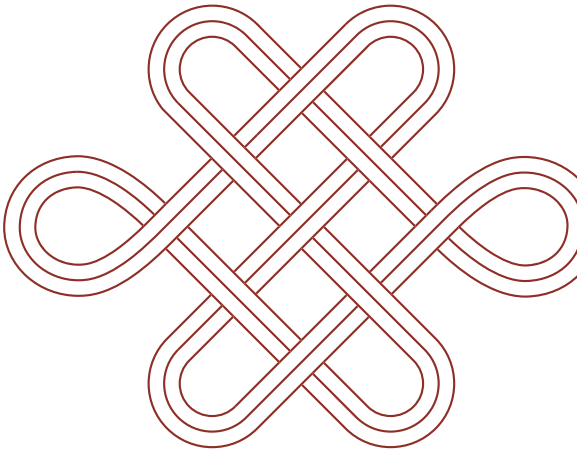
JST's 20th Anniversary Commemorative Publication

Japan Way

Supporting Science and Technology in Japan



Greetings from the President to commemorate JST's 20th anniversary

Japan Science and Technology Agency (JST) celebrated its 20th anniversary in October 2016. We would like to express our deepest gratitude to all those involved in guiding and supporting us since our establishment, especially government organizations including the Ministry of Education, Culture, Sports, Science, and Technology (MEXT), the industry, the academia, and research institutions. I am also grateful to my predecessors, officers, and staff members who have undertaken tremendous efforts for the progress of JST.

Japan Science and Technology Corporation (the former JST) was established by merging two existing organizations, Japan Information Center of Science and Technology (JICST) and Research Development Corporation of Japan (JRDC), in October 1996. The objective of this merger was to proactively implement initiatives set out in the "Science and Technology Basic Law" while strengthening the infrastructure for the promotion of science and technology in a comprehensive and effective way. After its establishment, it was reorganized as an independent administrative institution, the current JST, in October 2003 and later as a national research and development agency in April 2015.

JST has made considerable achievements since its establishment and is now recognized globally, currently ranking third in Reuter's "Top 25 Global Innovators – Government." However, due to the rapidly changing environment in both Japan and abroad, we recognize that JST may face various challenges in the future. To overcome these potential difficulties, scientific and technical innovation is, undoubtedly very important, and urgent action is imperative. JST is committed to lead the "co-creation of innovation for the future" as a network-based research institution conducting top-level R&D in the world.

JST has a role in leading the advancement of science and technology in Japan as the navigator of innovation, and as a premier organization of the world, it bears the responsibility of promoting and driving innovation that may benefit all humankind. JST aims to meet these responsibilities by predicting the future based on available evidences and properly grasping the trends in global science and technology. We compiled the "HAMAGUCHI Plan" in April 2016, through which we plan to strengthen collaborations with foreign and domestic universities, research institutions, and industries. We are committed to carry out these reforms for new breakthroughs that will contribute to the sustainable improvement of people's lives.

We will also strive to keep our organization flexible and effective, contribute to society actively on a wider range of fields by closely cooperating with diverse organizations in society, and meet people's needs using the strength of our organization accumulated over many years of experience.

We hope that this commemorative issue will help strengthen our ties with all relevant organizations and be useful in highlighting the efforts that JST has made in promoting science and technology. Furthermore, it is our hope that this issue will serve as a useful guide for the next generation of people including those related with JST, our officers, and staff members.

I would also like to express my sincerest gratitude once again to all those involved, including MEXT, the Cabinet Office, related academic circles, and other organizations for making the publishing of this commemorative issue possible. Marking its 20th anniversary, JST promises to continuously make efforts to live up to both domestic and international expectations with renewed determination and utmost sincerity. We appreciate your further support and cooperation. Thank you.

October 2016

Michinari Hamaguchi
President
Japan Science and Technology Agency

Congratulations

It is my great pleasure to congratulate the Japan Science and Technology Agency (JST) on the occasion of the 20th anniversary of its establishment.

Over the past 20 years, science and technology have played vital roles in Japan as key drivers of economic and social development. However, the economic and social structures prevalent in Japan and around the world are rapidly and drastically changing. New technologies such as IoT (Internet of Things), Big Data, and AI (Artificial Intelligence) are not only enriching our lives, but are also radically changing our economic practices and lifestyles, both domestically and internationally. Furthermore, many nations around the world are already implementing aggressive approaches in both the public and private sectors to generate innovations that may change the entire concept of manufacturing. As a result of this rapidly changing environment, the roles of science and technology, as common intellectual assets that can be used to build bases for social development and to create a prosperous future for the next generation, are becoming more important than ever before.

JST was originally established in 1996 as the Japan Science and Technology Corporation. In conjunction with the Science and Technology Basic Law, which was enacted in 1995, and the Science and Technology Basic Plan, JST has made significant contributions to innovation in science and technology in Japan over the past 20 years.

The agency's various accomplishments in R&D include many notable scientific and technical innovations, such as the development of LED illumination for practical use, which was achieved through the invention of blue light-emitting diodes, and the introduction of applicable regenerative medicine, made possible by the generation of human iPS (induced Pluripotent Stem) cells. These innovations have greatly enhanced industrial competitiveness and have concurrently contributed to solving social issues.

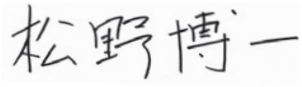
JST has comprehensively engaged in not only R&D promotion, but also strategic planning and the fostering of the next generation of human resources in science and technology. I wish to express my deepest respect to the officers and staff members of JST and to all relevant parties who have supported the development of scientific and technical innovation in Japan.

With the 5th Science and Technology Basic Plan, which was approved by the Cabinet in January 2016, our goal is to become a world pioneer in realizing a "Super Smart Society." As the leading organization implementing this basic plan, we have high expectations that JST, by marshaling domestic and international resources, implementing independent and strategic R&D, and developing human resources who can contribute to innovation, can create scientific and technical innovations that will become a source of national strength.

MEXT will work to actively deploy and implement scientific and technical innovation policies in coordination with related ministries and will also assist in the creation of new values for society through industry-academia-government cooperation.

On this occasion, I believe it is extremely meaningful to celebrate the advancements JST has made over the past 20 years and also to consider its current role and methods through which it can pursue further development in the future.

I am certain that the officers and staff members will continue to devote themselves to the further advancement of JST, and I would greatly appreciate all parties concerned continuing to provide their support for JST.



Hirokazu Matsuno

Minister

Ministry of Education, Culture, Sports, Science and Technology (MEXT)

Congratulations

I wish to express my sincere congratulations on the 20th anniversary of foundation of Japan Science and Technology Agency (JST).

The year 1996 was a landmark year that started the establishment of Japan Science and Technology Corporation, the former JST, and the initiation of the 1st Science and Technology Basic Plan. The plan was initiated based on the Science and Technology Basic Law that provides the foundation for science and technology policy with the aim of making Japan a nation oriented towards advanced science and technology.

Science and technology in Japan have made steady and significant progress since 1996. During this time, JST contributed significantly to the promotion of science and technology and to the creation of innovations through a wide variety of operations, including promoting world-leading research and development programs, constructing industry-academia networks, and enhancing the public understanding of science and technology.

Since 2014, JST has also played a major role in managing such programs as the "Cross-ministerial Strategic Innovation Promotion Program" (SIP) and "Impulsing Paradigm Change through Disruptive Technologies Program" (ImPACT). SIP aims to realize scientific and technological innovation based on the policy of the Council for Science, Technology and Innovation, and ImPACT promotes high-risk, high-impact, and challenging research and development.

The Japanese government formulated the 5th Science and Technology Basic Plan in January 2016 with the following four main pillars: 1) "acting to create new value for the development of future industry and social transformation," 2) "addressing economic and social challenges," 3) "reinforcing the fundamentals for STI (science, technology and innovation)," 4) "establishing a systemic virtuous cycle of human resources, knowledge, and capital, for innovation." In order to make Japan "the world's most innovation-friendly nation," we need to strive to further promote the creation of scientific and technological innovation through industry-academia-government collaborations.

I have great expectations from JST that it will play a leading role in implementing the various measures set out in the Science and Technology Basic Plan.

I would like to conclude my words of congratulations by expressing my wish that JST will continue to actively engage with the new approaches, aiming for the generation of scientific and technological innovation, based on the knowledge and experience it has accumulated over the past 20 years. I wish for JST's continued success and development in the future.

鶴保庸介

Yosuke Tsuruho

Minister of State for Science and Technology Policy

2001 Nobel Laureate in Chemistry

Ryoji Noyori

My relationship with JST goes back to the era when it was the Research Development Corporation of Japan (JRDC). In 1991, I was selected as the Research Director for the five-year Noyori Molecular Catalysis Project of the Exploratory Research for Advanced Technology (ERATO) funding program. This program was developed by Mr. Genya Chiba, Executive Director of JRDC, and has produced many valuable results. As an academic, I was given an exceptional off-campus research opportunity, conducting research in collaboration with numerous business people and foreign researchers in a fresh and open-minded atmosphere, which allowed me to make contributions to industry. The role of JST has evolved over time and in 2015 the organization changed from an independent administrative institution to a National Research and Development (R&D) Agency. It is now in a position to promote R&D positively by exercising its independence as a flexible and agile network-based institute. I hope that Center for Research and Development Strategy (CRDS), established in 2003, to which I belong, can navigate the ship of *Nippon* toward an advanced science and technology-oriented nation.

Born in 1938, Ryoji Noyori is currently Director-General of Center for Research and Development Strategy (CRDS), JST. Previously, he served as an Instructor in the Faculty of Engineering, Kyoto University, where he completed his master's degree in 1963. After receiving his doctorate in 1967, he was appointed as an Associate Professor at the School of Science, Nagoya University, in 1968. He later became a Professor there in 1972, following experience as a postdoctoral researcher at Harvard University. From 2003 to 2015, he was President of RIKEN. For his work on chirally catalyzed hydrogenation reactions, he jointly received the 2001 Nobel Prize in Chemistry.

2002 Nobel Laureate in Chemistry

Koichi Tanaka

Since graduating from university, I have worked in industry on mass spectrometric analysis research and development (R&D). In the early days of my career I could only conduct an analysis upon request, but eventually, I was able to collaborate with public research organizations. Shortly after I received notification that I had been awarded the 2002 Nobel Prize, JST launched its Development of Advanced Measurement and Analysis Systems (JST-SENTAN) Program according to the proposal by Professor Ryoji Noyori. I now realized that "analysis measurements not only confirm known substances but can also discover unknown compounds and their phenomena, and thus contribute to science and technology." I am grateful to monitor the progress of this program as a special advisor. Furthermore, I was able to achieve excellent results, nurture young researchers, and learn how to communicate with the general public while working on a project for the "development of the next generation mass spectrometry system, and contribution toward drug discovery and diagnostics" funded by FIRST. I also received, and greatly appreciated, enormous support from the industry–academia–government collaboration. The efforts of interdisciplinary teams develop world-leading products in Japan, but we are not fully utilizing the potential creativity available through collaboration with universities and others. We have just begun to draw from the achievements arising from research, leading to Japan's further development and its contribution to the world. I would like to express my gratitude to JST for its significant contribution to the industry–academia–government collaboration over the past 20 years and I hope for it to continue this progress into the future.

Born in 1959, Koichi Tanaka is currently a Senior Fellow at Shimadzu Corporation and General Manager of Koichi Tanaka Mass Spectrometry Research Laboratory. He joined Shimadzu Corporation after graduating from Tohoku University. He jointly received the 2002 Nobel Prize in Chemistry for the development of soft laser desorption ionization methods for mass spectrometric analyses of biological macromolecules. From 2009 to 2013, he acted as the research director for the project to develop "the world's highest performing mass spectrometry system, to contribute to drug discovery and diagnostics" as part of Funding Program for World-Leading Innovative R&D on Science and Technology (FIRST). Since 2005, he has been a special advisor for JST Development of Advanced Measurement and Analysis Systems (JST-SENTAN) Program.

2010 Nobel Laureate in Chemistry

Ei-ichi Negishi

I was fortunate enough to receive the 2010 Nobel Prize in Chemistry along with Professor Akira Suzuki of Hokkaido University and Professor Richard F. Heck from the University of Delaware. Immediately after receiving the prize, I was invited to meet Naoto Kan, then Prime Minister of Japan, and given the opportunity to provide advice on what we should do to revitalize research and development (R&D) in science and technology in Japan. I had previously discussed this topic with Professor Tamotsu Takahashi of Hokkaido University (who was a postdoctoral researcher in my research group at Purdue University), and was therefore able to list ten topics that I thought Japan, and other countries, needed to undertake in the field of science and technology, focusing on chemistry. Of the ten topics, I strongly recommended the following as the top three topics: (1) producing useful chemical agents such as CO, CH_3, OH, CH_4, etc., from CO_2 reduction; (2) developing more synthesis methods for organic materials including fullerene, and other materials that had just been discovered at the time; and (3) producing all types of organic substances from the efficient use of natural resources available in bulk at low prices (such as cellulose) for food, clothing, and shelter, and also as advanced chemicals. A year or two years later, a highest-level nationwide research system called Advanced Catalytic Transformation Program for Carbon Utilization (ACT-C) was established at JST, and I was asked to assume the important role of Principle Program Director in 2012. Since then, from the research presentations given by a few dozen teams every six months, I have come to realize that I have reached a stage where I can observe steady progress in various fields. However, I must say that there is still a long way to go in a large number of projects. Japan has certainly begun to lead the world in the R&D of these fields and has also generated some wonderful results related to their practical applications.

Born in 1935, Ei-ichi Negishi is a Distinguished Professor at Purdue University. After graduating from the University of Tokyo, he received a doctorate from the University of Pennsylvania while he worked for a private company. He has worked as a postdoctoral researcher and assistant professor at Purdue University as well as associate professor at Syracuse University before becoming professor at Purdue University. He received the 2010 Nobel Prize in Chemistry for developing palladium-catalyzed cross coupling in organic synthesis. Since 2011, he has been acting as the principal program director of JST. From 2011 to 2015, he served as the associate research director for Advanced Catalytic Transformation Program for Carbon Utilization (ACT-C), one of the programs under JST's Strategic Basic Research Programs.

2012 Nobel Laureate in Physiology or Medicine

Shinya Yamanaka

In 2003, when iPS cells still did not exist, my research was selected as one of JST's Core Research for Evolutional Science and Technology (CREST) Projects and was granted a generous research fund. Thanks to this funding, I was able to devote myself wholly to the project and in 2006 I announced the successful generation of mouse iPS cells. The continued support from JST has led to the generation of human iPS cells, research for the medical application of iPS cell technology, and patent-related efforts. Such support from JST has helped make it possible for the research on iPS cells to achieve steady progress. I would like to express my deepest gratitude to JST. JST is devoted to increasing the general public's interest in science and technology, focusing particularly on the youth by holding such events as the Science Agora and Science "*Koshien*," the Japan High School Science Championship. I deeply admire the contributions made by JST over the past two decades. I hope that JST will continue to support research, promote science to the general public, and encourage researchers to make new discoveries and expand the field of science and technology.

