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Special Feature

Open Innovation and Successful Startup Cases in Japan

Governmental Policies toward Forming an Innovation Ecosystem

Open Innovation Initiatives

Creating the Future of Brain-tech with Brain wave AI Platform

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About ITU-AJ

The ITU Association of Japan (ITU-AJ) was founded on September 1, 1971, to coordinate Japanese activities in the telecommunication and broadcasting sectors with international activities. Today, the principle activities of the ITU-AJ are to cooperate in various activities of international organizations such as the ITU and to disseminate information about them. The Association also aims to help developing countries by supporting technical assistance, as well as by taking part in general international cooperation, mainly through the Asia-Pacific Telecommunity (APT), so as to contribute to the advance of the telecommunications and broadcasting throughout the world.

Governmental Policies toward Forming an Innovation Ecosystem

Seira Suzuki
Deputy Director for Innovation Policy
Secretariat of Science, Technology and Innovation Policy, Cabinet Office

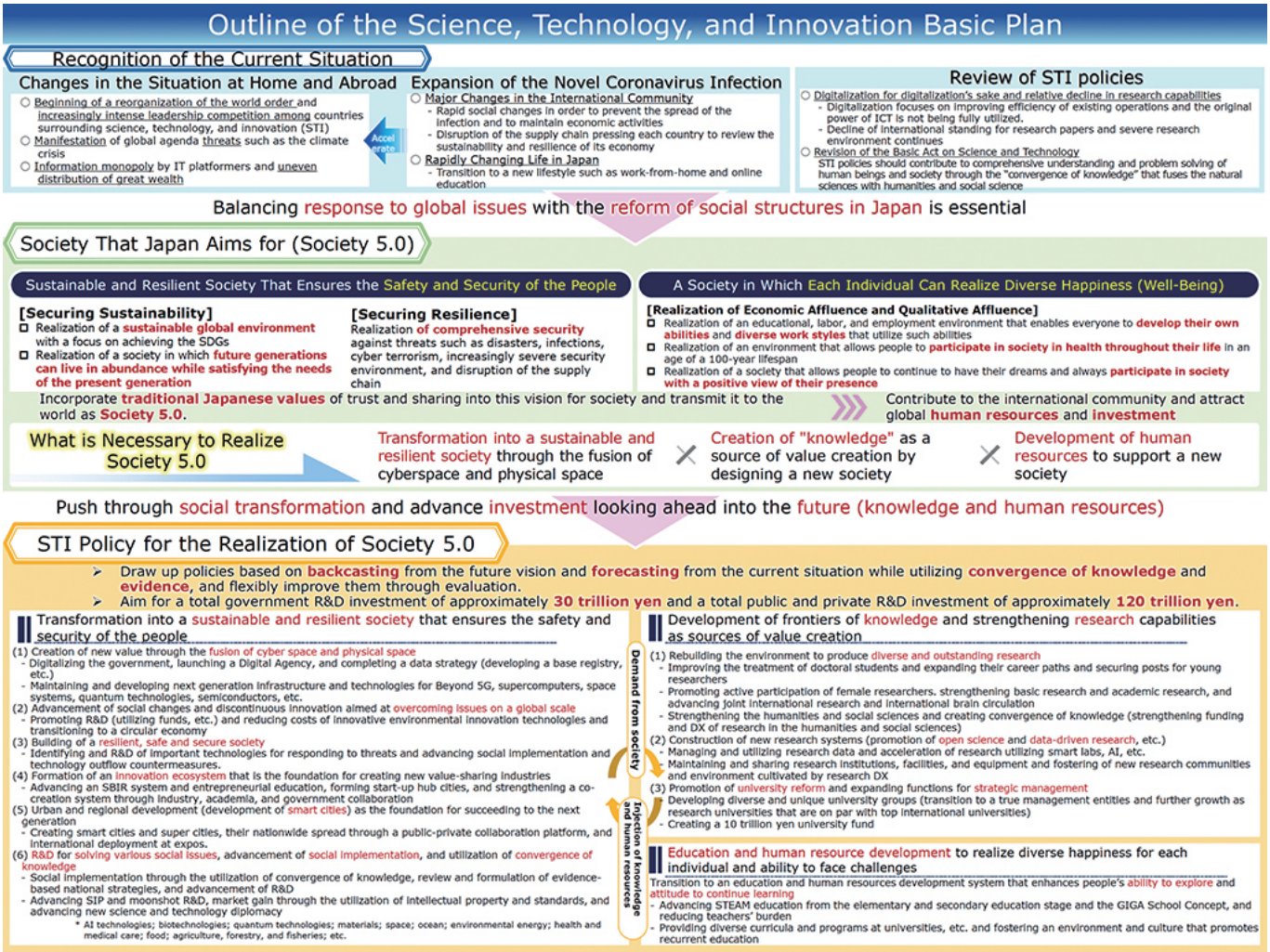
1. Introduction

A law revising parts of the Basic Act on Science and Technology (enacted in 1995) was established during the 201st session of the National Diet in 2020, and it was changed to the "Basic Act on Science, Technology and Innovation." In addition, the "Science, Technology and Innovation Basic Plan"*1 was created for the five-year period starting in FY2021, based on the Science, Technology and Innovation Basic Law in March 2021 (Figure 1). This article will provide a deeper understanding of policies related to forming an innovation ecosystem in the next five years, as indicated in the Science, Technology and Innovation Basic Plan.

2. Positioning within the Science, Technology and Innovation Basic Plan

Based on the addition of "Innovation" in the revisions described above, the Science, Technology and Innovation

Figure 1: Science, Technology and Innovation Basic Plan overview (March 2021 Cabinet decision)

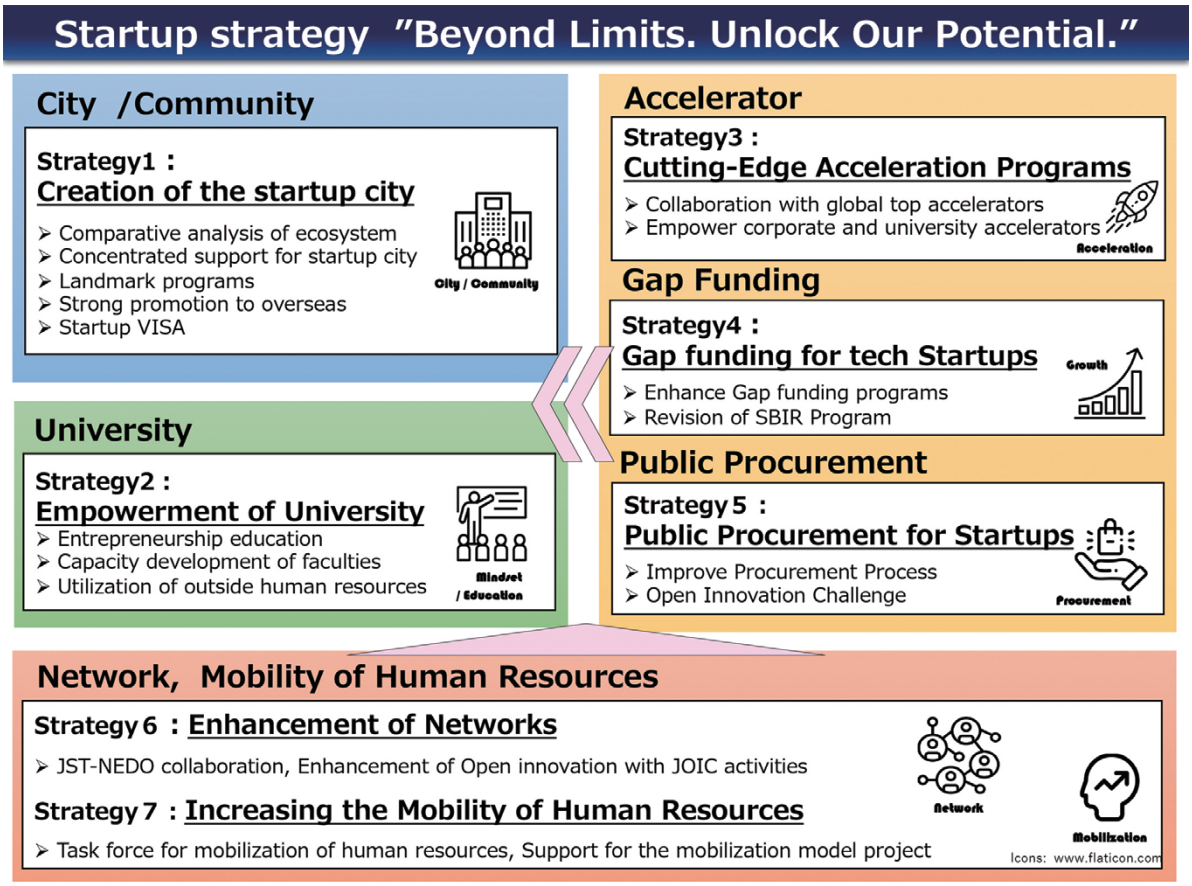


*1 Science, Technology and Innovation Basic Plan (March 2021 Cabinet decision) https://www8.cao.go.jp/cstp/kihonkeikaku/index6.html

Basic Plan set in March 2021 goes beyond discussion of research and development, stipulating creation of societal value and solutions to societal issues by creating and using "Comprehensive Knowledge" that integrates the natural sciences with the humanities and social sciences. While the concept of creation implied by "innovation" has conventionally tended to be taken as behaviors directly related to product development or production activities by enterprises, in the Science, Technology and Innovation Basic Plan, it is understood as a broader subject, creating larger changes in the economy or society and encompassing creation of new value and reform of society itself. This also provides background for the changes to the Basic Act on Science, Technology and Innovation and the additions regarding creation of innovation.

