechnology that underpins new medicines and treatments. Meanwhile, progress in the information sciences brought to reality machines capable of rapid calculation and also the Internet. Via these developments, scientific knowledge, cutting-edge technology and the knowledge to fully use these became a key resource supporting the growth of a knowledge-based society or information society.

The diversity and inclusivity critical to innovation

The concept of innovation was proposed about a century ago by the economist Joseph Schumpeter. He arrived at the conclusion that destructive innovation in products and services, management structures, and social systems was the driving force behind economic expansion. In Japan, the 4th Science and Technology Basic Plan was decided by the Cabinet in 2001. This clearly defined science, technology and innovation as realizing diverse value through the integrated advancement of science & technology as well as innovation, and its definition became widely used in society.

Destructive STI is essential to both advanced and developing countries achieving the SDGs by 2030. In order for this to happen a holistic approach must be taken, covering not just cutting-edge science and technology, but economic aspects such as developing new markets, commercialization models and finance, and also social aspects such as regulation and standardization, human resources development, ethics, and even the nature of people's everyday lives. For this reason, the participation of diverse stakeholders is essential; not just scientists and engineers, but also industry, investors, policy makers, and members of the public.

From the standpoint of commercialization, new products and services can only reach society after first "crossing the Devil River" (confirmation of technological validity), "crossing the Valley of Death" (demonstration of commercial validity) and "surviving the Darwinian Sea" (achieving superior competitiveness).

The Science, Technology and Innovation needed to achieve the SDGs

So, how can science, technology and innovation contribute to achieving the SDGs? Below, I'd like to address that, including with concrete examples from Japan's case.

Firstly, it can contribute to the SDGs via a combination of economic growth and protection of the global environment through the invention of new technology and the employment of existing technology. As SDGs themes, it is necessary to achieve sustainable economic growth by science and technological advancement while eliminating the "negative legacy." In the past, Japan caused severe industrial pollution during the process of developing its heavy chemical industries, as represented by four major pollution-caused disease cases. It overcame this with technology to purify factory wastewater and gas emissions. The issue assigned to us now is how to make sustainable economic development possible while solving serious pressing global-scale issues such as climate change, exhaustion of natural resources, and destruction of terrestrial and marine biodiversity. It is said that if we go on with business as usual, we will need three Earths to survive.

That's why, through cooperation between industry, academia, and government, Japan is eagerly aiming for a low-carbon society and working on energy-saving, as well as the popularization and expansion of renewable energy. Japan is moving forward with ambitious research and development, including for example: large-scale perovskite solar cells that can efficiently convert light energy from the sun into electricity; high efficiency inverter technology using silicon-carbide transistors that can dramatically reduce loss of electrical power; or large volume energy storage technology that uses hydrogen. As an important theme within its core strategy, Japan is also working on the development of materials to replace scare resources and is aiming to realize high-power and high-efficiency motors that use magnets not containing rare elements.

On biodiversity, the Nagoya Protocol states that the genetic resources in agricultural products should be protected and that the "access and benefit-sharing" laid out in the Protocol should be promoted. As one example of technology transfer based on access and benefit-sharing, Japan is promoting an international collaborative research project to preserve Mexico's special genetic resources.

Secondly, the gap between rich and poor is getting wider across the world. Meanwhile, when it comes to creating a society in which no one gets left behind, STI can contribute by protecting food and water, correcting inequality, and securing education, health and privacy.

Right now, mainly in the developing countries of the world, around 10% of people suffer from extreme poverty and hunger, while one in three people cannot secure clean drinking water. There are also large numbers of people who are forced to live inconvenient lives without electricity. Since these countries to date have lacked the necessary social infrastructure, people have started to look at shortening the process developed countries went through and are creating new services that use cutting-edge technology (also known as leapfrogging). Examples of this are distributed electric power systems that use renewable energy and smartphone payment systems. At the level of research and development, if the low-electricity-consumption distributed ammonia production method recently developed by Professor Hosono Hideo and others at the Tokyo Institute of Technology as a replacement for the Haber–Bosch process one day spreads to developing countries, we can expect it to contribute greatly to increasing crop yields.

In low-birthrate aging Japan, STI to extend healthy life expectancy will be particularly important. Additionally, the use of advanced information technology is an important theme for regional revitalization and the empowerment of young people and women.

The third area where STI can contribute to the SDGs is activities for evidenced-based determination of future-intention (policy) such as observation and simulation. Japan's Data Integration and Analysis System (DIAS), as the nation's data infrastructure, collects together various kinds of big data such as satellite observation data for a diverse range of analysis and use. Such big data system provides valuable information to help solve a wide range of problems, not just climate change and disaster prevention, but also water supply, food production, biodiversity protection, health and medicine, and more. Going forwards, it is vital that we keep an eye on trends in open science and open data, and also cooperate via relevant international frameworks.

Photo: A small satellite being assembled as part of a joint-research program to observe and predict extreme weather
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There are high hopes for data science as a cross-disciplinary scientific technology to realize the SDGs. Data is an inexhaustible resource for reaching the SDGs. That's why improvements in technology to use data and developing the human resources to implement it in society have become pressing tasks. There is also a need to press on with reform of social systems to respond to shifts in employment, security risks, ethics and other issues caused by rapid advances in technology.