Born in 1962, Shinya Yamanaka is Director of the Center for iPS Cell Research and Application (CiRA), Kyoto University, and Professor at Kyoto University. After graduating from Kobe University School of Medicine, he served as a resident in orthopedic surgery at the Osaka National Hospital and obtained a Ph.D. in pharmacology at the Osaka City University Graduate School of Medicine. After acquiring his Ph.D. in 1993, he went on to become a postdoctoral researcher at the Gladstone Institute of Cardiovascular Diseases and began working on research that would lead to the development of iPS cells. After returning to Japan, he worked as a research associate in the Department of Pharmacology at Osaka City University Graduate School. It was when he moved to the Nara Institute of Science and Technology (NAIST) that he began his research on iPS cells as an Associate Professor in his own lab. In 2006, he announced his success in generating iPS cells and received the 2012 Nobel Prize in Physiology or Medicine. His work with JST includes being the Research Director for a CREST Project from 2003 to 2008 and the Research Director for the Yamanaka iPS Cell Project from 2008 to 2012.

2014 Nobel Laureate in Physics

Isamu Akasaki

I would like to start off by expressing my deep gratitude to JST for selecting my project for Contract Development Program as I was just about to realize the first breakthrough of realizing high-quality GaN single crystals in my research and development of a blue light-emitting device based on GaN. This led to the discovery of high-performance GaN-based LEDs and the potential they have for overcoming major challenges to today's ultra-efficient LEDs and power electronics. However, when I developed the GaN p-n junction blue LEDs, the U.S. was the first to respond with interest. In the early 1990s, various physical properties of the GaN-based materials were analyzed one after another, and blue LEDs and electronic devices were being discovered, but most human and material resources were still invested in ZnSe-based devices. While attending an international meeting at the time, I noticed that officials from government-related organizations from the U.S. and France, on even ground with researchers at the forefront of their fields, were discussing the matter and studying where to invest. This collaboration made me think about how public funding ought to be. In this sense, I have great expectations for JST to become a think tank for those on the cutting edge of science and technology, who have set out on unchartered waters.

Born in 1929, Isamu Akasaki is a Tenured Professor at Meijo University Graduate School of Science and Technology, and Professor Emeritus and Distinguished Professor at Nagoya University. In 1985, he was the first in the world to create a high-quality GaN single crystal. In 1989, he succeeded in creating a p-type crystal, which was said to be theoretically impossible and led to the development of GaN p-n junction blue LEDs. He jointly received the 2014 Nobel Prize in Physics along with Professors Hiroshi Amano and Shuji Nakamura for the invention of efficient blue light-emitting diodes. From 1986 to 1990, he developed the manufacturing technology for GaN blue light LEDs with Toyoda Gosei Co., Ltd. as a Contract Development Program of JRDC (currently JST). On the same project with Toyoda Gosei Co., Ltd., he developed the manufacturing technology for GaN-based short-wavelength laser diodes from 1993 to 2001. He acted as the advisor of JST from 2002 to 2004.

2014 Nobel Laureate in Physics

Hiroshi Amano

It was thanks to the support of JST that we were able to bring blue LEDs into the world. In the future, JST will have to meet increasingly high demands and expectations in order to establish a safe, secure, and sustainable society. It is vitally important to have both a clear vision for the future and the passion for realizing it. I hope that JST will continue to develop further in the next 20 years.

Born in 1960, Hiroshi Amano is a Professor of Nagoya University and the Director of Center for Integrated Research of Future Electronics, Institute of Materials and Systems for Sustainability, Nagoya University.Together with Professor Isamu Akasaki, his mentor at Nagoya University's Akasaki Laboratory, and Professor Shuji Nakamura of the University of California Santa Barbara, he jointly received the 2014 Nobel Prize in Physics for inventing efficient blue light-emitting diodes. Between 2006 and 2009, Professor Amano developed LED "Moth-Eye Structure" technology with the EL-Seed Corporation as one JST's Contract Development Programs. From 2012 to 2013, he developed a variable wavelength deep-ultraviolet solid-state laser source, under the auspices of JST's Adaptable and Seamless Technology Transfer Program through Target-driven R&D (A-STEP).

2014 Nobel Laureate in Physics

Shuji Nakamura

The first and only favor I ever received from JST involved the Exploratory Research for Advanced Technology (ERATO) funding program. In 2000, I moved to the University of California, Santa Barbara, where I found it difficult to secure research funds. It felt like a gift from heaven when my project was adopted by ERATO. This project became the foundation of my research activities in the U.S. Based on the research results, five venture companies were founded and many patents were filed. However, various problems remain with rights to the patents. I hope that JST will establish a stronger and more flexible research support system in the future, becoming an independent organization that can truly be the leader for science and technology research.

Born in 1954, Shuji Nakamura is a Professor at the University of California, Santa Barbara. After graduating from the University of Tokushima, he joined Nichia Corporation, where he succeeded in developing efficient blue LEDs and greatly contributed to their commercialization. He was a joint recipient of the 2014 Nobel Prize in Physics for the invention of efficient blue light-emitting diodes, sharing this honor with Professor Isamu Akasaki of Meijo University, and Professor Hiroshi Amano of Nagoya University. From 2001 to 2006, Professor Nakamura was the Research Director for JST's ERATO Nakamura Inhomogeneous Crystal Project.

2015 Nobel Laureate in Physics

Takaaki Kajita

I am very grateful to JST for promoting science and technology in various forms.
I think projects aiming to train and inspire the younger people responsible for carrying forward the legacy of science and technology into the next generation are especially important.
I look forward to JST promoting these activities in the future.

Born in 1959, Takaaki Kajita is Director of the Institute for Cosmic Ray Research (ICRR), and Special University Professor at the University of Tokyo. After graduating from Saitama University, he furthered his studies at the University of Tokyo's Graduate School under Professor Masatoshi Koshiba's group, where he engaged in cosmic ray research. Since 1996, he made detailed observations of atmospheric neutrinos with the Super-Kamiokande detector. He received the 2015 Nobel Prize in Physics for discovering neutrino oscillations, which shows that neutrinos have mass. He worked with JST as a team leader on a model project to promote the outreach activities of researcher information from 2005 to 2006.

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Supporting Science and Technology in Japan

PART 2 History

Documents & Materials

Note:
Events held on or before September 30, 2016, were documented in this publication. We used the Western calendar to express the dates and included supplementary Japanese calendars. Proper names of people, companies, and districts reflect what they were called as of this date, with the addition of the current names whenever appropriate.

Part 1 Vision

It has been 20 years since JST was founded. Its predecessor organizations, JICST and JRDC, supported the development of science and technology (S&T) in Japan even before JST's foundation. Based on the history of JST and by reviewing numerous statements made by former presidents, we have studied how JST reached its current standing through a number of changes it has experienced as an organization over time. The study of these statements has revealed JST's role and efforts as a "bridge builder" between S&T and society. Where is JST headed in the future? By considering the challenges ahead, we will see JST's prospects for the future.

Chapter 1

Expanding Roles of JST along with Social Changes

From a Backstage Task Group to an Innovation-Driving Organization

The Japan Science and Technology Corporation, which was the predecessor to the Japan Science and Technology Agency (JST), was founded on October 1, 1996. This organization resulted from a merger between the Japan Information Center of Science and Technology (JICST), founded in 1957, and the Research Development Corporation of Japan (JRDC), founded in 1961.

These two organizations were special public corporations affiliated with the former Science and Technology Agency, and both organizations resided for a long time in the same building, adjacent to the Prime Minister's official residence. However, JICST mainly functioned to supply both internal and external S&T document information to researchers in businesses, universities, and research institutions, while JRDC mainly operated to support work that linked the findings of research at universities and national research institutions to their commercial purposes. In addition to their contrasting business roles, the nature of the work performed by JICST and JRDC differed in terms of both employee character and working conditions from the very start, and there were almost no business connections nor personal interactions between them. The merger, therefore, was a political requirement in the name of administrative reform.

On the other hand, the merger abruptly expanded the demands and expectations of the new organization. This increase in demands was partly because nearly all other special public corporations under the former Science and Technology Agency specialized in just a single area, such as nuclear power, space, materials, oceans, disaster prevention, or other basic research.

In addition to creating epoch-making basic research indispensable to the development of new S&T policies responding to changes in domestic and international environments, the new organization had to bear diverse and large responsibilities for overall S&T policies, including building a bridge towards commercialization, regional revitalization, further promotion of international cooperation, and enhancing public understanding of S&T.

Let us revisit JST's 20-year history, along with the frank thoughts of former presidents focusing on how an organization that for a long time had been operating behind-the-scenes as a supporting-role functional organization came to bear huge responsibilities after the merger, developing into a core organization for promoting innovations that have now become global trends.

October 1, 1996: Launch of the Japan Science and Technology Corporation (left: Director General of the Science and Technology Agency, Hidenao Nakagawa; right: President of the Japan Science and Technology Corporation, Moritaka Nakamura)

Foundation of ERATO, Which Changed the Methodology for Promoting Basic Research

JST was established as the Japan Science and Technology Corporation in 1996, when the bubble economy came to an end and a long period of economic stagnation called the "lost 20 years" began. Ezra Vogel's *Japan as Number One* was published in 1979. Upon entering the 1980s, which were known as the Golden Age of the Japanese economy, negative opinions against Japan began to form in the U.S., which was overwhelmed by the export drive of Japanese industrial products. In the later years, an incident was widely broadcasted, with images showing a big name in Congress (who later ran for president) smashing up a Japanese car with a hammer.

The then-Prime Minister Yasuhiro Nakasone's private consultation body, "Advisory Group on Economic Structural Adjustment for International Harmony" prepared a report that became a guideline for Japan's various policies when countering the Japanese-American trade friction caused by the massive trade surplus with the U.S. This was called the "Maekawa Report," after the Governor of the Bank of Japan, Haruo Maekawa, who was the chairman of the group. The Maekawa Report advocated for economic policies correcting the economic imbalance and improving the quality of life of people. Heading in the direction of the report, policies were implemented focusing on increasing domestic demands, transforming the industry structure, promoting imports, and opening the markets. Polices also aimed to increase government expenditure, with a focus on investments on public utilities and deregulation to encourage private investments.

One of the policies aimed at improving the trade imbalance, which also affected JST, was the introduction of a system that required international procurement for public systems, devices, and equipment exceeding a certain fixed amount. This system required significant time and labor for the process of public notification to carry out this obligatory international procurement, and it continues to the present day.

Of greater impact to JST was the advocacy of "basic research freeloading," which had arisen in the U.S. as a form of Japan-bashing. This was based on the judgment that Japan was making products using technology developed on the basis of basic research conducted in other countries, which it then exported overseas to make a fortune. During the 1980s, almost 400 Japanese researchers were working at the National Institutes of Health (NIH) in the suburbs of Washington DC, the capital of the U.S. Even now, on one hand, some are of the prevailing opinion that summoning researchers from other countries improves the host country's core technologies and, in addition, has the potential to strengthen the country as a whole. Nevertheless, such exchange programs were used at the time as a piece of evidence by critics claiming that American funds were being used to train Japanese researchers.

Thus, according to people who seized this good opportunity to review Japan's S&T policies with regard to the criticism of "basic research freeloading," new noteworthy endeavors emerged in the history of Japanese S&T, as well as academic policies. The Exploratory Research for Advanced Technology (ERATO) was started by JRDC in 1981. Until then, the only system for basic research funding had been the Grants-in-Aid for Scientific Research (KAKENHI) under the Ministry of Education, Science, and Culture (at that time). The Council for Science and Technology comprised of researchers in leading positions had the actual authority to distribute research grants; researchers in various fields took turns judging the recipients of these grants under this setup. The recipient research fields were characterized broadly as rolling out original and cutting-edge research, and not much focus was placed on whether they were linked to the development of new future technologies.

Researchers with the ability to develop new technologies using original research were chosen as leaders (research directors) and allocated extraordinary research funds during this five-year period. These leaders were given wide-ranging

Headquarter building
(Kawaguchi-shi, Saitama Prefecture)

Tokyo Headquarter building
(Chiyoda-ku, Ward, Tokyo)

powers, from selecting the members of research groups to determining the progress of research. In the Japan of the time, it was JRDC that came up with the unprecedented ideas and mechanisms of ERATO.

Initially, however, even within the then Science and Technology Agency, which had been approached with the subject, very few people were in agreement, including Jiro Miyamoto, Director of the Japan Science and Technology Promotion Bureau and Manager Kiichiro Nagara (who later became Vice-President of RIKEN and a member of Space Activities Commission). Before negotiating the budget with the then Ministry of Finance, negotiations with the then Ministry of Education and the Ministry of International Trade and Industry (MITI) failed and were almost stuck at an impasse. Through behind-the-scenes ministerial year-end budget negotiations by Director General Ichiro Nakagawa of the Science and Technology Agency and the Minister of Finance Michio Watanabe, JPY 600 million of research adjustment funds resurfaced as a settlement. After assuming the post of JRDC Managing Director in 1991, Masahiro Kawasaki (Managing Director following the launch of JST, and its president from January 2000 to July 2001), who strived to develop ERATO, said the following: "This was accomplished with the extraordinary efforts of Genya Chiba at JRDC and Jiro Miyamoto, who was at the time Director of the Japan Science and Technology Promotion Bureau."

Genya Chiba, of whom Kazuki Okimura (President from July 2001 to September 2007 and current special counselor to the president) said, "The DNA of JST is Genya Chiba," had studied at an American university. He was persuaded by Harushige Inoue (who was the first President of JRDC and whom he happened to meet when he returned to Japan temporarily) to become a JRDC staff member immediately after its launch. Contract development was one of JRDC's support programs, which began with one full-time director and a few dozen members of staff. It was arduous work to start off by explaining to researchers at universities and other institutions the significance of JRDC's Contract Development. Then, at the very moment that the Contract Development was getting on track, there was a movement of consolidation of the various governmental agencies by "Second Provisional Commission for Administrative Reform," which was known by the name of the "Doko Rincho." To survive consolidation, Chiba thought of the establishment of a new basic research support system that was completely different from the Grants-in-Aid for Scientific Research (KAKENHI) as a make-or-break attempt.