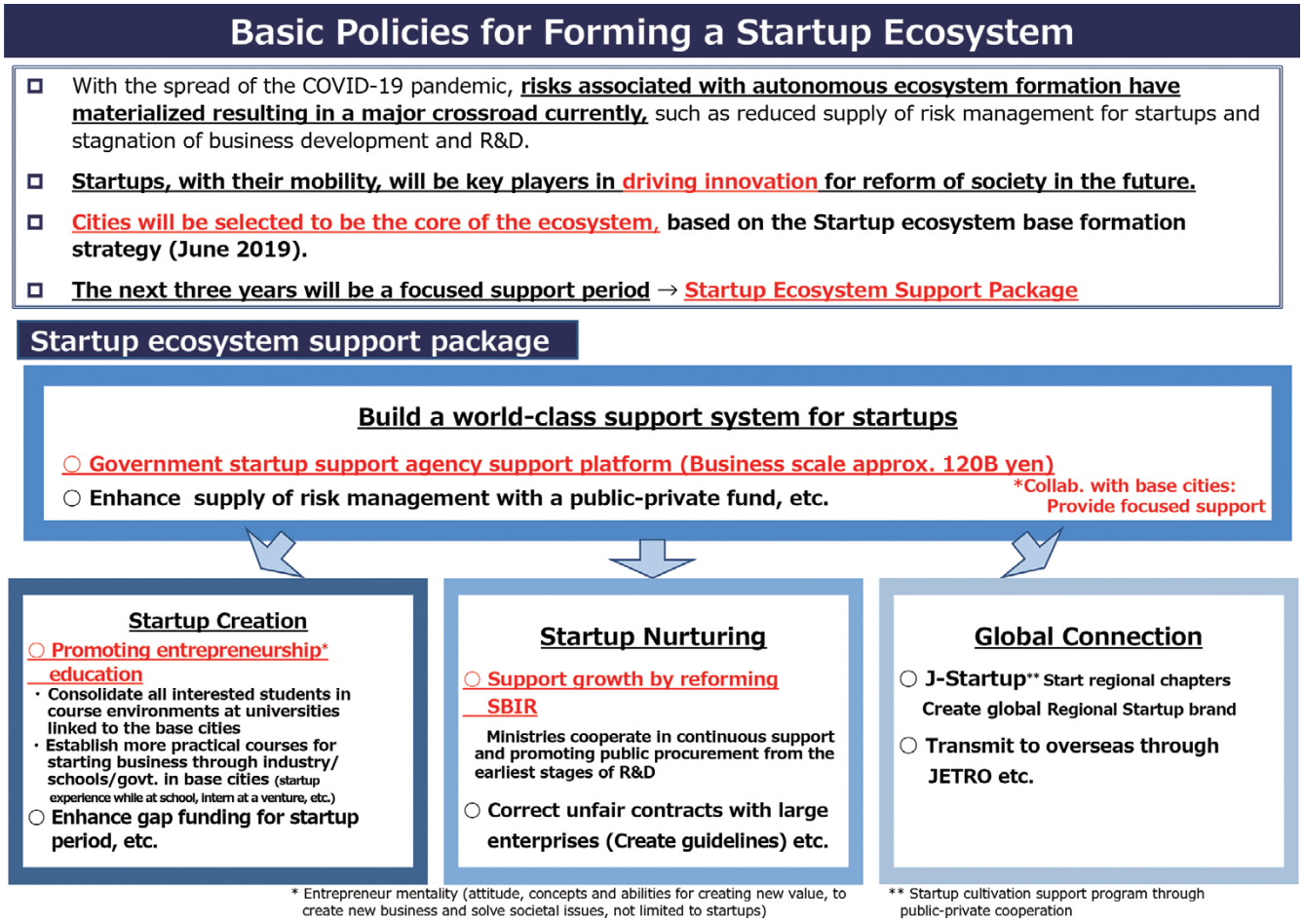
Based on the above, the Science, Technology and Innovation Basic Plan includes a policy to "Form an innovation ecosystem that will be a foundation for creating new industries that co-create value," which the government will work on in the next five years, with the goal reforming society by creating new value and solving societal issues. Also as background to this is the trend in which startup enterprises typified by the GAFA companies, grow very quickly in a short time, overcoming larger enterprises to become huge IT companies and reforming the structure of industry and even lifestyles. Creating innovation is an important driving force in creating startups, and advanced nations are working strategically to form startup ecosystems to support creation of innovative startups. It is important for Japan to also form a world-class startup ecosystem. It is also important to form positive cycles of innovation driven by societal need, creating businesses from the R&D results of startups responding to societal need and creating products and services that become popular around the world. Open Innovation is also necessary for existing large enterprises to collaborate with startups that are utilizing their mobility to face challenges, and universities and R&D companies

Figure 2: Basic policies for startup ecosystem formation (Excerpt from "A Startup Ecosystem Support Package: A new path to growth and overcoming COVID-19," July 2020 Cabinet, MEXT, METI)



*2 Global base cities: Tokyo area (Tokyo, Kawasaki, Yokohama, Wakou, Tsukuba, etc.), Nagoya and Hamamatsu, Kansai area (Osaka, Kyoto, Kobe), Fukuoka. Driver base cities: Hokkaido area (Sapporo, etc.) Sendai, Hiroshima, Kita-Kyushu.

■ Figure 3: Startup ecosystem base formation (Excerpt from "Beyond Limits. Unlock Our Potential: Strategies for forming bases for a world-class startup ecosystem," June 2019)



that have seed technologies. The Science, Technology and Innovation Basic Plan requires creation of an innovation ecosystem as described above, closely-connected and inter-linked to produce innovation.

3. Forming a startup ecosystem

To form a world-class startup ecosystem in Japan, eight "startup" cities (four as Global Startup Cities and four as Startup cities) were selected in July 2020[*2], based on "Beyond Limits. Unlock Our Potential: Strategies for forming the base of a world-class startup ecosystem" (June 2016)(Figure2). In July 2020, the Cabinet, the Ministry of Education, Culture, Sports, Science and Technology and the Ministry of Economy, Trade and Industry also compiled, "A Startup Ecosystem Support Package: A new path to growth and overcoming COVID-19," to build startup support systems for a focused support period of three years starting in 2020 (Figure 3).

For example, in its program to expand investment in public and private R&D (PRISM), the Cabinet established a new project to promote formation of a startup ecosystem in FY2020, nurtured startups in the base cities through lectures, individual consultation and network building, and started an Acceleration Program to support overseas expansion and other initiatives. In FY2021, the number of enterprises being supported was expanded, field-specific courses were started so that programs suited to the needs of participating companies could be offered, and other support was provided for activities such as expanding domestic startups overseas, conceiving business plans to attract investment from overseas investors and enterprises, matching specialists with startups and promotional activities[*3].