The need for mission-oriented R&D

To achieve the SDGs, there is a need to rethink the nature of university and corporate R&D. For example, importance is being placed on "mission-oriented R&D" that focuses on the SDGs and beyond. It works on significant high-impact research themes using a back-casting method that looks to social issues of twenty or thirty years in the future and considers what kind of society we wish to bring about.

In mission-oriented R&D, a constructive and integrated approach is needed. To that end, the recommended process for achieving the SDGs is a circular model in which goals are set, the gap with the present situation is analyzed, various stakeholders cross their normal boundaries and "create together" (co-design) to narrow that gap, the results are implemented in society and evaluated, and then the same cycle takes place once again. Regarding academia, it is vital to have links not just with the natural sciences, but also the social sciences and the humanities. R&D funding has a big role to play in making this happen.

Additionally, there have been joint and coordinated efforts of diverse stakeholders including the UN IATT to create STI for SDGs Roadmaps (Roadmaps) at national and international levels. In July 2019, a Draft Guidebook on STI for SDGs Roadmaps was put together by the UN IATT, and there are plans to start drawing up roadmaps in pilot nations. Japan has been actively involved in preparing these guidelines. During the course of Osaka G20, host country Japan took the lead in delivering Guiding Principles for the Development of Science, Technology, and Innovation for SDGs Roadmaps, which will serve as a reference for individual nations as they draw up their roadmaps.

Furthermore, so that diverse stakeholders can share knowledge and experience, and to speed up joint design and cooperation, from last year the UN IATT started work on building a knowledge base, in the form of an online platform. In Japan too, the government and various bodies have also started the creation of a knowledge base. I hope that these can be brought together via a network and that global-level cooperation on both the knowledge supply and demand sides will be accelerated.

International cooperation programs have started to show results

The Advisory Board for the Promotion of Science and Technology Diplomacy announced "Recommendation for the Future STI as a Bridging Force to Provide Solutions for Global Issues" in 2017 and noted four key actions of STI diplomacy towards achieving the SDGs: "Change through Innovation: Global Future Creation through Society 5.0"; "Grasp and Solve: Solution Enabled by Global Data"; "Link across Sectors, Unite across the Globe"; and "Foster Human Resources for "STI for SDGs.".

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One such significant Japanese international collaborative R&D program is the Science and Technology Research Partnership for Sustainable Development (SATREPS). The Japan Science and Technology Agency (JST), Japan Agency for Medical Research and Development (AMED), and Japan International Cooperation Agency (JICA) have been working together to encourage joint R&D between Japanese researchers and researchers from developing countries. Its main themes are global issues that are difficult for one country or region to solve alone and require the international community to work together, such as environment and energy issues, disaster prevention, infectious disease and bioresources issues. It also aims to build structures to encourage sustainable activity geared towards local problem solving and improvement of independent R&D capabilities in those nations' universities, research organizations and other bodies. To date, there have been around 140 joint research projects, including: in South Africa, development of an early warning system to predict climate change and infectious disease; the setting up of a system in Thailand to solve and respond to storm and flood damage; and the development of a kit to enable cheap and easy diagnosis of tuberculosis and African sleeping sickness.

The e-ASIA Joint Research Program was formed as a joint research community in East Asia with the aim of regional economic development through innovation. Between 2012 and today, there have been more than 30 joint research projects, covering the fields of new materials, renewable energy, agriculture, health and disaster prevention. These include: observing and forecasting concentrated rainfall by satellite observation of cumulonimbus cloud; creating distributed smart grid electricity systems suitable for island regions; and developing methods to diagnose new malaria viruses that are resistant to standard malaria treatments.

The New Energy and Industrial Technology Development Organization (NEDO) is working to support the international spread of technology, such as the practical implementation of bioethanol production using heat-resistant yeast.

Increased funds for international joint research and for commercialization are desirable in order to put the results of joint R&D to use in society, to provide benefits to regional communities and economies, and in order to accelerate the spread of such technologies to other regions. As part of this, Japan needs to lead other nations in thinking how to expand private investment as well as its official development assistance (ODA) for STI.

Japan also has an important role to play in supporting developing countries create human resources development and system design frameworks for STI and STI policy.

Society 5.0 is Japan's vision to use STI for realizing a human-centered and sustainable society and is in line with the SDGs. I hope that STI for SDGs roadmaps addressing the priority themes of Society 5.0 will be put into practice, and that government, ministries, industry, universities, research institutions, entrepreneurs, NGOs and others will cross traditional boundaries to work on this together and with speed. The mission for us living today is to accelerate STI to realize a sustainable society in which no one is left behind, and to bequeath a bright future to our descendants.

Translated from "'Nihon-ban SDGs' e no kagakugijutsu senryaku" (A Science and Technology Strategy for "Japan's SDGs"), Gaiko *(Diplomacy), Vol. 55 May/Jun., 2019 pp. 42–47. (Courtesy of Toshi Shuppan)* [August 2019]

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