Granting ERATO a budget ensured that they were not targeted for consolidation, at least for a while, and four intellectuals, President Chikara Hayashi of the Japan Vacuum Engineering Co., Ltd., Professor Tsuyoshi Masumoto of Tohoku University, Professor Naoya Ogata of Sophia University, and Professor Jun-ichi Nishizawa of Tohoku University, were selected as the research directors in charge for the first fiscal year. The tradition of naming projects such that the objective of the research follows the name of the leader, such as the "Hayashi Ultra-Fine Particle Project," "Masumoto Amorphous & Intercalation Compounds Project," "Ogata Fine Polymer Project," and "Nishizawa Perfect Crystal Project" continues from the time of launch to this day. Let us remember Kawasaki's words:

"This is a research support system founded on the idea that organizations should develop and invest in people. Despite being an unprecedented case, it was positioned as a link in the structural reforms that were triggered by the Maekawa Report and was accepted by the financial authorities." The idea of focusing on the contents and particularly the people, rather than the packaging, became the major spirit that has come to permeate JST activities ever since. The fact that ERATO has subsequently achieved real and actual success as expected can also be inferred from an episode in which the then President Akito Arima of RIKEN (1993 to 1998) (former Minister of Education, Director of the Science and Technology Agency,

First President Moritaka Nakamura

Lecture commemorating JST's third anniversary. The enlargement shows President Moritaka Nakamura

President of the University of Tokyo, and currently Director-General of JST China Research and Communication Center) asked the following:

"Why can researchers participating in ERATO mass-produce such highly-quoted papers? I suspect that it costs a considerable amount of money for the researchers to even make overseas business trips." Kawasaki's response to this inquiry was as follows: "There is nothing special about this. We leave the decision of overseas trips to research directors. We told them to spend lots of money. However, strangely, they do not spend much contrary to our expectation." Even Arima, who initially said that the ERATO method of granting powers to research directors was "something of a gamble," eventually looked satisfied himself.

In practice, external pressure from the Ministry of Education was strong from the start. The uncooperative attitude continued with comments such as "If you appoint professors from national universities as research directors, we will not allow their applications for KAKENHI" and "You are not allowed to use university facilities." However, there was fortunately a major policy trend in favor of regional devolution at the time. Thanks to the establishment of regional hi-tech centers by MITI, and by using facilities other than those at national universities, ERATO could make do without being based at national universities. In fact, the Kunitake Molecular Architecture Project (Research Director: Professor Toyoki Kunitake of Kyushu University from 1987 to 1992) and the Shinkai Chemirecognics Project (Research Director: Professor Seiji Shinkai of Kyushu University from 1990 to 1995) used Fukuoka Industrial Laboratories (currently the Fukuoka Industrial Technology Center) as their research base.

New Business Challenges in Core Basic Research Support

JST was launched on October 1, 1996. This merger was decided upon in the context of the trend towards administrative reform, but once the decision was made, the challenge then was how to achieve the best possible outcome. In June, four months after the Cabinet Office decision of February 1995 to merge JICST and JRDC was made, the Japan Science and Technology Promotion Bureau at the Science and Technology Agency prepared the "Interim Report Concerning How to Proceed with the Foundation Mergers." In addition to "eliminating waste," this proposed a long-term vision for the new corporate body that looked forward to "agilely responding to the needs of the new administration" as part of the administrative reforms, which JST looked upon as a positive initiative.

The first point to be cited therein was the "further promotion of basic research." The prevailing opinion at the time was that the Ministry of Education, which oversaw academic administration, was responsible for basic research. One may believe that what made basic research its priority was the confidence acquired from the high regard for ERATO, both within Japan and overseas. At this time, ERATO had already been established and was functioning effectively. The statement "In order to fulfill a role commensurate with being a nation of dignity," which was cited as a reason for the necessity to promote basic research, implied the strong notion that there was a need to respond firmly to the criticism of "basic research freeloading."

In addition, the long-term vision emphasized the need to "develop a base for promoting S&T" that aimed to achieve each of the following: "To fulfill our international role," "To secure sufficient S&T personnel" and "To revitalize regional S&T activities." In all cases, these goals were incorporated into the business objectives of JST when established. In particular, "increasing understanding" and "international cooperation" were new responsibilities given to JST from the very start.

Moritaka Nakamura, who led JST as its first President (October 1996 to December 1999) after working for approximately five years as JICST director, reflected on the days when JST started with the following words:

"From the JICST era onwards, budgets were squeezed, and there were strong demands to eliminate waste. The reason for establishing JST was that it would be good to merge similar organizations and reduce the number of special public corporations. Even I put emphasis on determining how much work could be rationalized and made more efficient, rather than trying

new developments as a new corporate body. I never imagined that we would expand our business and become an organization with such extensive operations as we have today."

Nakamura also noted that the background to the expansion of the role of JST includes the existence of congress members who understood the importance of S&T and consequently offered their support. The background also includes social changes, such as the increase in the number of researchers who focus on the applications to society even within basic research fields.

On the other hand, there was an issue of profitability for the Science and Technology Information Department. The "Current Bibliography on Science and Technology Service" had been a pillar of JICST's work ever since its establishment in 1957. It was restarted as the JICST Online Information System (JOIS) in 1976, and the number of science, technology, and medical documents accumulated from both within Japan and other countries have grown every year since then. In 1997, work began on building the "Directory Database of Research and Development Activities" (ReaD) to gather information pertaining to researchers at national research institutions, research subjects, research bodies, research resources, and research results for the purposes of promoting R&D and contributing to the creation of new industries. Further, the "J-STORE" database service started in 2000 with the aim of transferring the results of research conducted by universities, national experiments, and research institutions to corporations, and to promote their commercialization.

On reflection, it seems that following the launch of JST, the information service business has progressed steadily. JICST, however, was beset by a major financial "framework" called the Industry Investment Special Accounting System. This system targeted the businesses where investment could be recovered in the long term, but private funds alone could not supply sufficient funding. This system was applied to the Current Bibliography on Science and Technology Service, which was a core JICST business, and also to JOIS that developed from that Service. Nevertheless, businesses that had been proceeding smoothly gradually found themselves in difficult circumstances, and for quite some time, funds borrowed from industry investment special accounting could not be repaid.

Under these circumstances, Nakamura, who was the last President of JICST, was also worried about the situation. Although some insisted that as a special public corporation, public benefit should be prioritized in response to the requirements for rationalization, even after the launch of JST, Nakamura continued to tell employees, "Rationalizing work and planning to reduce expenses in order not to place an undue burden on the public is the same as in any private company."

Moreover, the merging of JRDC and JICST highlighted the differences in working conditions between the two organizations. On the one hand, associate managers were treated as managers and were therefore not paid overtime allowances, whereas on the other, they were paid regional weighting for working in Tokyo. It took several years to adjust to the differences in the working conditions between the two organizations. Masahiro Kawasaki said, however, that the greatest problem was the difference in job consciousness between the employees of the two organizations. "There was a difference in feelings and in culture. The focus of JRDC employees, for whom the Contract Development had been their main duty for many years, was mainly on 'people,' whereas JICST employees were focused on 'products,' such as information."

Nevertheless, from a larger perspective, it is clear that the merger was positive for JST. Moritaka Nakamura reflects by saying, "The employees responded to my expectation that we should do our best to unite under the idea that 1+1 does not equal 2, but rather 1+1=3, and they cooperated magnificently. As a result, the fusion of the two

"ReaD" website

organizations went smoothly, and I am thankful that we were able to develop our duties efficiently." Undoubtedly, many of the JICST employees would not have been able to cope with the expanded work from JRDC if they had not considerably divided up the increased workload. It is clear that they could cope with the rollout of new tasks, such as international cooperation and increasing public understanding, by allocating JICST personnel to tasks without increasing the total number of employees.

New Involvement in Increasing Understanding

Promotion of public understanding was newly added to JST's objectives and the first President Moritaka Nakamura also cited it as being a memorable task. The "Science Channel" movie program service, which introduces topics related to S&T into everyday life, started trial broadcasting in October 1998. This was a method of broadcasting that sent programs to cable television stations via broadcasting satellites. Eight months after the start of trial broadcasts, "Science Channel" was broadcasted to 162 cable stations nationwide and viewed in around 2 million homes. Subsequently, it was broadcasted by communications and broadcasting satellites until March 2012, and currently, both new and past programs can be viewed online. Its service of supplying the programs on DVD to educational institutions free of charge continues to this day.

Meanwhile, there are some opinions that, as over 3,000 programs had been made, a more appropriate way to use them should have been considered. Evidently, there may be some potential to recreate new programs using the extensive past products as the base material. Nakamura acknowledges that there was room for rethinking even in the basic idea of program creation itself, saying that "It might have been better to make shows that interest children without leaning too heavily towards science PR."

In July 1998, the "Virtual Science Museum" was established to display S&T topics in an easy-to-understand manner online. We asked people who can perform experiments for young people in teaching laboratories or workshops to register. The Grassroots Programs that support dispatching such people to host locations upon demand also started in 1997.

The idea of building the National Museum of Emerging Science and Innovation (Miraikan), which is increasingly popular and has repeatedly been selected as a destination for foreign VIPs, was handed down from the top when Nakamura was the first President. In July 2001, during the era of the next President, Masahiro Kawasaki, the museum opened in a very short time. Nakamura look back on those days:

"The creation of a museum under the new concept to promote understanding of S&T has existed within the Science and Technology Agency since the very start, but public opinion remained lukewarm, and it was not adopted as an agency policy. In the meantime, calls grew louder that we should do something to improve the economy of Tokyo Waterfront City, which was on reclaimed land. Thus, a supplementary budget was added urgently, and the decision to build the 'Tokyo Academic Park' was made. Subsequently, as JST was required to build an exhibition hall, the science museum became a reality all of a sudden."

The building plans were moved forward before the contents of the exhibition were decided. Both Kawasaki, who was the President when the museum opened, and his successor, Kazuki Okimura, had to tackle those issues. Okimura says, "At the 1998 supplementary budget, we were planning to request the budget for the survey costs for the science museum at initial talks. Building a science museum in a little over two years seemed to be impossible, and we concluded that we could not request a budget for construction costs at that time. However, the survey costs alone did not guarantee realization of actual construction. We negotiated the details with an architectural company and received assurances that construction was possible. Then, we changed our scheme and requested a construction budget. Nevertheless, upon looking at the proposed plans for the science museum from the

At the opening ceremony for National Museum of Emerging Science and Innovation (MIRAIKAN). President Masahiro Kawasaki is third from the left

construction company, it was the same ordinary building as could be found everywhere, which was totally unacceptable. We asked Professor Hiroyuki Yoshikawa (formerly President of the University of Tokyo and currently JST special counselor to the president) to chair the committee, and created a general supervising committee comprising of researchers to deliberate the plan. What they came up with was the concept of 'A lineup of cutting edge exhibits to show how much S&T contributes to society and is involved in the future.'"

Based on this concept, we entrusted the creation of the exhibition to the following four academic leaders: Professor Koichi Kitazawa of the University of Tokyo (later President of JST from October 2007 to September 2011), Professor Yuichiro Anzai of Keio University (later Keio University President and currently President of the Japan Society for the Promotion of Science), Professor Ichiro Kanazawa of the University of Tokyo (later Chairman of the Science Council of Japan), and Yoichi Kaya, Professor Emeritus at the University of Tokyo (current President of the Research Institute of Innovative Technology for the Earth). These leaders were made responsible for the four exhibition fields of "Technological innovations and the future," "S&T information and society," "Life sciences and humanity," and "The global environment and frontiers." In addition, we asked Mamoru Mohri to become the Chief Executive Director. Mohri was originally a researcher of structural materials for fusion reactors, and more than anything, was the first Japanese to board a space shuttle as an astronaut, so his name was well known.

Okimura clarifies that the objective was to create a "science museum in which the scientists created the concepts and exhibits, to be a 'base for Japanese scientists' run by scientists.'"

Thus, the creation of a completely unprecedented science museum where "the contents of the exhibits are discussed after construction started" and "opening a mere 2.5 years after the decision to build" was completed without problem. The initial concerns of whether "ultimately visitors would come to a science museum despite a bad location compared to the National Museum of Nature and Science in Ueno Park or the Science Museum in Kitanomaru Park" proved to be groundless.

Social interest in science museums cannot be said to be adequately high when compared to other developed countries. For example, the Smithsonian Institution, which occupies a vast space between the United States Capitol and the Lincoln Memorial in Washington D.C., the capital of the U.S., attracts visitors with its free admission in addition to each of its valuable exhibits. "A feature of American science museums, including the Smithsonian, is that they operate not only on government funds but also through donations. It is our wish that Japanese businesses would also give support to science museums in the same way." Nakamura, who worked as the first Director-General of Miraikan after leaving the JST presidency, observes the difficulties of running science museums in Japan.

To meet Nakamura's demand to "get the people to understand S&T policies, and to have other countries also understand the current state of Japanese S&T," new ideas and mechanisms may need to be planned in order to increase revenue without relying solely on public support for Miraikan to develop as a science museum beloved by many more people.

Second President Masahiro Kawasaki

Basic Research Programs Attracted Much Attention Both inside and outside the Country

Japan used to have a long tradition of distributing basic research funds widely and shallowly. ERATO, which fundamentally changed the way of research support in Japan, captured the attention of other countries to the extent that an observation party from the American National Science Foundation (NSF) came to visit twice.

Masahiro Kawasaki, during the period of his presidency, made visits to partner institutions of international

collaborative research in USA, such as the Massachusetts Institute of Technology and received a question at the National Institute of Health (NIH): "How do you select research directors at ERATO?" Upon explaining to the questioner, he was told, "It's good that you don't assess them based on peer-review. With peer-review, you would end up choosing average researchers." Peer-review is widely used as the most common way for disbursing funds implemented both within and outside of Japan, whereby researchers of the same specialist area investigate and determine the recipients to be allocated research grants. It is the same for Japanese Grants-in-Aid for Scientific Research (KAKENHI). However, this means that people in the leading position at the NIH are already well aware of these weaknesses in peer-review. This episode is an example of why ERATO received attention and interest outside Japan.

It was during the JRDC era before the launch of JST that PRESTO (Precursory Research for Embryonic Science and Technology) was launched, focusing on one of the three pillars for basic research programs that started with ERATO. This was in 1991, 10 years after ERATO was founded. It was under these circumstances, while conducting research at ERATO, in bases outside of universities, that research directors began to say "we should let young researchers demonstrate their abilities more freely without restrictions," which led to the formation of PRESTO.

The purpose of PRESTO, which is goal-oriented basic research, was the same as that for ERATO. However, the majority of those selected through public recruitment were young researchers in their 30s, and the feature that they could do their own research independently was greatly attractive to them. Further, the selected young researchers were not only advised by research supervisors and area advisors on their comprehensive research, on which they previously did not have any opportunity to receive instruction, but they could also pursue research whilst interacting and drawing inspiration from other researchers with various backgrounds in the same research areas. Selecting appropriate young researchers was particularly important with this system, which thoroughly incorporated JRDC's original ideas. Kazuki Okimura, the then manager of the Science and Technology Agency, who was assigned for obtaining PRESTO's budget, said the following.