*3 FY2020 Supplementary budget Program to Expand Investment in Public and Private R&D (PRISM), Policy to enact the startup ecosystem formation project https://www8.cao.go.jp/cstp/gaiyo/sip/210210/siryo3.pdf

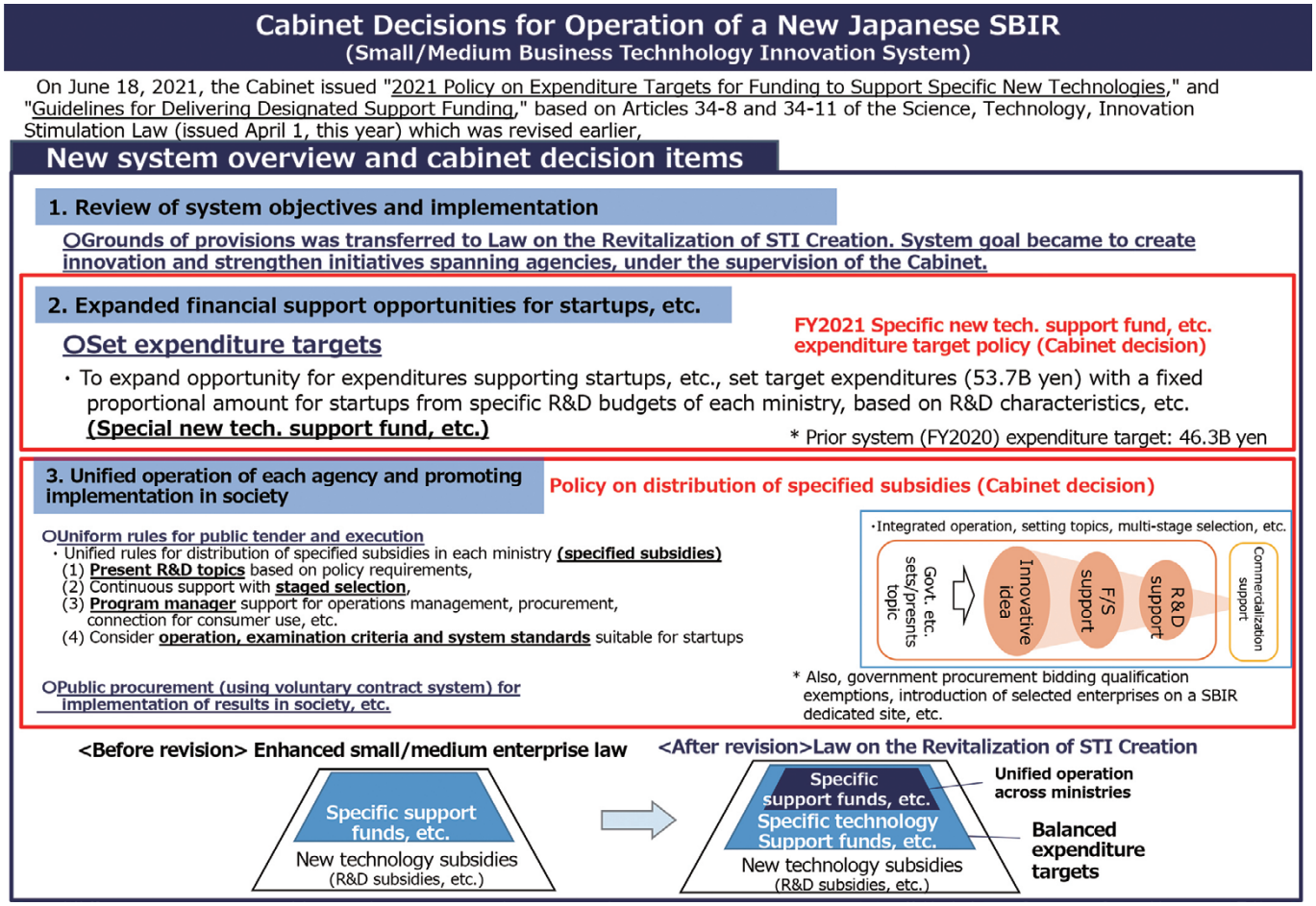
4. Forming positive cycles of innovation driven by the needs of society

Based on the concept of innovation described above, as something that creates new value and brings reform to society itself, producing solutions to problems considering the needs of cities, regional areas and society is an important driving force for innovation. The United States has a Small Business Innovation Research (SBIR) system that suggests topics based on the needs of the country, supports a wide range of R&D from the earliest stages, and supports startups and other companies through a multi-stage selection process. With the USA SBIR, government ministries have a duty to spend a fixed ratio of their R&D budgets on initiatives such as startups, operating on uniform rules across ministries, and this has produced many enterprises, such as Qualcomm and iRobot, that have brought innovation to industry and continued to grow.

Japan has also operated our own version of an SBIR since 1999, the Small and Medium Enterprise Technical Innovation System, operated mainly by the METI Small and Medium Enterprise Agency. However, some shortcomings have been identified, such as not being strategic in fields of expenditure, insufficient support for earlier stages of R&D such as feasibility studies and proofs of concept, and the lack of consistent rules for multi-stage selection and evaluation.

In 2020, the Law on the Revitalization of Science, Technology and Innovation Creation was reviewed and revised to strengthen initiatives spanning ministries and agencies and overseen by the Cabinet Office, to make the SBIR in Japan more effective (enacted April 1, 2021). Based on the law, the Cabinet issued "2021 Policy on Expenditure Targets for Funding to Support Specific New Technologies," and "Guidelines for Delivering Designated Support Funding," in June 2021. Through this, a fixed ratio of specific R&D budgets (Specified new technology subsidies, etc.) in each ministry would be allocated to initiatives such as startups, and a target expenditure of 53.7B yen was established. Further, as a consistent set of rules for offering and operating the designated support funds from each ministry, concrete

Figure 4: Japanese SBIR



R&D topics were presented based on policy requirements, guidelines were given for public procurement and performance in order to implement results in society using a voluntary agreement system, and plans were made to build an integrated support system spanning R&D through government procurement and use by consumers, with cooperation among ministries and agencies and coordination by the Cabinet Office (Figure 4). These initiatives are building a system that will stimulate new challenges for startups, which are responsible for much innovation.

5. Casting off policies of closed innovation and promoting Open Innovation

Implementing results of R&D and other efforts in society quickly and applying them as solutions to societal issues or to create new value is a major issue recently, and Open Innovation is attracting attention as a way to overcome organizational barriers, combine knowledge, technology and management resources, and to promote new initiatives. Businesses are also beginning to move away from policies of closed innovation and toward collaboration with startups that are using their mobility to take up challenges in various fields, and universities and national R&D agencies that possess seed technologies.

To further promote Open Innovation in Japan, the "Japan Open Innovation Prize," has been held each year starting in 2018, to give recognition to initiatives that show strong leadership and originality, and promise to be role models for the future. This is the fourth year that prizes have been awarded*4, and a variety of participants have been honored, including startups, businesses, universities and local governments. It is hoped that this recognition will help to overcome the barriers of organizations, combining knowledge, technology, and management resources to drive new initiatives and promote advanced projects, thereby accelerating the positive cycles of commercializing R&D results and creating new added value through Open Innovation among the various participants.

6. Conclusion

As discussed above, there is a need to form a startup ecosystem and establish positive cycles of innovation driven by the needs of society, and also to promote movement away from policies of closed innovation toward Open Innovation, based on the Science, Technology and Innovation Basic Plan. These objectives are closely related to realizing an innovation ecosystem, to creating new value in COVID and post-COVID times, and to reforming society to achieve "a society in which all citizens can benefit from the creations of science, technology and innovation," as stipulated in the Science, Technology and Innovation Basic Law.

Cover Art

kyotomeishonouchi arashiyama manka
(Full Blossom at Arashiyama on the Oi River)

Utagawa Hiroshige (1797~1858)

Collection of the Art Research Center (ARC)
Ritsumeikan University
Object number: arcBK06-0013_004

*4 https://www8.cao.go.jp/cstp/openinnovation/prize/index.html

Open Innovation Initiatives

Tomoya Hiroe
VP Operations, Stuff Co. Ltd.

Stuff Co. Ltd. has actively pursued development initiatives using Open Innovation since 2016. We approach our startup and Open Innovation initiatives with the following three perspectives.

The first is that we use external intellectual property and create businesses and products in-house.

The second is that we use internal awards to turn budgeted plans into businesses and products working with external companies.

And finally, the third is that there are things we cannot develop ourselves for various reasons, but with support from other enterprises, we can make something of our ideas.

For the first one, we take a unique idea or technology that a startup or university has, and make it into a product using the branding and commercialization capabilities and the sales channels of a large enterprise. For the second, we take a plan created with our own expertise and use it for marketing or with another company's technology to commercialize a product. And for the third, when you have internal obstacles so that even though your idea is strong, it does not suit your company, you can make something of it with support from another enterprise.

Here, we introduce some of our successes with each of these patterns (See Figure).

As an example of the first case above, we created a STUFF product called "TISPY," that came from a Toshiba internal startup. The product (currently being sold as TISPY2) is a blood-alcohol level checker that learns using a memory card with Wi-Fi function from Toshiba.

Figure : Created products
From the left: Kitoki, TISPY, INFINI MIX

This project was a voluntary startup within Toshiba, which we joined in February 2016, combining professional software and hardware development and design members from Toshiba with our product creation capabilities. We began crowd funding in March 2016, and sent a product to our supporters in autumn of that year. When we joined the project, Toshiba had already decided to use crowd funding to get support and created the web page, planning to make 3000 units. It was difficult to create a Toshiba branded product with this number of units, so after some compromise, we finally created the product, raising 15M yen of funding. We collaborated with Life Care Giken Inc. for tests to evaluate effectiveness of the product. There were some heated discussions and some conflict of personalities before we arrived at a product, but we continued to pursue the goal and finally achieved a product in quite a short amount of time.

An example of the second case, is a vital sensing device made of wood, called "kitoki," which is being sold through Open Innovation with JT. We participated in this project from the planning stages, studying the product value and concept and designing it in a group of four companies, with JT, a design company called we+, MIS (Makuake), and our company, STUFF. We produced a new idea combining a range of research knowledge from JT, the design capabilities of we+, MIS's vision for value, and STUFF's technical and product-development capabilities. By forming a team to realize that idea, we reached a common understanding of our objective. Through Open Innovation, we created a product in only 11 months from the start of planning, and with Makuake we were able to raise over 10 million yen.

A final example is the INFINI MIX product from Mitsubachi Products, which is currently on the market. Mitsubachi Products is a startup that was carved out of a major enterprise. Mitsubachi Products' goal was to produce value based on the main themes of "building a chocolate-drink culture," and "hot chocolate drink machines." We collaborated with them on developing and manufacturing these machines. We were introduced to CEO Hatsumi Ura by Makuake, and were allowed to join from the planning stages. This is the first product of its kind, so there were many hurdles to overcome in creating

the product.

Two major points stay with me from these experiences. The first is that we only joined the project in the spring of 2018, but after we decided to exhibit at Salon du Chocolat in France in the autumn of that year, we were able to realize a usable product from the design concept in only about two months. The second is how I could relate with the Mitsubachi Products sentiment that, while they wanted to introduce a product to the world, they also wanted to create a new food culture at the same time.

In all cases, we would not have been able to create the products on our own efforts alone. They started with a plan from a startup or a large enterprise, and were implemented by gathering together various strengths, whether technical, research data, parts processing or procurement, design or sales. Gathering together many strengths to proceed is what makes Open Innovation able to speed up the product development process.

Looking back now, each of these initiatives also had a turning point.

For TISPY, the Toshiba internal startup was formed in December, 2015, when we had our first consultation. It is embarrassing to say, but it was our first experience with crowd funding, with a startup, and with Open Innovation when we started at the time. We launched anyway, and although there was much we did not know and were experiencing for the first time, we did not take an attitude that delivery delays were inevitable, as is often the case with crowd-funding projects. We had a shared understanding that we would proceed with development and production as planned, and this was a major point in our success. However, as is often the case for a startup within a large enterprise, members are often required to do two things at the same time during development, and this was also true for TISPY. The two things were "everyday business" and "TISPY development." Because of this, things progressed smoothly through design part of product development but then, when studying specifications and developing the software, we often could not contact the people involved until the evening, so development took more time than usual.

Reflecting on the results, this was a major issue in the fact that we shipped one month later than our original plan.

Learning from this experience, when developing kitoki in the second initiative, with JT, we set a rule in the project team that we would not start crowd-funding until the prototype product was completed. Thus, we were able to control the product production volume, which is one of the benefits of crowd funding. When we developed TISPY, we did not even have a working mock-up on hand when we started. Thinking about that now, it was a terrible thing to do.

Incidentally, we have heard that Makuake has also had a similar experience, so now when they use crowd funding, they have a rule that they must have various conceptual prototypes completed already when starting a crowd funding project.

Returning to discussion of kitoki development, a major product planning issue was how to generate user experience value. The product was intended to be a "vital sensing device," which raised the question of how to measure one's state of excitement or relaxation, and how to induce a relaxed state. We settled on an arrangement that senses perspiration on the user's hand and promotes relaxation using an original algorithm with vibration sensations. During development there was much discussion back and forth and we completed the product in 11 months.

The final example is of the INFINIMIX hot chocolate machine, created by Mitsubachi Products. Mitsubachi Products President, Hatsumi Ura, has a business background, so we provided technical expertise. Mitsubachi Products handled marketing and sales, while STUFF handled development and manufacturing. When we started development, there were already plans to exhibit at a trade show in Paris and to give a presentation at a Panasonic 100th Anniversary event, so we began with those plans in mind. Development was organized with members from Mitsubachi Products handling product design, while we handled design of circuits, software, structure and enclosure, fabrication and evaluation of prototypes, and later, assembly, manufacturing, packaging and shipping for mass production. The design was completed in August, 2018, and the Paris exhibition was at the end of October. Looking back, I realize what a tough job that was. However, having those plans in place was the best motivation we could have had, and we were able to exhibit the product at the trade show and the event in December, and also to refine the drinks further.

The value of our experience with Open Innovation is increasing as we receive many development proposals recently, and having learned how to quickly clarify the product creation process is an important factor in being able to respond quickly. Thus, through many projects, we have learned that with Open Innovation, making an absolutely firm schedule during the early stages of development is a very important task.

A second important task is to clarify the costs.

Our company takes on many product development contracts from other companies, with various requirements such as development and consulting on basic prototypes for verifying specifications, studying products emphasizing appearance from the designer's perspective, developing devices incorporating multiple sensor modules, and developing products that require various certifications for commercialization.

For many development consultations, clients have

jumped the gun starting development without having considered the specifications thoroughly, but with our design partners that have not considered the overall costs, we try to create good products by considering customer needs over a broad scope. I do not think this approach is wrong, but in many cases, not much thought is given to costs. As a result, time considering specifications can increase greatly, which can inflate costs. It also means that many projects are not able to satisfy both their content and their costs, they do not have capacity to make the right judgments in real time, and in the end they need to take a different direction than originally intended, such as re-thinking or suspending development. Even in the rare cases that they move to the next development phase, it is likely that they will need to reconsider their budgeting.

For these reasons, it is important to disclose as early as possible and to the extent possible, the overall budget, the development budget, and plans for procuring funding, and what has been decided with business partners. This is the second task and has benefits for both parties.

And finally, a third task: to make responsibilities clear.

To avoid misunderstanding, this is not leaving decisions to others at all. With Open Innovation, it often gives partners a point of contact in a joint project. If each partner involved in development takes responsibility for its own tasks, there will be less chance of diverging from the schedule or costs as discussed above.

These are three fundamental issues for startups and Open Innovation initiatives, but they are often forgotten and members often proceed as with regular business in a large enterprise.

With startups, people's hopes and visions often expand during discussion, and they run too far ahead and forget take a stance in terms of cooperative Open Innovation. When this happens it is difficult to pull back, so it is better to be mindful of this at all times.

These are basic issues and it is important to think about them from the very beginning.

Another extremely important task is selecting partners to work with.

We are a design company, handling everything from software, hardware and structure to product enclosures, both in-house and outsourcing, so we have a network of hundreds of designers, other design companies, and fabricators from prototyping to mass production. We receive thousands of inquiries per year, and work with partners to optimize each design phase, solving development problems and working to accelerate these processes.

Our company could be the "best match" in some cases, but if the customer can use their own resources or their existing network, they could ask other companies to handle individual aspects such as design, prototyping, or mass production of the product.

I have described some of our experiences, based on concrete cases that we have worked on, but we normally try to collaborate with partners that we can exchange views with at trade shows or through web research, so it is easy to form a development arrangement and development proceeds smoothly.

I have one final point to mention.

When kicking-off a development project, it is necessary to have details such as level of quality required, evaluation, and certification decided and assigned among partners to a certain degree. This point is sometimes omitted, but it is extremely important, since it can determine whether the product turns out well or not.

If the enterprises, departments or partners have experience producing products, they will each bring their own information to the project, I can recommend engaging in Open Innovation, taking these points into consideration.

However, even if the issues described above are handled smoothly, projects are not guaranteed to go well, and when introducing a product that has not been on the market before, it may be difficult to attain the certification and quality standards that people expect from Japan.

We have also had several cases where we evaluated prototypes, but encountered major obstacles when moving to mass production, and this highlights the difficulty of creating products, for a startup or an established enterprise.