"When I acquired the budget, I was surprised to find a huge difference between the content shown to the financial authorities compared to the content when actually starting the program at JRDC. It was as if the program was completely reformed by Genya Chiba."

As an anecdote to demonstrate the uniqueness of PRESTO, Kawasaki repeatedly mentioned the following phrase to the research supervisors, who were in charge of selecting young researchers to receive support from PRESTO research grants.
"Sir, this is a world of 'long shots.'"

As one of the NIH executive researchers pointed out to Kawasaki, this program may become meaningless if researcher selection is made based on peer-review, which tends to end up choosing average researchers. The research supervisors were repeatedly told to avoid this and were expected to use their discernment to identify outstanding researchers.

Using the PRESTO experience as a springboard, researchers were able to achieve a leap in their career, and subsequently many of them continued to be active in posts such as university professors. However, in practice, the opinions endorsing Kawasaki's concerns are now heard again. Because the operation of the system had changed since its initial launch, there are criticisms that only young researchers in similar fields are likely to be selected. "Since the program has changed, research fields are 'decided based on strategic targets determined by the Ministry of Education, Culture, Sports, Science, and Technology (MEXT),' only researchers in specific fields can now apply," wrote former JST Executive Director Hiroshi Nagano in his book *Nurturing Globally Competitive Next-Generation Leaders* (Kindaikagakusha, 2013). Before being appointed as Executive Director, Nagano left MEXT for JST, and as he had experience in operation of PRESTO before it changed purpose, this criticism is of great importance.

In FY1995, immediately before the launch of JST, another one of the three pillars for basic research programs, CREST, was launched. Its purpose was to conduct team-based research that generates innovations with a major impact. Kawasaki said the following upon the launch of CREST: "Based on ERATO's track record over the 15 years since its launch, people engaged in ERATO proposed that we should 'not only continue current work, but also create new work that adopts new themes and new challenges.'" The scale of the budget for the overall work was the largest among all basic research programs.

Research fields are set based on the government's strategic targets, and then research proposals are publicly recruited. One notable feature of CREST is that it lines up powerful research groups in one field and then promotes research to achieve its policy goals. Whereas ERATO gives the control over research to research supervisors, CREST aims to promote multi-peaked mountain style research.

In 2001, there was a major event in S&T policy that became a turning point in these three programs. In January, the Council for Science and Technology Policy was launched to steer S&T policy, and in the reorganization of ministries and agencies, the Ministry of Education

and the Science and Technology Agency merged to form MEXT. Further, the Second Basic Science and Technology Plan (target period FY2001 to FY2005), which advocated strategic focus on S&T by promoting basic research and prioritizing the R&D to provide solution to national and social challenges, was also determined in January. It cited four fields of focus—life sciences, information and communications, nanotechnology and materials, and the environment—and the allocation of research resources were prioritized accordingly. In July 2001, Okimura, who succeeded to Kawasaki as president, came under pressure to respond to the newly established MEXT and to the new Science and Technology Basic Plan. The immediate issue was how to clarify the role of the Japan Society for the Promotion of Science and JST. Both organizations were under the control of the Ministry of Education. How should JST's role be under the new relationship with MEXT? Okimura reflects on that period in the following words:

"When JST launched, entrusted with new mission of promoting international cooperation and increasing understanding, it changed into a new organization that comprehensively promotes S&T. In addition, the launch of MEXT caused a strong awareness at JST that the organization had to work closely with universities. Many researchers, such as Akito Arima, former President of the University of Tokyo and former Minister of Education, Hiroo Imura, former President of Kyoto University, and Atsuko Toyama, former MEXT Minister, were invited to JST as advisors. Moreover, it was necessary to change the organization's culture in order to cope with comprehensive work, and we recruited mid-career persons one after another who had extensive experience in research and corporations, and people who were proficient in English." Research support also faced pressure to undergo restructuring as it was now under the control of MEXT in the same way as the Japan Society for the Promotion of Science, which was responsible for allocating the Grants-in-Aid for Scientific Research (KAKENHI). JST's clear objective was to become "an organization responsible for strategic innovation based on the basic research results of universities." In practice, MEXT instructed JST on its strategic targets, but to JST, the details were unsatisfying.

This led to the foundation of Center for Research and Development Strategy (CRDS) within JST in July 2003. The purpose of this organization was to survey, analyze, and propose national S&T innovation policies from a neutral standpoint. The aim was to create an R&D roadmap to lead the industry ahead of an industry roadmap which was created by MITI (presently Ministry of Economy, Trade and Industry).

Okimura says the following about the objective, "I told the first Director-General, Ryoji Noyori (later to become President of RIKEN and currently Director-General of the CRDS) and his successor as Director-General, Toshiaki Ikoma (Professor Emeritus at the University of Tokyo), that we

The "Hakone Conference," which led to the Element Strategy Initiative

wanted them to create strategic research targets not for JST nor for MEXT, but for Japan." The idea that nothing is more important than strengthening the support for basic research remains unchanged. Toshiaki Ikoma, who joined the center while concurrently working as a company director, created a scheme in which CRDS invited top class people from business and academia, led intensive discussions, and proposed the strategies to MEXT and the Cabinet Office. Then, MEXT developed the strategic targets based upon the proposals and sent them back to JST. In addition to the role of implementing S&T policy, JST became a group functioning to propose policy recommendations.

The following year, in April 2004, approximately 40 top-class Japanese researchers and government officials gathered at the Hakone Prince Hotel in Kanagawa Prefecture for a conference. This was a two-day overnight residential conference held by CRDS with the aim of thoroughly discussing the issue of "taking an overall view of Japanese materials science to see how best to advance R&D in the future." The "Element Strategy" was the outcome of this conference, which subsequently determined the direction of important R&D in Japan. This is a challenging R&D concept that aims to replace rare elements that are indispensable industrial materials with elements that are abundant, and also to identify the features of those elements that were not yet known.

The "Element Strategy" is a good example that clearly shows the role of CRDS. The discussions at the residential Hakone conference came to fruition as the CRDS strategic proposal called the "Element Strategy" (November 2007), and over 3.5 years passed before MEXT's "Element Strategy Project" based on this proposal, and the related "Rare Metals Replacement Materials Development Project" by METI and the New Energy and Industrial Technology Development Organization (NEDO), started. This is also an example showing that well thought-out actions toward the policy leaders and mobilizing ambitious researchers from academia are essential to motivate policy leaders to develop proposals. This example of success shows that the most important thing is the ability to foresee the future of CRDS supervisors, with their strong will that spares no effort and time in negotiations. CRDS has just entered its 14th year since its launch. Can CRDS continue to be a professional organization, tasked with the developing strategic policy proposals, linking them to significant policies that satisfy the same enthusiasm now, as at the time of its launch on strategic research goals not for JST, nor for MEXT, but for Japan? It seems that CRDS is standing at a critical crossroad.

Actively Distributing Information Using the Internet

"Aiming for an internet corpus" was one of the policies promoted by Kazuki Okimura after he was appointed as president. In practice, information was actively distributed using the Internet, unlike other government organizations or incorporated administrative agencies. A lots of websites were set up under the leadership of Okimura, but they were not merely for introducing the activities of JST or MEXT. Many websites were characterized by the concept of "for All-Japan".

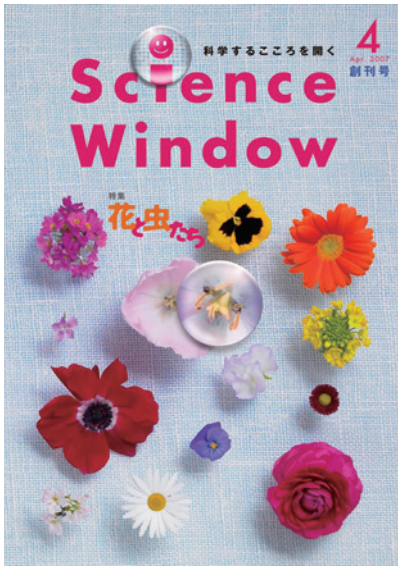
The "Portal Site for Industry-Academia-Government Collaboration," which was established in January 2005, distributes collected data on industry-academia-government collaboration and information of relevant events, as well as those original articles that introduced specific examples of collaboration between these three sectors. Moreover, the website "Science Portal" was established in 2006 with the editorial policy of distributing original human-centered articles, including contributed articles, interviews, and the detailed contents of lectures, in addition to public documents on S&T policies, information of research support, recruitment openings, and events relating to S&T. The English website "Science Links Japan" was established

Third President Kazuki Okimura

Top page of Science Portal at its launch

in 2006 and distributes S&T-related comprehensive data that is publicly available in English, enabling easy access to Japan's basic S&T information from abroad. The website "Kagaku Navi" was established in 2007 and distributes a range of topics, from specific topics aimed at junior high schoolers to topics of global interest and dictionaries of scientific jargon. None of these websites focus exclusively on JST activities or aim to advertise JST or MEXT.

The video website "Science News," which was established in 2010 when Koichi Kitazawa was the President, distributes unprecedented five-minute-long TV programs that introduce, in an easy-to-understand manner, diverse S&T topics not normally communicated through newspapers or television, and they are highly regarded.



First Number of Science Window

The website "Science Portal China" was established in 2008 and distributes news articles introducing S&T policy, education policy, and the latest research trends in China, as well as diverse original articles by specialists in both Japan and China.

The website "Objective Japan" was established in 2011 and introduces a broad range of topics on economy, S&T, and the social climate in Japan, for Chinese people who are interested in Japan, written in Chinese. This site fits with JST's newly added objective of international cooperation, and the number of people accessing the website has been steadily increasing.

Among these sites, there are some whose initial editorial policy and contents changed due to organizational changes of the department in charge, or some were closed down. However, they have appropriately fulfilled their expected roles as sites characteristic of JST, whose objective is to build an internet corpus.

The monthly educational science journal "Science Window" was launched in April 2007 and is also available on the website as a part of the Science Education Support Program. This journal is sent free of charge throughout Japan to elementary and junior high schools through the Boards of Education, and to science museums, zoos, and aquariums. The frequency of publication has shifted from monthly to bimonthly, and then to quarterly. However, it has made an unprecedented contribution in encouraging many people to develop an interest in science through its scrupulous editing in each issue.

An Organization that Leads Innovation into the Light

Kazuki Okimura thought that in order to achieve the strategic research targets set by the government, greater focus than ever was needed on to basic research in order to fully realize the task of basic research programs. He believed that a person who is in charge of identifying the research outcomes best suited to basic research programs from the numerous basic research achievements, and distributing funding should be selected from researchers, that is, a university professor. Based on the idea, Koichi Kitazawa, the then professor at the University of Tokyo, was invited to be the managing director and assumed the post in May 2002.

Since then, the system continued in such a way that President Okimura continuously worked towards increasing the budget for basic research programs at the same ratio as the Grants-in-Aid for Scientific Research (KAKENHI) under the control of the Japan Society for the Promotion of Science. Special Director Kitazawa, continued this system in order to enhance the contents of basic research programs and improve

Fourth President Koichi Kitazawa

efficiency.

In October 2007, Kitazawa assumed the role of president, succeeding Okimura. Until then, there was no press conference when a new JST president was appointed; however, Kitazawa held a press conference for the first time, during which he expressed his aspirations and the specific tasks he was going to address at president. It was a symbolic event in which JST clarified its intention to change from a "Supporting Role" organization focused on supporting researchers and specialists of technology transfer, as emphasized by previous Presidents Kawasaki and Okimura, to an organization that drives innovation.

Four months before Kitazawa assumed a new role of the President, "Innovation 25," the long-term strategy initiative that the first Abe administration had dedicated its efforts towards, was approved at the Cabinet meeting. With a vision up to 2025, it showed the policies that be pursued to achieve a prosperous future for Japan. This was based on the results of an investigation by the "Innovation 25 Strategic Council," chaired by special cabinet advisor Kiyoshi Kurokawa, former president of the Science Council of Japan. It incorporated such R&D policies as "Drastic investment in young researchers, and ambitions and challenging research" and "Reinforcing research capabilities and educational strengths of universities."

The Science Council of Japan cooperated fully in formulating the policies for "Innovation 25," including its President Ichiro Kanazawa's assuming a role of a member of the "Innovation 25 Strategic Council." Kitazawa, who was concurrently a member of the Science Council of Japan, led the discussions as the committee vice-chairman of the "Committee for the Investigation of Innovation Promotion, Science Council of Japan," of which Kanazawa was the chairman. Ultimately, they compiled various proposals that were incorporated into "Innovation 25."

Regional Support Experience Utilized at the Great East Japan Earthquake

Koichi Kitazawa's activities at the Science Council of Japan continued even after he took office as the President. On March 11, 2011, the Tohoku-Pacific Ocean Earthquake (magnitude 9.0) occurred, which caused a critical accident at the Fukushima Daiichi Nuclear Power Plant. It became clear in both within and outside of Japan that Japanese nuclear power plants actually lacked the necessary countermeasures and were not fully prepared in the event of serious disasters. Japan had not implemented the safety measure called "defense in depth," which consists of five layers of defense and is regarded internationally as a common protection measure. Public trust of scientists, including nuclear engineers, was completely lost and has not yet recovered.

The measures taken by JST were to support the researchers, including those at Tohoku University, to ensure that essential research was not interrupted. At the next step, JST then introduced a research and survey support program in collaboration with overseas funding agencies that allocate research grants. A month after the earthquake, the American National Science Foundation (NSF) called for proposals on urgent research needs relating to the Great East Japan Earthquake through their Rapid Response Research (RAPID) program, which triggered JST's action. The program started by JST was also subsequently used as J-RAPID during the 2015 Nepal earthquake and the 2016 Kumamoto earthquake.

The Center for Low Carbon Society Strategy (LCS), which was founded in December 2009, also surveys and analyzes low-carbon technologies and energy systems that mainly target reusable energy, and in July 2012, they announced their "Comprehensive Strategy and Scenario for Creating a Low-carbon Society." Currently, Japan has chosen to continue using nuclear power. Kitazawa advocated that a national debate is required on the issue and thereafter, similar views are being repeatedly presented by others on various occasions.

President Michiharu Nakamura

(October 2011 - September 2015), who succeeded to Kitazawa, continued the revitalization promotion support program for regions of Japan, respecting each independent regional leadership. Among them, there was an example of success that enabled the delivery of Tohoku's fishes to Kyushu whilst keeping their freshness. This was made possible by the discovery that fish can be kept fresh for longer using sherbet ice rather than freezing the fish completely. Before that, there was a restriction in delivery of Tohoku's fresh fish in refrigerated condition. The delivery was limited up to the restaurants in the Kansai area but not beyond. This case demonstrates the role of coordinators, in other words the experience accumulated since the time of JRDC of focusing on people, being put to good use.