There are many plans to execute, mainly from internal startups and pitch events in large corporations, but after awards are won and budgets created, there are still many issues before a product is created, such as profitability and standards, and many initiatives do not achieve product success. Above all is the inherent difficulty of starting a new business from the bottom up. Every enterprise has its own way of thinking, but by taking care of fundamentals and carefully selecting project members as I have discussed earlier they should be able to continue development without stopping,.

There is much support for startups from the various regions, prefectures and national agencies, and we should expect even more in the future, but it is not an exaggeration to say that whether an organization or enterprise can make a product or not will be determined by how they think about it.

In addition to the above examples, we have created products with many universities, agencies, large enterprises and startups. For these accomplishments and activities, we had the great honor of being recognized and awarded the first Ministry of Internal Affairs and Communications Open Innovation Prize in 2019. We are very thankful to all involved for this recognition of our methods, and we hope to promote even more activity in Open Innovation and produce more successful experiences.

Creating the Future of Brain-tech with Brain wave AI Platform

Hideki Matsubara
CEO, PGV Inc.

1. Founding of PGV

PGV is a startup enterprise from Osaka University, established in September, 2016 to create a practical implementation of results from the research of Professor T. Sekitani, of the Institute of Scientific and Industrial Research (ISIR, or SANKEN) at Osaka University. Professor Sekitani conducts research on flexible electronics technologies, and he has attracted attention from around the world in this field. He has achieved excellent research results with technology using highly elastic electrodes to accurately capture brain wave data, which is particularly difficult to measure, even compared to other biological data. PGV was established to implement a patch-type electro-encephalograph (EEG) device based on these results. With this patch-type encephalograph device, PGV aims to become the technology leader in the brain-tech market.

2. Characteristics of brain wave data

With brain activity, tiny electrical currents flow in the brain. Electroencephalograms (EEG) are a record of electrical activity produced by nerve cells in the brain of a person or animal, taken using electrodes placed on the scalp or other locations. They have two characteristics that differentiate them from other biological signals such as pulse, heart-rate or myoelectric (muscle) signals.

The first is that brain wave response is extremely fast. During human activity, the brain must process and send instructions to each part of the body before that activity. For example, when one is nervous, the pulse and heart rate increase, but the brain feels the nervousness first, and then sends instructions to the heart. Thus, its response is faster than pulse, heart rate or myoelectric signals.

The second characteristic of brain waves is that they carry more information. Brain waves are signals that change with a modulation width of roughly 0 to 50 Hz. They also change without regulation or pattern. For example, when you are reading a book, watching a movie, or listening to music, the waveforms of brain waves are different in each case. In contrast, pulse and heart rate have a set pattern; a fixed waveform centered around 60 to 70 Hz, getting faster or slower according to level of stress (autonomic nerve action). Differences in the book, movie and music experiences can be distinguished from brain waves, but such differences cannot be classified easily from pulse or heart rate.

Brain waves have these characteristics, but they are difficult to handle because they are extremely small signals and have complex waveforms. Pulse and heart rate signal strength is in the range from 1 to 10 mV, but brain wave signals are only 1 to 50 μV, and unlike pulse and heart rate, brain waves also occur with an unlimited number of waveform patterns. They are also measured together with myoelectric signals due to the movement of eyelids and eyeballs, and this adds to the complexity of the waveforms. As a result waveforms can be different, even for the same activity or state, making analysis to select the common components very difficult.

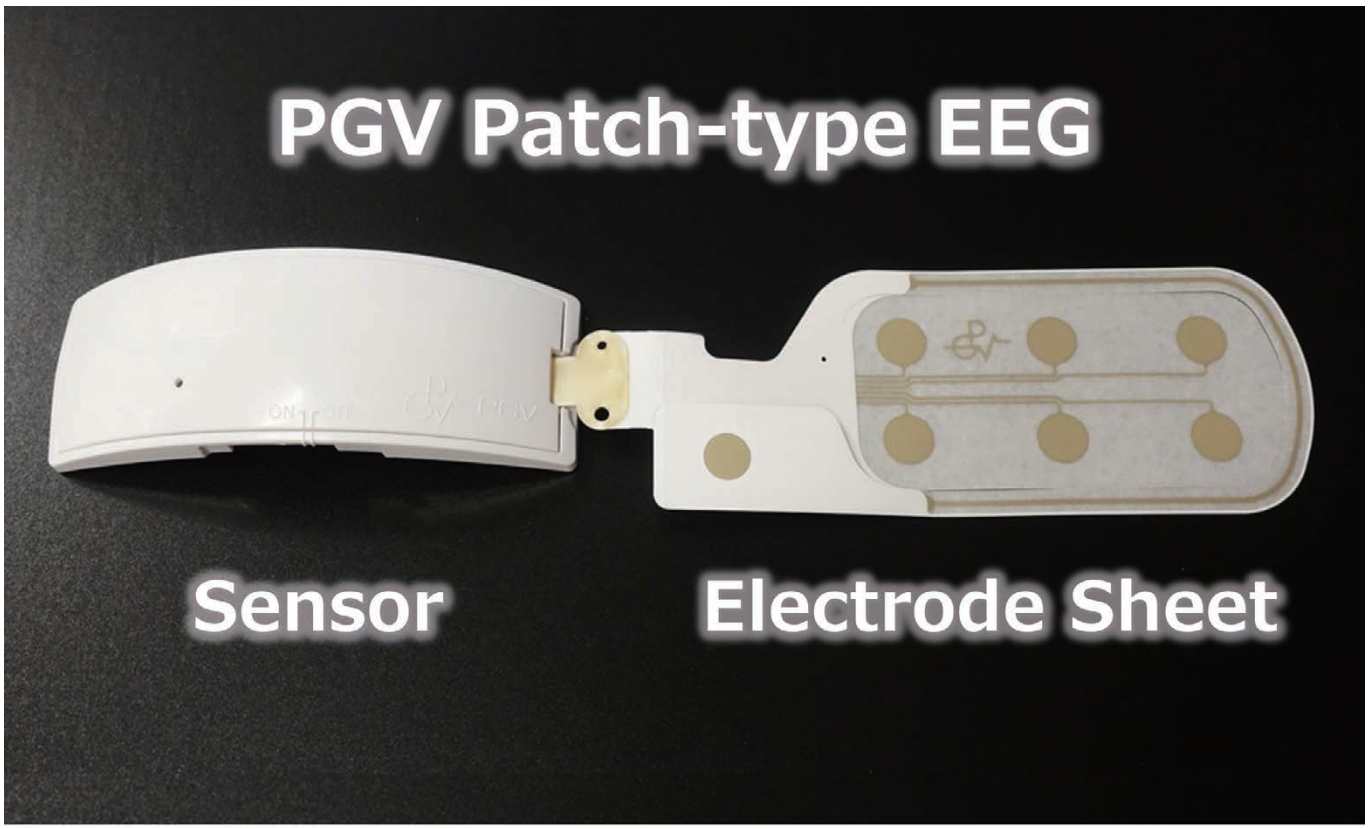
3. PGV Strengths

As can be seen from the above characteristics, useful and effective utilization of brain waves requires 1) the ability to accurately and easily measure brain waves, which are very weak biological data, and 2) to overcome the difficulty of analyzing these measurements.

For the first point, we have implemented a patch-type EEG (Figure 1) product using flexible electrode sheet material by combining Prof. Sekitani's research results with expertise from Nippon Mektron Ltd., a world leader in the field of flexible printed circuits (and a member of the NOK group, which is a PGV shareholder). In the past, brain waves were measured using large, medical EEGs, but their range of use was limited because they required up to 30 minutes to set up, they placed a heavy burden on the subject, and they were very expensive systems. PGV's patch-type encephalograph is extremely easy to use compared to conventional large EEGs, and is able to obtain brain wave data without compromising accuracy. The electrode sheets used to measure brain waves are a patented technology that is an extremely thin 50 μm, has excellent elasticity, clings tightly to the forehead, and fluctuates very little in resistance, so the subject's minute brain wave signals can be captured. The device also uses excellent noise processing technology to achieve stable EEG readings.

For the second point, we have incorporated AI in analysis of brain waves and are accumulating know-

Figure 1: PGV's patch-type EEG



how in efficient analysis of brain wave data. Brain wave fluctuations do not show patterns and appear to be irregular. As such, even when performing a frequency analysis, there are many dimensions that are beyond the scope that a person can understand. It is extremely difficult to derive patterns linking brain wave changes with changes in the body or mind. This has lead to use of AI analysis. In AI analysis of brain waves, large amounts of brain wave data labeled with the person's activity or state are collected and they can be analyzed to make associations between the person's activity or state of mind and body and the brain waves. By developing many brain wave AIs in this way, it may also become possible to understand various states of a person's mind and body objectively, by measuring their brain waves.