Nakamura said the following in response to the revitalization promotion support program: "We adopted around 250 programs, and created employment for around 270 people. With fake technology, it is impossible to support even small or medium-sized businesses of three to five people. This is exactly the same as my idea of training up top-level science towards top-level innovations."

Reinforcing the Links between Industry, Academia, and Government that Focus on Top-Level Science

The basic research program, which generates innovation, was naturally the most important issue for President Koichi Kitazawa. Among those research results arising from the Grants-in-Aid for Scientific Research (KAKENHI) of the Japan Society for the Promotion of Science, which are distributed widely and shallowly, JST invests its research funds in the research that they find promising. The "Two-stage rocket system for allocating research grants" used by Kitazawa in his explanation of basic research program is also widely supported by many university researchers who previously preferred KAKENHI and peer-reviewed methods.

In November 2007, an American medical journal published the results of Professor Shinya Yamanaka of Kyoto University, who created iPS cells from human skin cells. JST's subsequent response was prompt. In addition to emphasizing the significance of promoting iPS research, CRDS proposed a specific direction for research, and ERATO immediately set up a research system. In May 2008, they hosted an international conference in Kyoto to which they invited leading researchers from across the globe, including Nobel laureates, and worked hard to improve public understanding on the importance of iPS cell research.

JST's support for Professor Yamanaka's research goes back to four years before the epoch-making research report of the creation of iPS cells from human skin cells was released. President Tadamitsu Kishimoto of Osaka University, who was a research supervisor at CREST, chose Professor Yamanaka's research as the challenge for the FY2003's research theme, in the area of "Advanced Medical Technology for Intractable Immune Disorders and Infectious Diseases." Kishimoto narrated the following story about Yamanaka's research in later years: "I didn't think it had any chance of going well, but I chose him because I was fascinated by his impressive impact during the interview." This is often quoted as an example of the importance of "discernment" to find

iPS international symposium held by JST in Kyoto, May 2008

International symposium "Induced Pluripotent Stem (iPS) Cell Research - Frontier and Future"

research(ers) with great potential in order to make future breakthroughs.

In light of the research successes attributed to ERATO, PRESTO, and CREST, a new program for research development, the Solution-Oriented Research for Science and Technology (SORST), started in 2000. SORST aims for seamless development and continuation of research themes that are promising and have a strong chance of commercialization if supported further. Among the excellent results emerging from SORST is the research of In-Ga-Zn-O (IGZO) amorphous oxides by Professor Hideo Hosono of the Tokyo Institute of Technology, which contributed to the production of organic EL displays and e-paper. These successful results received attention both in Japan and abroad. SORST was eventually discontinued; however, JST under Kitazawa accelerated this technological transfer, thereby starting two new funding systems in 2009 called the Adaptable and Seamless Technology Transfer Program through Target-driven R&D (A-STEP) and the Strategic Promotion of Innovative Research and Development (S-Innovation).

A-STEP is a technological transfer support system that targets the broad R&D phases with the aim of commercialization. S-Innovation is a system that defines the "R&D themes" that are the cornerstone of industrial creation and supports R&D by multiple R&D teams that form collaborations between industry and academia. S-Innovation is characterized for being a long-term system with a maximum duration of 10 years.

In the meantime, what was the reaction of the U.S., which was eager to bash Japan with claims of "basic research freeloading?" Did they do nothing but to fold their arms? While the news of criticizing Japan dominated headlines, the report known as the "Young Report," which took its name from the chairman of Hewlett-Packard, was published in 1985. The report was created by the Commission on Industrial Competitiveness, which was formed by President Reagan, and reported that the fall in the industrial strength of the U.S. was attributed to the decline in manufacturing industries, and made various proposals. The subsequent report, the so-called "Innovate America" (also called the "Palmisano Report" after the President and CEO of IBM, who chaired the commission) was published at the end of 2004. This report was submitted by the Council on Competitiveness, which was established by leaders from industry, academia, and labor unions, who prepared the report following year-long deliberations.

The report stated that in the 21st century, innovation would be crucial for the nation to gain and maintain its superiority over the competition. The report proposed the reinvigoration plan of cutting-edge research, including securing talented human resources by the establishment of new scholarships by the private sector for university students, an introduction of problem-solving learning to foster creative thinking and innovative abilities from elementary schools to university, and the allocation of 20% of the R&D budget from the Department of Defense for long-term research to enhance the role of basic research as before. This report was also characterized by not being written with the idea that only the U.S. should remain strong. The report also emphasized the importance of innovation in building a better world for everybody, rather than one country beating another in competition, which attracted attention.

CRDS, which paid close attention to this report, released a detailed analysis on the report and subsequently made a proposal in 2005. Then in September 2006, an international conference was held in Tokyo hosted by the "Global Innovation Ecosystem" organization committee under the leadership of Director-General Toshiaki Ikoma of CRDS. At the second symposium and workshop in 2007, Deborah Wince-Smith, President and CEO of the U.S. Council on Competitiveness, gave the keynote speech on the Palmisano Report. In response to an invitation from Director-General Ikoma of CRDS, Michiharu Nakamura (then Fellow of Hitachi, Ltd.) also participated as a panelist. Nakamura remembers, "JST was the first to realize the importance of innovation. This example clearly shows that JST has a key role in creating a new paradigm in Japan as well as in the world, and making them secure."

Accordingly, it was natural that Nakamura, after taking office as president, formulated a top-priority policy to "encourage top-level science that leads the world and generates results with a potential to change the world." The following statement clarifies JST's strategy: "Trying to do something by combining what we already have is a consumption-type R&D and acceptable as a flow of R&D. However, to prepare new technologies for the next era, 10 or 20 years from now, it is important to create new technology stock. It is necessary to link the success of top-level science to top-level innovations that have social value, while maintaining a balance."

Since its foundation as JRDC, JST has a history of nurturing top-level science and steadily continuing the work of linking this to top-level innovations. Aiming to revitalize the regions of Japan, JST has made efforts to link the results of local research and of local industry from the very start. It is clear that regional revitalization is not an easy task from the fact that the government has taken every possible means necessary to initiate regional promotion programs.

JST is also no exception, and as a result of review and prioritization of government programs under the Democratic Party in 2009, JST had the bitter experience of discontinuing JST Innovation Plaza and Satellites as unnecessary, which had acted as bases for regional revitalization.

In some regions, however, the skill and knowledge left from the regional revitalization programs, where JST coordinators showed a great effort, are retained even today. "It is an unthinkably long way to continue coordinating efficiently with researchers and industries while keeping discussion with them. JST nurtured such human resources internally, but the idea was to 'be in a supporting role.' I conversely said that we should make actions for words. In fact, when I took office as JST president, many researchers told me that they found it difficult to understand what JST actually wanted," said Nakamura, strongly appealing for JST employees to change their consciousness.

Ever since its establishment, JST has recognized the importance of people with discernment like Tadamitsu Kishimoto, who found the latent potentials in Shinya Yamanaka's research outside of JST, and sought out such people externally as well as nurturing them within JST. Moreover, today, there are demands for "program managers (PM)," human resources who can not only discern the quality of basic research, but also capable of building a bridge by transferring the research results towards industry. Under Nakamura, the Development Program for Program Manager (PM) Candidates started in 2015. Prior to this, ACCEL was launched in 2013 with the objective that PMs with rich experience in academia and industry collaborate with the research directors who lead the research, all to link R&D activities between researchers and companies and venture businesses.

According to Nakamura, "Toyota hired the top PM of the Defense Advanced Research Projects Agency (DARPA) in the U.S. and made him director in charge. There may not be many capable PMs (they could be counted on one hand) who can be called 'super' in Japanese major companies." Nakamura emphasizes even today the necessity for creating a multi-course HR system in JST that can help build careers of PMs and super-PMs by hiring outsiders or by training specialists with excellent coordinator abilities.

Fifth President Michiharu Nakamura

Contributing to S&T Diplomacy through International Cooperation

The proposal for "Strengthening Science and Technology Diplomacy" by experts from the Council for Science and Technology Policy (now the Council for Science, Technology and Innovation), including President Masuo Aizawa of Tokyo Institute of Technology (currently JST counselor to the president) and Taizo Yakushiji (current Program Director, SATREPS), was presented to the Council for Science and Technology Policy in April 2007 and approved by the Council in May 2008. It called for creation of a system that would be of mutual benefit to both Japan and

partner countries through synergy effects between S&T and diplomacy of Japan as well as taking a leadership in solving issues on a global scale for mankind. Aizawa emphasizes the importance of S&T diplomacy, saying, "While being called an advanced S&T-orientated nation, Japan is not good at using S&T as a part of national power. We should aim at strengthening Japan's soft power."

JST promptly acted in tandem with this trend of focusing on S&T diplomacy. The Science and Technology Research Partnership for Sustainable Development (SATREPS) program was started in FY2008. This organization's aims were to strengthen S&T diplomacy immediately after the Council for Science and Technology Policy decided in May FY2008 to support the independence and improvement of S&T in developing countries while solving issues together through joint international research, not merely by providing technological support. A major feature is to promote joint research from the standpoint of equality with the research institutions of the partner country in the cooperated fields, such as environment and energy, disaster prevention, and infectious diseases, which are common issues for both advanced and developing nations.

Joint operations with the Japan International Cooperation Agency (JICA) were also a tremendous boost. Even for JICA, this was a worthwhile program, as it had reached an impasse in Official Development Assistance (ODA), which mainly provided unilateral assistance to developing countries, focusing on infrastructure such as bridge building. Young researchers from partner countries were invited and stationed in Japan's joint research agencies through international cooperation, and conversely, Japanese postgraduates also widened their views by experiencing other countries, greatly improving the human resource training aspects.

Signing ceremony with JICA at the launch of SATREPS (left: President of JICA, Sadako Ogata; right: President Koichi Kitazawa)

The government policy, which aims for synergy effects by unifying S&T cooperation and government development support, garnered international interest through its well-received workshop at the Organization for Economic Co-operation and Development (OECD) Global Science Forum, which was held in Pretoria, South Africa, in September 2010.

Michiharu Nakamura, who focused on international collaborative research, worked hard to realize the e-ASIA Joint Research Program. In June 2012, this project formally started with the participation of eight countries: Indonesia, Thailand, the Philippines, Vietnam, Malaysia, Myanmar, Laos, and Japan. The mechanism solicited international collaborative research to solve problems common to the Asian region, and the funds necessary for the selected joint research projects were supplied by each of the participating countries to their own researchers.

In some cases, the target fields overlapped with SATREPS, such as with disaster prevention and infectious diseases; however, as more than three countries were participating, it could expect more diverse research. Currently, the American National Institute of Allergies and Infectious Diseases is also among the participating bodies, which has increased the number of participants to 12 countries and 17 organizations. It is expected that the strengths of multinational collaborative research will work toward solving regional issues, such as infectious diseases and disaster prevention, facing each country.

The Japan-Asia Youth Exchange Program in Science (SAKURA Science Plan), which started in 2014, is not merely restricted to youth exchange with various Asian countries, but also contributes greatly to improving friendly relations between the countries. The basis for this plan were exchange activities with China initiated by China Research and Communication Center (CRCC). CRCC was established within CRDS in 2006 and became an independent center equivalent to CRDS in 2013. Both the "Japan-China Symposium," which was held for the first time in 2006, and the "Japan-China University Fair and Forum," which was held for the first time in 2010, play a vital role in increasing, year by year, the interest in Japan-China exchange at the universities of both countries.

However, the results of a survey conducted by a private survey company revealed that 90% of people

in both Japan and China hated people from the other country in 2013. After retiring as president, Kazuki Okimura, who had devoted his efforts to CRCC activities, felt a sense of crisis and proposed the "SAKURA Science Plan." Initially, the idea of the program was to invite 10,000 Chinese youth to Japan for a short period annually. However, Minister Hakubun Shimomura of MEXT, upon hearing the explanation from Okimura and CRCC Director-General Akito Arima, counter-proposed: "Let's include the whole of Asia, not just China." Okimura recalls, "This proposal was truly a blessing. If we had started only with China, the program might not have developed as well as it has."

Even when political exchange between Japan and China was almost completely at a standstill due to the Senkaku issue, both the Japan-China researchers and youth exchanges as well as the Japan-China University Fair and Forum, sponsored by CRCC, continued without interruption (although the Fair and Forum scheduled to be hosted by Japan in September 2012 was postponed and was instead hosted in China during the same fiscal year). In January 2016, the Chinese government chose Okimura as one of the seven foreign nationals to receive the Chinese government's International Cooperation Award in Science and Technology. Although all other foreign nationals who received the award were researchers, he was the only Japanese recipient and a veteran administrative official. At the awards ceremony in Beijing, Okimura had his photograph taken standing alongside Xi Jinping, President of the People's Republic of China, and Prime Minister Li Keqiang. The photo was widely disseminated in Chinese newspapers and television.

There is no doubt that the founding of CRCC, the annual "Japan-China University Fair and Forum," the establishment and operation of "Objective Japan," the "Science Portal China" websites, and the creation and promotion of the "SAKURA Science Plan" are all well regarded. However, Japanese newspapers, communications, and television companies stationed in Beijing did not report the award. They showed no interest in Okimura's achievements nor the role that CRCC had played to date. The Japanese media evidently failed to grasp that Okimura's award was a sign from China that they wanted to restore relations with Japan.

Former President Kazuki Okimura (right) receiving the International Cooperation Award in Science and Technology from the Chinese government

Steady Efforts in Regional Promotion

Efforts to revitalize the region through S&T was inherited from JRDC following the launch of JST and has continued to be an important task. Support for Regional Science Promotion Program (RSP), which started in 1996, was one of such efforts. Prior efforts to support the regions of Japan, including the establishment of Tsukuba Net (Hi-Tech Net), which was started by the Science and Technology Agency in 1978 with the goal of concentrating national research centers universities and businesses in the Tsukuba district of Ibaraki Prefecture, or the establishment of "Technopolises" in 26 locations nationwide under the leadership of the then-MITI, failed to produce the expected results. With this evaluation in mind, Masahiro Kawasaki reflects on the characteristics and objectives of RSP, "Even with academic oriented or with the hardware priorities, it was not sufficient. RSP focused on the role of coordinators, who take action and leadership. This is the same as ERATO, which succeeded with human-centered work."

The simple idea that if the research results are good, the flow of commercialization would happen naturally and a market would be born eventually does not work any more. It is necessary to change this mode of thinking, by first considering commercialization and then seeking and gathering usable research subjects. Therein lies the task of establishing the idea that the role of the coordinator is significant.

Regional revitalization through S&T was one of the tasks on which Okimura, who succeeded Kawasaki as president in July 2007, also made efforts. The Regional Innovation Creation and Support Program was promoted from Innovation Plazas and JST Satellites in 16 locations nationwide. One of the four support

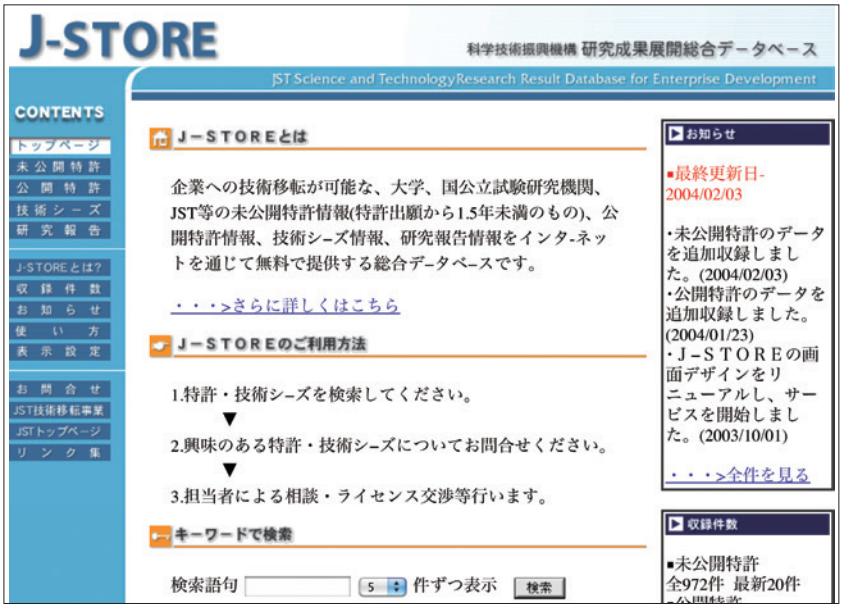
programs, the "Research for Promoting Technological Seeds," aimed at promoting commercialization of research seeds at universities unearthed by the coordinators, creating innovation, and supporting coordinator activities. To make it accessible for applicants to apply for support, the R&D period was defined up to one year, and the grant had a maximum limit of 2 million yen. Another support measure was also taken to anticipate open innovation by the "Database for Industry-Academia-Government Collaboration," which was made available to public.

This was based on Okimura's idea that "Industry-Academia-Government Collaboration needs to involve the whole country, including regional universities and researchers." The idea was that Innovation Plazas and JST Satellites should be platforms for everyone to participate. The databases were also publicly available, allowing anyone to contribute to innovation.

Modeled on the American Bayh–Dole Act, major changes involving patents were incorporated into the Act on Special Measures concerning Industrial Revitalization, which was formulated in Japan in 1999. This regulation enables patents arising from R&D research outsourced by the government to belong to the researchers and affiliated bodies and to be vested in the same way as in the U.S. It aims at promoting technology transfer by R&D contractors to play a central role.

Whereas the general consensus is that the Japanese Bayh–Dole act works positively in industry-academia collaboration, there is currently a contrary belief that there is an aspect which is making it difficult for university researchers who have been actively presenting their research results to companies, and who are passionate about industry-academia collaboration, to freely provide the information to companies.

Hiroyuki Abe (former member of the Council for Science and Technology Policy, former President of Tohoku University, currently JST special counselor to the president), notes the pros and cons of the Japanese Bayh–Dole Act: "Engineers who want the results of their research to be of benefit to society have never hesitated in supplying their research information to businesses, and there are many companies that have received assistance from university researchers."



"J-STORE" website

JST also faced pressure to change its stance due to the Japanese Bayh–Dole Act. This was because one of JST's major tasks was to hold approximately 2,000 usable patents obtained from research support and then transfer promising research outcomes as a foundation to outsourced research. However, the main implication of the Japanese Bayh–Dole Act is that it is not the role of JST to apply for patents; rather, universities, local governments, and companies ought to apply for patents based on the results obtained from the research grants supplied. Based on this, the review was made with the following statement: "JST's collaboration activities between industry, academia, and government offer total support from the all-Japan perspective" (Okimura).

One of such actions was the content enhancement of the "J-STORE" database, which started its service in 2000. J-STORE stores various research data that contribute to promoting commercialization through technology transfer from research outcomes of universities and national research institutions to businesses. A revision was made in which unpublished patents pending approval were added to J-STORE, along with those patents held from the start by universities throughout Japan.

As this is a sensitive issue related to infringement of right, we consulted a patent attorney regarding the unpublished patent data. The core of the rights issue could not be grasped, but the expression was adjusted in a way that the direction could be understood. As soon as unpublished patent data was included to J-STORE, the number of hits at the site increased drastically, and this endorsed the great impact of J-STORE on businesses.

Currently, among the universities that have realized unexpected expenses and labor involved in patent applications and management of approved patents, there are some universities that are reluctant to apply for patents for the results of their research. JST currently supports patent applications made overseas;

however, it is reasonably expected that the demand of further support for management of patents is on the increase ever more.

Science for Society Responding to the Budapest Declaration

In 1970s and 1980s, words were exchanged overtly centering on national universities that were formerly imperial universities, saying that "Alliances in which universities cooperate with industry to create industry-academia collaboration are inconceivable." The "World Conference on Science" was held in Budapest, the capital of Hungary, between June and July 1999, when such words were still in the public's mind. The forum resolved an important declaration, the "Declaration on Science and the Use of Scientific Knowledge," to which references are frequently made as the "Budapest Declaration," named after the host city. In addition to "science for knowledge," which hitherto has been appealed to as the responsibility of 21st century science, "science for peace," "science for development," and "science in society and for society" were hammered out. It is no longer acceptable that science and scientists are only concerned about enriching knowledge, and the declaration was taken as a message that science and scientists will work together with government and citizens to contribute to society through sustainable development.

JST's response was prompt. It launched the former Research Institute of Science and Technology for Society in 2001 jointly with the Japan Atomic Energy Research Institute (now the Japan Atomic Energy Agency), and relaunched in 2005 as Research Institute of Science and Technology for Society (RISTEX).

Observing the themes that they have adopted, many major issues emerged, such as how society should be reformed in the era of Social Technology Research System towards a "sustainable society" or a "brain-science and society" (merely assuring social implementation was not so simple). After the launch of RISTEX, the themes were highlighted, focusing on those targeting actual incorporation into society such as "Community-based actions against global warming and environmental degradation" and "Redesigning communities for aged society." They will work towards creating new social values through further research and contribute to solving actual concrete social issues. It is expected that RISTEX's activities policy will be continuously discussed with the participation of external experts.

Involvement in Science and Technology Information from which New Developments Are Expected

Before the launch of JST, the organization was a special public corporation. It changed to an incorporated administrative agency and then to a national Research and Development agency. The name of the organization also changed at the time when JST was launched from the Japan Science and Technology Corporation to Japan Science and Technology Agency in October 2003.

The first President, Moritaka Nakamura, now says, "I never thought even in my dreams that JST would become an organization with such a wide range of tasks." JST has expanded its tasks and made major transformations over the past 20 years. Its international cooperation and regional revitalization activities, which it has consistently strengthened over the past 20 years, are the result. Through the former presidency periods of Masahiro Kawasaki and Kazuki Okimura, both had continued to clearly insist that S&T policies were insufficient and asked for a change of JST's involvement and efforts.

President Koichi Kitazawa promoted joint collaborations between universities and the Science Council of Japan, and further reinforcement policies for the collaboration between industry, academia, and government were hammered out by President Michiharu Nakamura.

Meanwhile, the field in which JST needs to devote its efforts and become involved in the future is promoting R&D using data. The Information of Science and Technology Program has provided databases that allow access to S&T papers, patents, researchers, and compound information both within and outside of Japan, which has underpinned university and business R&D for many years. Further, although the organization had been involved in supplying databases and forging links with relevant overseas organizations as a core organization in the field of information in Japan for many years, cost reduction was planned by reviewing jobs. This included dissolving the alliance with Chemical Abstracts Service (CAS), an information department of the American Chemical Society and withdrawing from STN, an international database network. By implementing those measures, the Special Accounts for Industrial Investment, even in this difficult situation, managed to move into the black within a single fiscal year base. Switching its focus to overseas, it is notable that the information service companies not only provide a data search service but also develop various services actively using their stored data.

In April 2016, the international information service company Thomson Reuters divided research fields into 22 fields based on their in-house database for papers; they then published rankings of the domestic universities and national R&D corporations with the number of papers in the top 1% that were most quoted in each field (target: the 11 years from 2005 to 2015).

Although JST was excluded from this ranking because it falls under "business activities as a funding agency that promotes the strategic creation of S&T innovations," the data has been opened. According to this report, during those 11 years, there were 767 publications that made up the top 1% of the most quoted papers, and JST was second largest after the University of Tokyo, which ranked first. Kyoto University and RIKEN ranked second and third, respectively.

There is another figure which JST can be proud of: the ratio of most quoted papers to the total papers announced by the organization for the 11 years from 2005 to 2015, or in other words, the production efficiency of the highly valuable papers. JST is 2.4%, exceeding the 1.6% of the University of Tokyo. Akito Arima, who was President of RIKEN at the time, asked Managing Director Kawasaki of JRDC, some time after the establishment of ERATO, "Why can the researchers participating in ERATO mass-produce such highly-quoted papers?" We can say the tradition is still alive.

Another ranking that supports JST's power was published by the international news agency Reuters in March 2016. This was a list that ranked government agencies and public research organizations as global innovators. The fact that the basis for this was the Thomson Reuters database remained unchanged. However, patent information had also been added, and the results included an analysis from the viewpoint of whether the research is made by actively collaborating with industry and whether there were suitable systems in place to protect the research results as intellectual property rights.

JST was ranked third in the world as a global innovator. This evaluation is higher than not only other Japanese organizations such as the National Institute of Advanced Industrial Science and Technology (7th place) and RIKEN (13th place), but also higher than the American Department of Health and Human Services (4th place) and Department of Energy (8th place).

However, if we turn our attention to Japan's overall R&D capabilities, there is some concerning data. Thomson Reuters also announced a ranking that compared the number of papers, by country, in the top 1% of those referenced in other academic papers published from 2005 to 2015. In this ranking, Japan dropped to 10th place. In contrast, China has risen rapidly. Even in the annually announced university rankings published by the British education journal The Times Higher Education in 2015, the rank of Japanese universities has fallen. Up to 2014, five universities were in the top 200, but three out of five were no longer ranked in the top 200 by 2015, and the remaining two, the University of Tokyo and Kyoto University, have fallen in the ranks respectively. One cause is said to be because the data for evaluating papers, which is one of the evaluation criteria, changed from Thomson Reuters to Elsevier. However, there is other additional data showing that Japan's overall R&D capabilities are declining in recent years, heightening the sense of crisis.

Nearly all the data assessing the actual state of Japan's research base capabilities and R&D is generated by overseas information service organizations. This data is key material referred to when considering Japan's S&T and academic policies. Approximately 320 Japanese academic journals are registered with the Thomson Reuters papers database "Web of Science," and approximately 400 Japanese academic journals are said to be registered with Elsevier's abstract and quoted documents database "Scopus." On the other hand, JST's information department has approximately 9,000 publications. JST has collected and accumulated data for nearly 60 years, from the times of JICST, and the amount of accumulated data is huge. Here, Michiharu Nakamura became involved as President and appropriated the utilization of those information resources accumulated by JST. Adding citation information to Japanese documents as well as merging them with an overseas papers database enabled analysis of Japanese research activities that were not previously possible. It thus became possible to analyze the status of R&D particular to Japan, such as to what extent and on which papers Japanese researchers were being quoted in corporate technical reports and the number of

2004 Innovation Japan opening ceremony. President Kazuki Okimura is second from the right

co-authored papers between businesses and universities.

In addition, Nakamura established a new Office of Information Analysis in 2015 and started to actively provide analysis results, both within and outside JST. One of such activities was the establishment of a Funding Management Database (FMDB) that incorporates not only JST data, but also research funding allocation data, including the Grants-in-Aid for Scientific Research (KAKENHI) under the control of the Japan Society for the Promotion of Science and the data on papers, patents, awards, and implementation costs. The aim is to centrally manage R&D information to be used in establishing policies, evaluating and analyzing organizations, and promoting joint R&D.

Research result reports by researchers selected by JST's Basic Research Programs, trends in the numbers of research papers before and after acquiring funding, and research trends such as changes in the number of co-authors can be identified from the FMDB, which contains acknowledgement letters and author affiliation information described when the paper was published. It is expected that in the future, it will be possible to easily acquire information that can help identify promising young researchers, when the author IDs are networked as keywords with internal and external databases. JST's information department has thus developed the tasks commensurate with promoting open science and open innovation, such as development of a full range of various databases, active publications, and networks, starting with the "National Bioscience Database Center." Currently, they are rolling out activities suited to the big data era by actively disseminating knowledge that contributes to innovation by analyzing the databases that they hold.

Meanwhile, Okimura also talks about the delay in the field of "information" of Japanese S&T: "What I could not accomplish as president was 'information.' I should have had more discussions with the people in charge regarding the information base that needed to be established as essential infrastructure." Nakamura also stated that the delay of the information project was "one of my regrets during my time in office." Ever since the 1990s, electrics, electronics, and information science at Japanese universities have been unpopular subjects with few applicants. It has become a reality whereby a complete mismatch exists between the number of researchers and students in information technology fields at university and the number required by businesses. Even with the comparison of the number of highly quoted papers by Thomson Reuters as described above, the delay in the field of information is obvious. In addition to university rankings, they also publish a country by country comparison for each research field, and Japan ranks 16th in the field of computer science. Even compared to chemistry, immunology, and materials science, which are ranked fifth, the field of information is conspicuously weak. Nakamura recalls, "we should have taken appropriate measures and actions immediately to discern which research fields had more growth potential in 10 to 20 years' time and in what fields of research Japan could take leadership."

Based on the introspection of such successive presidents, JST started to adopt a new direction by formulating policies to strengthen research support in ICT fields, which are the core of the Fourth Industrial Revolution, such as big data, AI, and data-driven research.

The winning school at the 2012 Japan High School Science Championships and Nobel laureate in chemistry Ei-ichi Negishi (far right). Far left is President Michiharu Nakamura

Increasing Expectations as an Innovation-Driven Organization

The annual survey implemented by the National Institute of Science and Technology Policy of MEXT includes the "Expert Survey on Japanese S&T and Innovation System." Called a "fixed-point survey," approximately 1,500 people, including authorities from universities and public research institutions, teachers, researchers, experts in the industry, and people responsible for connecting R&D and commercialization are questioned, the purpose of which is to elucidate the trends in Japanese S&T by analyzing received answers.