4. PGV's business—Now and in the future

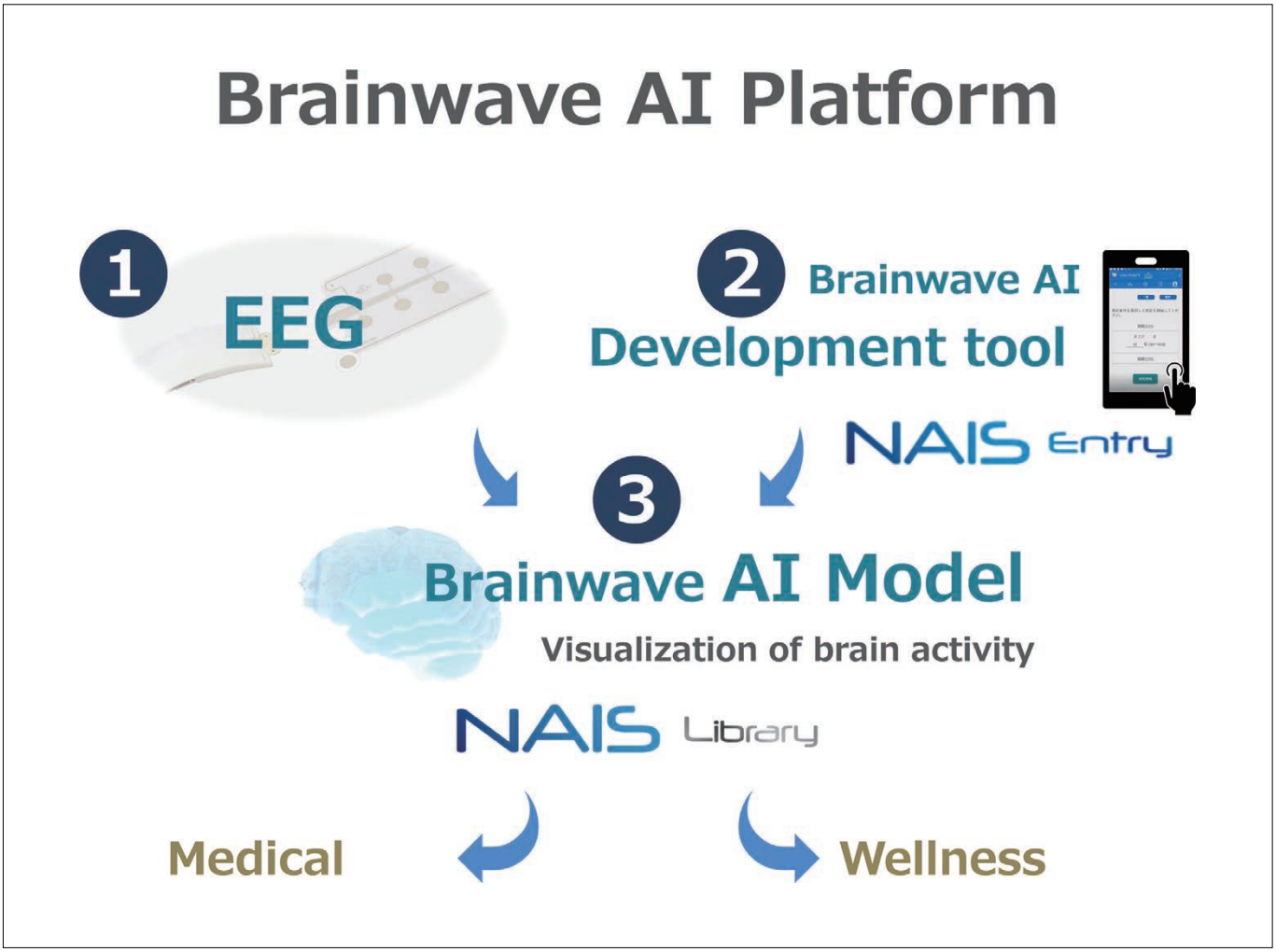
So far, most of PGV's work has been in developing, manufacturing and selling the patch-type EEG, and contracting services related to brain wave analysis.

PVG's patch-type EEG sensor is small and light-weight (27 g), is hardly noticeable when worn and is controlled wirelessly, making it very easy to measure brain waves. As of August, 2020, it has also received medical device certification (Class II, 302AFBZX00079000) as a telemetry EEG. It is helping to make clinical research using brain waves at universities and research facilities less expensive and more effective.

Our contract services in brain wave analysis involve medical research and also a range of research involving the five senses and other bodily states (fatigue, concentration, etc.). Our customers include university and other research facilities as well as enterprise R&D departments and new-business development departments. We have been performing frequency analysis of brain waves, but as mentioned above, since FY2020, we have been using AI based on the characteristics of brain waves.

To raise our competitiveness in the brain-tech market, we are promoting a brain wave AI platform concept. The platform is composed of three elements: (1) an EEG, (2) a brain wave AI development tool, and (3) brain wave AI models (Figure 2).

Figure 2: Three elements of the brain wave AI platform



Regarding the first element, we have begun developing a next-generation EEG. We are pursuing a more compact and user-friendly EEG while maintaining high accuracy, to further advance the current EEG. In the future, we plan to develop an AI chip, and automate brain wave pre-processing (data cleansing) and other tasks that require a large amount of effort to be invested.

For the second element, the brain wave AI development tool, we formally released the NAIS Entry brain wave AI analysis service in May 2021. Although the EEG is easy to use, the brain wave data is difficult to handle, so this service provides AI analysis of measurements that our customers have taken themselves, in an SaaS format. We implement brain wave analysis that is easier and costs less. Users first use a PGV device to measure brain waves, which they then upload to PGV servers using an application on a tablet. The results of AI analysis of the user's brain wave data are then sent back to the user. We plan to continue improving NAIS Entry functionality, to more precisely meet the needs of various types of customers.

For the third element, the brain wave AI model, we have consolidated various algorithms from both medical and non-medical fields in to our NAIS Library, and are working on visualizations of brain activity as a measure (an objective index) of brain waves. At PGV, we have already completed development of a brain wave AI model for sleep analysis (automatically determining stages of sleep and generating sleep indices). In the future, beyond development within PGV, we will strengthen our support

for external AI model development, providing our patch-type EEG and NAIS Entry service to other enterprises and research facilities. Our brain wave AI platform is positioned as a service platform promoting Open Innovation in the brain-tech field.

In medical fields, we hope to use brain waves as a biomarker for mental and nervous-system disorders. For example, brain waves could be used to diagnose dementia. We have already prototyped a program to diagnose dementia, but we are still collaborating with the Faculty of Medicine at Osaka University to improve its reliability. In the future, we will conduct clinical trials to verify the technology and hope to commercialize a brain wave AI program for diagnosing dementia (obtaining certification or approval as a Software as a Medical Device). We plan to implement a system that can be used for a preliminary diagnosis of dementia using brain waves, which can be done by a primary-care physician, even if they are not a specialist in dementia. This will contribute to the treatment of dementia as is needed in our hyper-aging society.

As of FY2021, we have also begun developing a NAIS Library for a non-medical field, visualizing people's state of fatigue and mindfulness, and using brain waves as an objective index of fatigue.

Finally, I would like to introduce PGV's long-term vision of "Brain health management with an EEG in every household." We hope in the future, to implement an EEG and brain-health management program for home use, by further improving our EEG so that it can be used easily by the general public, and by using evidence and brain wave AI models obtained through initiatives in the medical and health-care fields. We have about 15 technical employees (data scientists, software and hardware engineers) who are focused on implementing this long-term vision and working daily to improve performance in the brain-tech industry.

Figure 3: NAIS Entry service flow

APT Training 2021

— Development of fundamental network planning skills in regional communities to bridge the digital divide —

The ITU Association of Japan
International Cooperation Department

As part of APT's (Asia-Pacific Telecommunity) program to support human resource develop, the ITU Association of Japan has been delivering training programs[*1] since 2017 that aim to build skills in status analysis, solution formulation and conceptual design of communication networks as a solution strategy in an effort to bridge the digital divide between urban and less-populated communities in developing countries.

In 2021, the eight-day program[*2] was held between December 1-13, and for the second-year running was delivered online. As was the case last year, class times were limited to two-to-three hours a day, which was just long enough for trainees to maintain concentration for an effective training session. This year's training program welcomed eight trainees from five countries: Bhutan, Iran, Myanmar, Palau and Sri Lanka.