The survey period for the results published in 2016 overlapped with the Fourth Science and Technology Basic Plan (FY2011 to FY2015). It was also a period with an emphasis on solving important issues by "selection and concentration" of limited R&D resources. The survey results of analysis of annual survey results from 2011 to 2015 revealed that positive evaluation has been increasing, as survey respondents could see a certain development in interdisciplinary collaboration among the field of the natural science, joint overseas deployment by government and private sector, the implementation of government-led projects, and deregulations, etc.

On the other hand, it was clear that there was a pervasive sense of crisis that the basis for research activities such as basic research, including human resources and research environments, was being imperiled with the decline in core funding distributed to universities and teachers and the decline in the quality of people advancing to doctorate courses.

In publishing this survey report, Hiroyuki Abe, who was working as the chair of the survey committee (formerly member of the Council for Science and Technology Policy, former President of Tohoku University, currently JST special counselor to the president) presented his opinion. Abe cited therein the following as necessary items to be involved in the Fifth Science and Technology Basic Plan from 2016.

(1) The creation of an environment where young teachers and researchers can pursue their own independent research with long-term prospects and aid in recruitment.
(2) University teachers should encourage independence amongst students, through self-awareness and responsible education. Teachers should also work to improve the attractiveness of doctorate courses through financial support such as salaries, etc.
(3) To provide flexible research management and evaluation to cope with unexpected processes so that original research results are not lost.
(4) Organizational efforts by the university so as to not reduce the research time available to university teachers.
(5) Implementation of policies with a long-term viewpoint, with consideration given to continuity with regard to core items of S&T and innovation.

The state of the Japanese research infrastructure is quite grave, and the fact that Abe, who also had an experience as a former member of the Council for Science and Technology Policy, admitted that Japan is facing a number of problems with regard to the promotion of S&T policies, highlights the need for JST to treat this issue seriously. Even with the basic research programs that were the core work prior to JST's establishment, some problems can be seen. Regarding JST's basic research programs, which Koichi Kitazawa described as the second stage of the "Two-stage rocket system for allocating research grants," it seems to be primarily supported by academia and industry. However, further consideration will be needed on how to select the payload for the rocket, which is the results of epoch-making basic research, and how far we need carry that to make it contribute to creation of innovative tools. In addition to the three research promotion programs of "ERATO," "PRESTO," and "CREST," numerous programs are currently underway, including "ACCEL," "ACT-C," "ALCA," "S-Innovation," "Program for Development of Advanced Measurement and Analysis Systems," and "A-STEP."

The following statements are from former presidents: "I feel that we have spread our scope too wide. I wonder if we are missing what we have to do" (Moritaka Nakamura); "I would like to have a flagship program with a distinctive feature" (Masahiro Kawasaki); "There are too many programs, making them difficult to understand from the outside. It is necessary to evaluate them and reduce the number of the programs" (Kazuki Okimura).

Some researchers in leading positions in universities went on to say "although we basically agree with the idea of a 'two-stage rocket system for allocating research grants,' JST should mainly support R&D activities in universities and research institutions. Other institutions such as the New Energy and Industrial Technology Development Organization (NEDO) should give financial support to industry-related research developments." Moreover, some researchers on-site voiced their concern: "We can't see any difference between JST's research grants and KAKENHI." The purpose would be defeated if the allocation of research grants based on the concept of "selection and concentration," as promoted by the Science and Technology Basic Plan, has caused stagnation of Japanese research capabilities.

Japan is facing many issues, such as an ageing society and low birthrate, infrastructure that cannot adequately withstand disasters from both a hardware and software standpoint, and the need to strengthen its finances. This leads to the question: what sort of role will JST play in the future as an innovation-driving organization with the power to make contributions towards solving international problems such as sustainable development, supporting the growth of developing countries, and preserving the global environment, with its initial ambition? The hopes and responsibilities expected of JST are extremely important.

Chapter 2

"Fueki-Ryuko" (Continuity and Change)

Leading Co-creation of Innovation through Evidence-based Strategies

Michinari Hamaguchi
President of Japan Science and Technology Agency

When I was appointed as the President of the Japan Science and Technology Agency (JST) in October 2015, my first action was to propose the HAMAGUCHI Plan to reorganize JST. The motto for the plan was the words "Fueki-Ryuko" in Japanese, or "Continuity and Change" in English. Although JST has accomplished great things to date, we should be flexible to the shifting needs of our society while retaining our established values. This is the core meaning of "Fueki-Ryuko" (Continuity and Change).

JST is the only one organization in Japan that truly links industry, government and academia. In the rapidly changing modern world, JST must aim for higher levels of activity to meet society's demands. To achieve that, we must recognize our role as a coordinator to implement timely strategies.

In other words, it is critical for us to maximize our traditional ways of supporting science, "Fueki (Continuity)", and to enhance flexible and strategic response to modern demands, "Ryuko (Change)". How we change our organization to lead in innovation is key to achieving this. As a base for these activities, it is necessary for us to discover and support talents in a broad range of fields and regions of Japan. As human resources are shrinking due to our ageing population and low birth rate, it is necessary to identify talented people using big data and help maximize their abilities. I believe this is precisely the role of JST.

Sixth President Michinari Hamaguchi

The Decline in Research Competitiveness and Dwindling Human Resources

Today, Science and Technology (S&T) in Japan is facing tough challenges. Japanese research competitiveness is relatively but certainly on the decline. From an objective viewpoint, the world-leading position Japan has established once, is in rapid decline in relative terms. Below is a graph analyzed by JST based on Elsevier's "Scopus" database.

If you look at the top 10% of the most referenced papers across 27 S&T fields by country, using data from 1996 to 2015, the United States ranks top in all but five of the 27 fields. China leads the remaining five fields. Far from occupying first place, Japan does not even rank in the top three for any field.

Furthermore, if you compare data from the five most recent years with

those around 2000, you can realize the clear declining of Japanese science. Japan was in the top 3 of 8 fields around 2000 but does not rank in the top 3 in any field over the past five years. In addition, looking at the relative rankings of China and Japan over the last ten years, China has displaced Japan in nearly all of these fields, leaping into the top group. In contrast, Germany's position around the year 2000 and in the past five years remains largely unchanged, occupying the top 3 spots across 13 fields and in the top 4 for 10 fields.

Most Japanese, including researchers, seem to prefer the memories of post-war Japan's rapid upswing, instead of acknowledging today's less flattering reality. But China's growing strength and Japan's relative weakening will become even more conspicuous over time. As a researcher who used to be at the front lines of academic research, I understand the situation well, and one of the causes is undeniably the activities of national universities. I frequently hear complaints from researchers in the social science fields that they are not allocated budgets to attend academic conferences. This means that researchers must pay the cost to attend an academic conference out of their own salary. I would say, this is a serious situation.

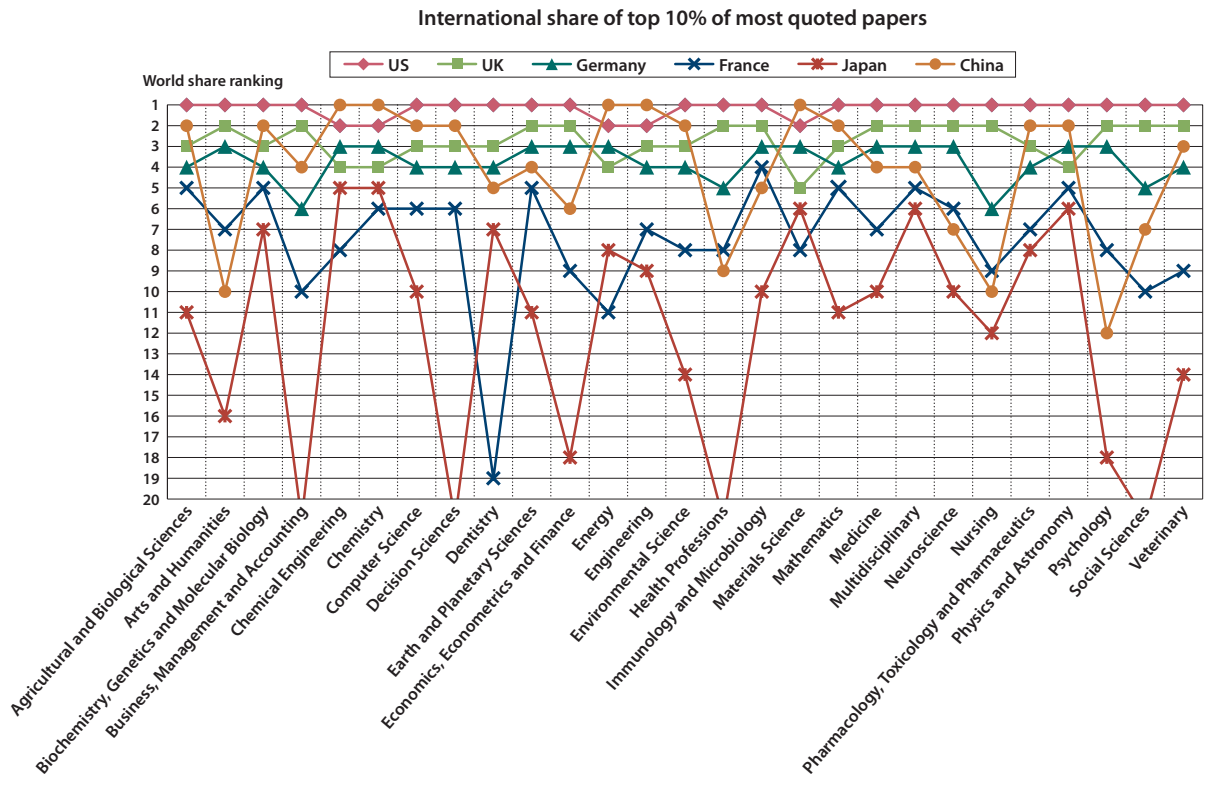
From the long-term viewpoint, the rapid population decrease is the underlying cause of declining research competitiveness. The population of 18-year-olds was approximately 1,510,000 in 2000, but now has decreased to around 1,190,000. Ten years from now, it will decline to around 1,070,000. The 1,510,000 people who were 18 in the year 2000 are now over the age of 30, and the current population of 18-year-olds will be the front line of research ten years from now. That means the future number of front-line researchers will be greatly reduced from current numbers.

Even if the new generation of researchers works hard, it is inevitable that Japan's research ability will decline quantitatively. If the population of over-30s thins out in the next decade or so, we can expect that this trend will accelerate further. Japan is facing dynamic and periodic structural shifts in a way it has never experienced before.

Public investment in S&T has been falling, while some of the persistent financial issues unique to Japan remain unchanged. Various

Data analysis to determine the status of Japanese research

- Database used: Scopus (1996 to 2015).
- Search conditions: Data printed between 2010 and 2015; Target: All papers (including reviews)



Data analysis to determine the status of Japanese research
Source: Aggregation by the JST Office of Information Analysis based on the Scopus database (Elsevier) (Created as of June 14, 2016)

surveys reveal that the support from people for Japanese S&T is declining. Japanese society is more skeptical about how much tax money should be allocated to S&T. However, we have no time for skepticism. If our generation is indecisive, the next generation – who will have to bear the responsibility of our society in the future – will be even more severe. The question is, how should we respond to this challenge? It is clearly necessary to promote S&T strategies in a completely different way from those in the past. While some might say that JST operates highly evaluated programs that drive basic research strategy in Japan, such as ERATO (overall implementation research) and CREST (team-type research), we should not be complacent because the situation of S&T will become even more serious.

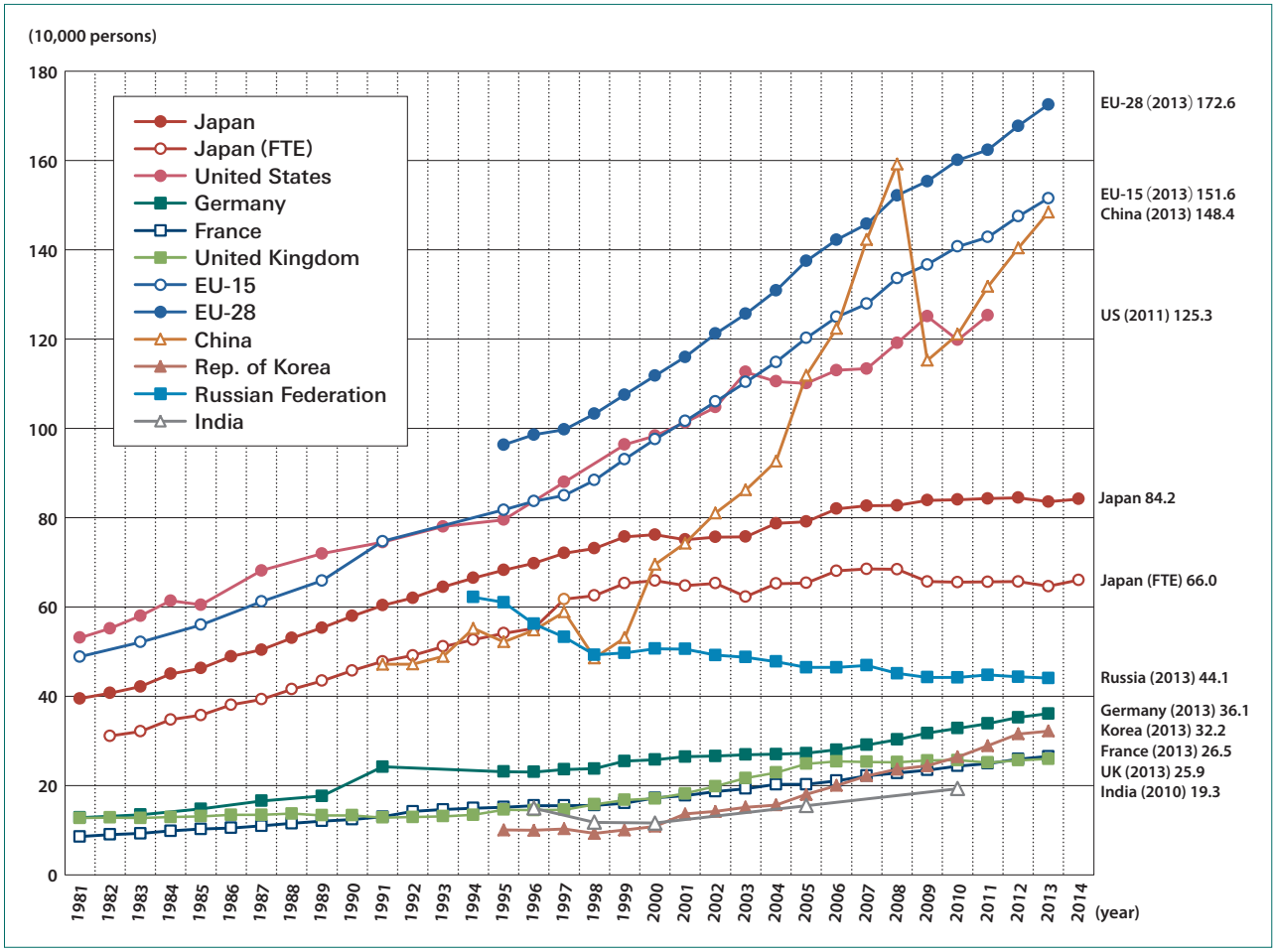
Need for Strategic Improvement and Efficient Management

As outlined in the HAMAGUCHI Plan, as a leading innovation body, JST should aim to be a network-based research institute. We should find and support young talent hidden in the various regions and fields of Japan. What should be done to achieve these two major tasks? What I believe strongly as the President is the fifth pillar of the HAMAGUCHI Plan: "Efficient and effective business implementation taking advantage of JST's comprehensive and integrated functions."