The training program has three clear objectives.

(1) Gaining an understanding of issues specific to one's own country and learn methodology for proposing tangible projects to overcome the digital gap in the various communities of that country.
(2) Understanding the importance of adopting clear government policies on network architecture.
(3) Developing skills in proposing and evaluating solutions for the various issues faced in one's own country.

On the first day of training all trainees delivered presentations on current ICT conditions and related issues in their own countries and/or specific regional areas. After the presentations, trainees were given plenty of time to exchange ideas and learn about and gain a deeper understanding of conditions in the countries of their fellow participants.

Day two started with an address by Kazuhiko Tanaka, the Secretary-General of the ITU Association of Japan, on the current status of ICT in Japan. This was followed by a lecture on the basic concepts of network design by former NTT-employee Takayoshi Hamano. Mr. Hamano joined the program as a lecturer this year to provide practical drills training, which is a major drawcard of the program.

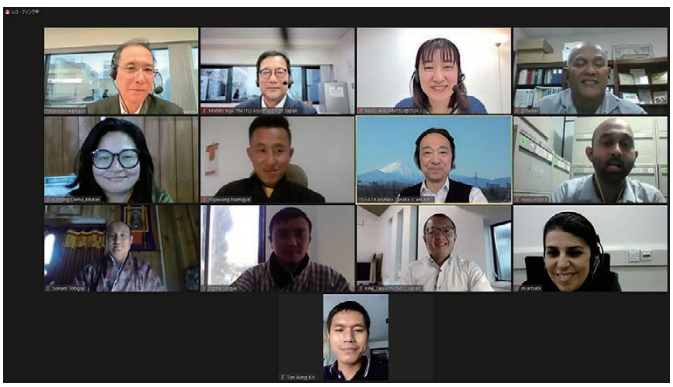
Trainees carried out various training drills from day three to learn how to design networks. Each drill presented a model of a typical regional area, such as a mountainous or coastal community, and trainees examined methodology for designing networks suitable for each region based on analysis of geographical and other conditions. They were also instructed in the development of region-specific ICT services and ICT environments.

On day six, trainees were given a virtual tour of KDDI DIGITAL GATE by KDDI, with a few staff from the ITU Association of Japan also visiting to support the virtual tour.

During this virtual tour, trainees shared in a lecture on KDDI's 5G initiatives and demonstrations of KDDI's advanced 5G technologies via a live stream. Despite trainees participating remotely via their computer screens, there must have been a real sense of presence about the training not generally available in such formats.

On the final day, each trainee

Group Photo



Lecture delivered by Mr. Hamano

*1 Training program funded by the Government of Japan for practitioners and technical staff from APT member countries to learn about Japanese technologies and services
*2 A rest day was scheduled during the week.

KDDI lecture

Virtual tour of KDDI

presented an action plan. The action plans proposed solutions to the issues identified by trainees on the first day, as well as applied the skills learnt on the program. Once all trainees had presented their plans, trainees were given the opportunity to exchange ideas with the lecturers and other trainees. By attempting to address challenges close to their own hearts, trainees were able to learn more practical approaches.

Training formats that center on practical drills induce independence in trainees and enable more active communication between participants. In view of the Covid-19 situation, this year's program adopted last year's training methods and was delivered entirely online.

Specifically, the program was designed so that trainees could read and familiarize themselves with texts and drills in advance via an e-learning platform so that they could concentrate on questions and answer sessions and meaningful discussions during online classes. During discussion-based drills trainees were divided into smaller groups using the breakout room function on the Web-conferencing tool, Zoom.

Drills were conducted four times, with members in each group taking turns to practice the techniques, and despite differences in nationality and skill levels, the trainees managed to deepen interactions with each other.

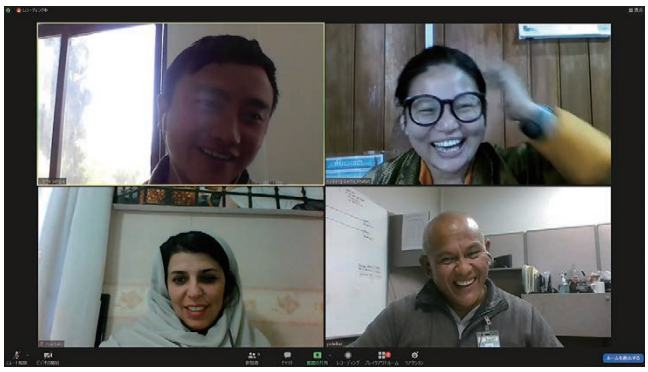
Once debate had been concluded on a group level, a representative from each group was asked to present their group's findings, with lecturers evaluating design ideas and giving suggestions on alternative methods. Trainees came to a shared realization that there was never a single strategy to solving an issue, which then prompted a wide-ranging discussion.

Despite being conducted entirely online, this year's program again proved to be comprehensive and productive.

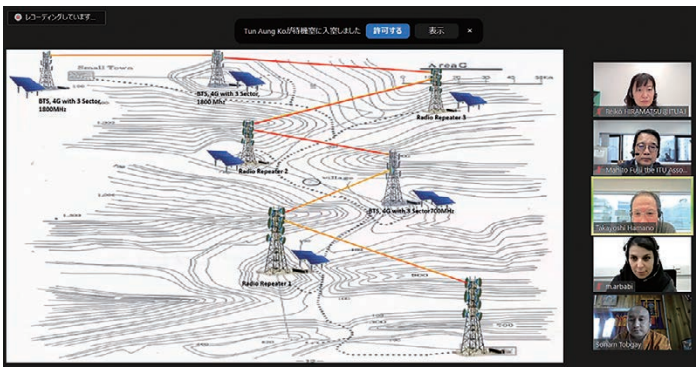
Even if the program continues to be held online in 2022, we would like to consider how best to deliver purposeful training sessions in view of the recent noticeable advances in communication technology.

In closing, we would like to express our gratitude to the staff of the APT and Ministry of Internal Affairs and Communications for their guidance and cooperation in carrying out this training, Mr. Hamano for his efforts in creating the course materials and instructing the trainees, and the staff of KDDI for providing a virtual tour of their facilities. In addition, we would also like to take this opportunity to thank Mr. Takuzo Fujii, who created the foundations of the program and continued to lecture up until last year.

Practice drills



Post-drill presentations



= A Serial Introduction Part 1 = Winners of ITU-AJ Encouragement Awards 2021

In May every year, The ITU Association of Japan (ITU-AJ) proudly presents ITU-AJ Encouragement Awards to people who have made outstanding contributions in the field of international standardization and have helped in the ongoing development of ICT.
These Awards are also an embodiment of our sincere desire to encourage further contributions from these individuals in the future.
If you happen to run into these winners at another meeting in the future, please say hello to them.
But first, as part of the introductory series of Award Winners, allow us to introduce some of those remarkable winners.

Masashi Kamei
Japan Broadcasting Corporation (NHK)
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Fields of activity: ABU, ITU-R SG4, WRC, Satellite Broadcasting

International Collaboration with ABU for Standardization Activity

It is an honor to receive this ITU-AJ Encouragement Award. I would like to express my sincere gratitude to the ITU Association of Japan and all those who have given me guidance and encouragement.

I have been involved in standardization activities since WRC-07. I participated in discussion of the agenda item on use of the 21-GHz- band broadcasting satellite service at APG07-5 and made contributions based on results from our study for WRC-12 agenda item 1.13, on the 21-GHz band broadcasting-satellite service. Our proposals, which enable flexible use compensating for rain attenuation and providing future broadcasting applications, were reflected in updates to Radio Regulations. We continue study on the 21-GHz band broadcasting-satellite service and contribution to ITU-R.

During the discussion in APG and WRC, the Asia-Pacific Broadcasting Union (ABU), which is a professional association of broadcasting organizations including NHK in the Asia-Pacific region, gave a lot of cooperation and support for our proposals and promoted better understanding in other members. I learned that this international collaboration was established by a tradition of both contribution by senior members of NHK to ABU and trust by ABU in those members.

I was elected as a vice chairman of ABU Technical committee in October 2018. One of the agenda items of WRC-19 was related to promotion of UHDTV satellite broadcasting, which is already being provided in Japan since December, 2018. Based on our traditional relationship, I was able to secure understanding and cooperation from ABU to support Japanese activities on this agenda. Since APG19-5 was held in Tokyo in August 2019, exhibiting UHDTV satellite broadcasting was examined to promote understanding in foreign members who would not otherwise have a chance to experience its immersive visual and sound. I also gave a presentation for the ABU supporting Japanese activity.

I will continue to make efforts for international collaboration with ABU and promote R&D results based on our traditional relationship.

Daisuke Kurita
NTT DOCOMO, INC.
kuritad@nttdocomo.com https://www.nttdocomo.co.jp/english/
Fields of activity: 3GPP LTE-Advanced and 5G standardization

3GPP Activities on UMTS/LTE/LTE-advanced Antenna Performance Standards and 5G Physical Layer Standardization

I would like to offer sincere thanks upon receiving this ITU Association of Japan Encouragement Award, and take this opportunity to thank the many people who offered their support and guidance.

I have participated in 3GPP RAN WG4 since 2007, studying mobile station antenna performance requirements and evaluation technologies, and in 3GPP RAN WG1 since 2018, studying and creating specifications for advanced 5G NR technologies such as NR backhaul-link application and NR communication area extension.

Mobile station antenna performance is the element that determines communication areas, and we faced two main difficulties when beginning discussion to create the standard specifications. The first was that network operators want high performance, while mobile device vendors want the minimum performance. I proposed performance requirements considering both perspectives and considering discussion from each company. The second was that in studying evaluation technologies for multi-antenna performance, support was divided between two different evaluation technologies. I proposed technology that permitted the technologies to coexist, and were able to guide discussion with each company to conclude the technical study.

In this way, I learned that although technical superiority is important in discussion of standards, it is also important to make flexible proposals that consider differing perspectives. I also devoted such thinking when involved in study of 5G NR advanced technologies and contributed to completing the technology verification according to schedule.

I look forward to further advances in communication technology, which will bring more richness and convenience to life in the future, and hope to contribute to that development.

Taiji Sakamoto
Nippon Telegraph and Telephone Corporation
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Fields of activity: ITU-T SG15

Next-generation Optical Fiber Standardization Activity

I am very thankful to receive this Encouragement Award from the ITU Association of Japan. I would like to express my gratitude to everyone at ITU-AJ and ITU-T SG15 for their guidance and cooperation for standardization activities in ITU-T SG15.

I have been involved in ITU-T SG15 (Transport, Access and Home) Optical Fiber standardization Question 5 (Optical fiber characteristics and test methods) and Question 8 (Optical fiber submarine cable system characteristics) since 2012, promoting standardization of optical fiber for high-speed, high-capacity transmission.

To support communication traffic as they continue to increase in the future, standardization of optical fiber capable of even higher speeds and capacity is needed, and we have already begun discussion of the next generation of optical fibers, called multi-core fiber, which are structurally very different from conventional optical fiber.

Communication standardization activity is essential to maintaining interconnectivity, and optical fiber is the hardware at the core of communication. I hope to continue contributing to establishing standards for next-generation optical fiber and developing the basic optical communications technologies supporting all of our lives and businesses.

Takuya Shitomi
Japan Broadcasting Corporation (NHK)
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Fields of activity: ITU-R WP6A, Digital Terrestrial Television Broadcasting

Activities related to digital terrestrial television broadcasting

It is a great honor to receive the Encouragement Award from the ITU Association of Japan. I would like to express my sincere gratitude to the ITU-AJ and everyone that has given me guidance and encouragement.

I have been acting as a member of the Japan delegation since 2017, contributing to WP6A mainly on two issues.

The first relates to transmission technologies for 4K/8K terrestrial broadcasting. I contributed documents on the transmission technologies developed in the research titled, "R&D related to advanced terrestrial television broadcasting technology," supported by the Ministry of Internal Affairs and Communications, and the information was added to several related reports. For the recommendation for 2nd generation digital terrestrial television broadcasting systems (BT.1877), I also proposed a revision of the system selection guidelines to summarize the technical differences and features between several transmission systems. In this work, the opinions of each country were in conflict, but we were finally able to lead to a revision of the recommendation allowing everyone to agree.

The second issue concerns methodologies for evaluating interference on digital terrestrial television broadcasting using Monte Carlo simulations. I participated in the rapporteur group meeting, discussing the correspondence between the interference probability obtained by the Monte Carlo simulations and the degradation of location probability used in the terrestrial broadcast link budget. We developed a new recommendation (BT.2136) and hope that the recommendation will be beneficial for both broadcasting and other systems.

Through these activities, I was able to experience international negotiations and broaden my perspective. I will continue to make efforts to contribute to the effective use of radio waves and the promotion of Japan's efforts on next-generation broadcasting technologies.

Kunihiko Teshima
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Fields of activity: Open RAN

Standardization activities at 3GPP and O-RAN

I am extremely honored to receive this ITU Association of Japan Encouragement Award. I would like to express my gratitude to everyone at ITU-AJ and all others involved.

I have been involved in RAN standardization activities at 3GPP since about 2013. One of the issues I was involved in was discussion on improving communication quality in high-speed mobile environments such as Shinkansen trains. At the time, the issue was raised as just a potential issue, because high-speed environments like Shinkansen are limited, even considering the whole world, so it was difficult to convince others that an extended specification to resolve the issue was necessary. However, through patient discussion to identify the issue using field test results and explaining it in detail, we finally reached understanding with many operators and vendors. I later became rapporteur for this discussion, and the fact that we finally completed the extended specification is a good memory for me, even today.

Currently, I have moved my activities to the O-RAN Alliance, working to implement an open and intelligent RAN, and am working as a co-chair of one of the groups studying open interfaces to realize a multi-vendor RAN. Enabling configuration of a RAN combining equipment from different vendors would allow combinations that utilize features from more vendors and products, to gain benefits in terms of performance, timing in providing services and cost. For RAN in the 5G era, with demand for more advanced requirements and diverse services, implementing and open, multi-vendor RAN is more important than ever. As a co-chair, I intend to continue driving discussion of creating an open RAN.

Standards for Connecting the World Through Technological Innovation

- Nomination for the Director of the ITU Telecommunication Standardization Bureau -

Telecommunications technologies have brought about the information society and promoted digital society around the world, and are supporting the progress of digital transformation. Its impact on people's lives, industries and society has been growing in recent years. ITU-T continues to play a role in ensuring technology evolution and its timely deployment throughout the world. Mr. Onoe's leadership will contribute greatly to the realization of a vision that brings inclusive, sustainable and reliable society through the worldwide spread of technology standards that result in the deployment of meaningful and affordable broadband connections all over the world. Here, the Government of Japan nominates him for the Director of the ITU Telecommunication Standardization Bureau and would like to seek your support for him.

ONOE, Seizo

Present Title
Chief Standardization Strategy Officer of NTT Corporation and Fellow of NTT DOCOMO, INC.

Born
12 May 1957; Hyogo, Japan

Nationality
Japanese

Marital Status
Married with 2 Children

Education

1980	Bachelor of Electronics Engineering, Kyoto University, Japan
1982	Master of Electronics Engineering, Kyoto University, Japan

Professional Experience

1982	Joined NTT Public Corporation
1992	Transferred to NTT DOCOMO, INC. at its foundation
2002	Managing Director of the Radio Network Development Department
2008	Senior Vice President and Managing Director of R&D Strategy Department
2012	Chief Technology Officer and Executive Vice President and a Member of the Board of Directors and Managing Director of the R&D Center (later R&D Innovation Division)
2017	President of DOCOMO Technology, Inc. and Chief Technology Architect of NTT DOCOMO, INC.
2021	Chief Standardization Strategy Officer of NTT Corporation and Fellow of NTT DOCOMO, INC.

Commendations

2007	Accomplishment Award by the ITU Association of Japan
2008 and 2014	The Commendation for Science and Technology by the Minister of Education, Culture, Sports, Science and Technology
2018	Medal with Purple Ribbon

Extensive International Experience in Standardization and Management

- Leading the evolution of generation for the mobile communications network
- Abundant experience in organization management
- Active in standardization organizations and forums
- Work on ITU related activities

Mr. ONOE has extensive experience in international standardization and management. He has led the evolution of the mobile communications network through standardization initiatives and global coordination, and is known as "the Father of LTE". Mr.ONOE's experience, capabilities and tested management skills will surely be a driving force for ITU-T activities.

通巻百三十四号

ONOE, Seizo

Candidate for the Director
of the ITU Telecommunication
Standardization Bureau

Standards for connecting the world through technological innovation

定価　一冊　一、六五〇円（本体価格　一、五〇〇円、消費税　一五〇円）　年間購読料　六、六〇〇円（本体価格　六、〇〇〇円、消費税　六〇〇円）

www.onoe-seizo.jp