JST has developed in budget volume and human capital over its 20-year history and our staff have been extraordinarily busy. As President, I am also extremely busy every day and I understand that JST is an organization with heavy tasks. For that reason, I believe that JST is required to promote efficiency and integrity in management, to increase a sense of solidarity among employees, and to better clarify our tasks.

There are certainly weak points in our management system. Given my experience managing a national university, JST's reforms are, I feel, behind those of national universities.

Another major issue that we should worry about, is the various incidents that undermine trust in Japanese scientists: data manipulation, plagiarism in papers or, more gravely, the misuse of research funds. In the past, such incidents were caused by individuals with low morals. In the last several years, however, organizational intention behind the incidents appears to be observed.



Trends in the number of researchers by major country
Source: Science and Technology Bureau, MEXT, *Indicators of Science and Technology 2015,* 2015, p. 46.

Multiple people manipulated papers consistently and systematically, publishing dozens of such papers. Among them were people who even took doctorates. This caused a major loss of credibility for S&T more generally. One can speculate that the current backdrop of exhausted researchers, based mainly at universities, eventually resulted in dishonesty in their science. Firmly ensuring the integrity of research is, therefore, a critical task for JST.

In addition, a major concern for us is where JST will lead research in five or ten years' time. "Visionary R&D strategies for co-creation of the future with society" and "Cultivation of human resources for science, technology, and innovation" – the second and third pillars of the HAMAGUCHI Plan – clarify the increasingly important tasks of JST. It is no longer acceptable for us to invest funds merely based on the levels of research and then leave everything to those researchers, as is currently the case. We should now be more serious about identifying Japan's strengths and weaknesses. Where are the new research results generated by a uniquely Japanese excellence? We need to analyze these questions by utilizing big data and seek to solve problems objectively. To create new value for the future, we should organize researchers and work together with a united destination: "designing our future." That kind of management is expected of us.

Another important aspect is to restore trust in Japanese S&T. In my view, we must raise awareness of the limits of S&T among the people – in other words, the uncertainty of truth – for the restoration of trust. This is the important point of view as "Visionary R&D strategies for co-creation of the future with society."

Regarding the "Cultivation of human resources for science, technology, and innovation," I believe that the most important issue is to support young people firmly and extensively so that they can prepare to play active roles in S&T in ten years' time.

Aiming for a Research Institute Similar to the Howard Hughes Medical Institute

The first pillar in the HAMAGUCHI Plan, an "Advanced network-based research institute promoting unique, challenging and high-impact R&D," seeks to establish JST as a research institution akin to the Howard Hughes Medical Institute (HHMI). HHMI is a private research institute that, at its launch, did not have its own research facility (although today it has some). HHMI's basic research support method is "cross-appointments." HHMI signs employment contracts with researchers at universities and pays their salaries, making research possible while assisting the university financially.

The major feature of HHMI is to provide support for revolutionary research for a duration of five years. Thus, the institute thoroughly examines and carefully chooses researchers working on a unique technology. If the technology reaches a point where it can be successfully commercialized, related industries could be dramatically impacted. HHMI invests in personnel who own such technology throughout the US. Under the system, a topic is determined and researchers are able to devote their research towards their goals.

Topics are chosen and funds provided to researchers in ways similar to those used at JST. The important differences are that HHMI's personnel selection is extremely advanced and the research institute itself pays the researchers' salaries.

JST has previously conducted cross-appointments, contracting researchers already in employment. Our experience was that, on balance, the drawbacks of this method outweighed the positives and we eventually ended this form of direct employment. In practice, however, university principal investigators (PIs) with experience of direct employment by JST pointed out the advantage of this working system. Such a system guaranteed PIs to concentrate on their research aside from their university jobs because they could work, according to their contracts, in the JST offices for a period each week.

JST does not currently engage in the direct employment of PIs. The work of PIs is combined with a university job, such as teaching students, work promoted by research support systems other than JST (such as the Grants-in-Aid for Scientific Research - KAKENHI) and research promoted using funds supplied by JST. As a result, I am concerned that the position of JST in the minds of researchers is somewhat unclear. A more significant problem is that JST has not secured the time, environment, and information required to promote JST-supported research by the chosen researchers under contract with universities.

Since the incorporation of national universities in 2004, university PIs have been appealing in unison that the time allocated to research is shrinking. Furthermore, among PIs there is dissatisfaction with being unable to pursue long-term research. In other words, it is difficult to engage in challenging and revolutionary research. As noted earlier, the background of the current state of Japanese research and the overall decline in competitiveness includes the burden felt by individual researchers in research organizations, and it is evident to me that this is expressed in the data indicating the decline in Japanese research abilities.

We want to ensure a proper environment and sufficient time for researchers to concentrate on challenging research projects that they truly want to pursue. To ensure this, JST has stepped forward to declare that "JST will become a network-based research institute." Our aim is

to change the current situation by signing cross-appointment contracts with universities. This is essential to create an environment where the excellent researchers we select can thoroughly perform their research. We work as a network-based research institute not for the benefit of JST but for the researchers. I have closely studied the methods of HHMI by visiting them immediately after taking office as President. HHMI has multiple levels of screening to choose the subjects for their five-year plan. What I was most impressed by was that post-docs are offered chance to perform the initial assessment. That means they have discerning eyes. In Japan, this approach is different from the beginning, as there is a tendency to give the views of young people lower priority.

Strengthening Bridge-Building Functions between Industry and Society

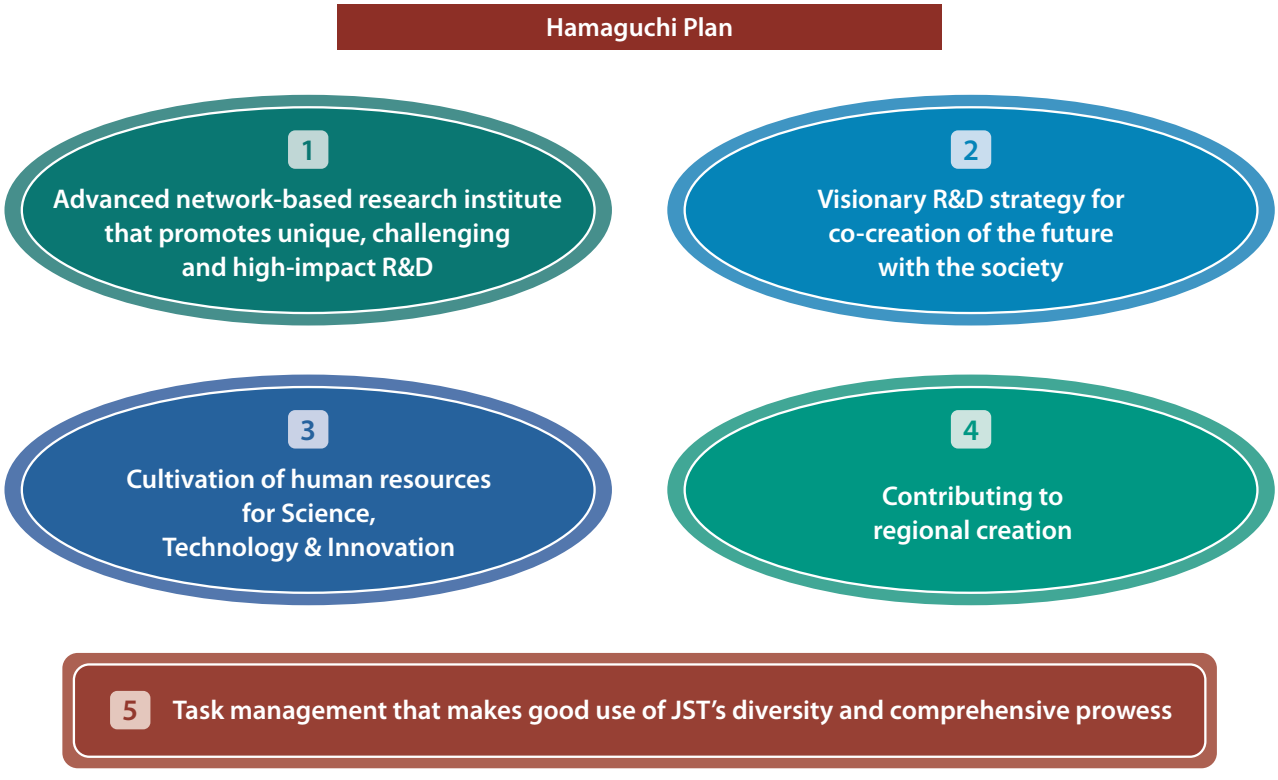
As a network-based research institute, JST seeks to promote innovation and strengthen its role as a bridge between academia and industries. We believe that our research operations should create socially valued outcomes by bridging society and R&D. Until now, however, strategic basic research programs and industry–academia collaboration projects have operated in separate frameworks. Various industry and academia collaboration projects are ongoing, and each project is examined, funded and evaluated independently. However, in the era of big data and the Internet of Things, this method is no longer functionally sufficient. It becomes a common understanding globally that innovations can no longer be made possible simply by passing through stages from basic strategy, basic research, application research and on to commercialization.

Dr. Francis Collins, Director of the American National Institutes of Health (NIH), also says, "Creating innovations in stages is old hat." The system of creating innovation is expected to integrate basic research with its application simultaneously. Even looking at an iPad, there are various revolutionary elements, but it is hard to state definitively what the most decisive elements or functions are. It is a tool that is comprised of multiple elements and functions. In the same manner, R&D cannot help but be multifaceted, and must go beyond its traditional domains.

As featured in CREST, JST has been leading projects by calling for researchers from completely different fields to conduct research on a single topic as a team. In addition, we are currently discussing how we can polish such projects to the levels to embed them in society. The JST way of programs that selects researchers from different fields to focus on a new single object is indispensable in an era where innovation systems are completely changing. I would say that these forms of continuous research support represent "Fueki (Continuity)," while management system reforms that match changes in innovation ecosystem represent "Ryuko (Changes)."

Responses to Open Science

Over the past few years, scientific journals have been digitized and can be read online. In the past, when my



Left: President Hamaguchi on-stage during a side-event workshop at the sixth Tokyo International Conference on African Development (TICAD VI)
Right: The Indian science and technology minister and President Hamaguchi exchange handshakes during the signing ceremony

generation was at the stages of post-graduate students to assistant professors, we could read papers only in printed form. Many of the publications from overseas arrived a month late and were expensive; we would therefore copy them to read. At the time, reading a paper from abroad was an extremely arduous task.

Nowadays, you can acquire information from journals online at your desk the day after its release. This is a great advance, while it has also resulted in a contradiction as the costs of maintaining research papers online have become enormous. The total expense paid to online journals appears to exceed several tens of billion yen annually for the 86 national universities. It is obvious to regard the cost as inappropriate after all. This is not just a problem Japan faces, but is becoming a universal problem throughout research communities worldwide.

Moreover, many major publishing houses seek to sell leading journals bundled with lesser known ones. Naturally, this increases the subscription costs. Even so, we cannot omit reading them. It is a reality that the impact factor, which is an index showing the importance of a journal, is used to evaluate both universities and individual researchers. Unless a researcher publishes papers in journals with high impact factors, there is a risk that the researcher will fail to obtain a stable post or guaranteed funding. Accordingly, researchers must continuously publish in journals with high impact factors.

There is another fascinating fact. When I was the president of Nagoya University, I studied Nobel prize-winning papers written by Japanese Nobel laureates. Nearly all of them had been published in domestic journals published in English with low impact factors. In the case of Dr. Koichi Tanaka, his paper was not even in a journal, but in an abstract paper within the academic community. Frequency of citation of a paper written by an individual researcher as well as the quality of the journal where the paper is published may be useful to select excellent personnel to a certain extent; however, it is not so effective to identify the excellent achievements that may change the world to deserve the Nobel Prize. Given such circumstances, "open access" has begun to be advocated in the US. A researcher no longer needs to pay a fee to submit a paper to a journal. Reading publications is also free. This is the basic concept behind open access. The role of JST in creating an environment that realizes open access in Japan is tremendous. Since we have been working in information service for science and technology for many years, we have the experience and staff. How we can prepare for open access will be a major issue in JST's information service. Assessment of common ideas and interests among Japanese scientists is needed. I would argue that we need further discussion on this issue.

Contributing to Regional Revitalization

After the Meiji Restoration, Japan became the only Asian country to achieve modernization without being ruled by Western powers. One reason for this was its centralized feudal system during the Edo period. It was a society with autonomous ecosystems, which naturally led to environmental conservation. Because people's travel was restricted, unique cultures and technologies developed in each region, and each region thus developed with

its own individual characteristics. When the country opened up, the revitalization of industry was extremely fast and smooth, with blacksmiths becoming ironworks, and ironworks becoming foundries, because of the existence of outstanding technicians and workers in each region. As people had world-class literacy rates and took pride in their own diverse local cultures, we could make the rapid development possible.

The new systems created after the Meiji Restoration were particularly effective in the era of high growth. Cutting-edge products were mass-produced quickly at low cost, starting in the fabric industry and spreading to other industries. For this system, the mass recruitment of new graduates and the lifetime employment system were particularly effective methods. Today, however, this system is becoming rather a weakness for Japan. One reason is that the system itself is unsustainable due to an ageing society and low birthrate. Another reason is that innovation is rather difficult to achieve with a single product so that new value is not created under the vertical and sequential R&D systems.

The primary concept taken during the period of high growth was standardization and mass-production in stable, flawless and high quality. Today, however, new value cannot be achieved without convergence of information and technology from completely different areas.

Since the start of the Obama administration, calls to return factories to the American heartland have been plentiful in the US. Nevertheless, movements responding to the call were scarcely observed because of a lack of mid-level engineers able to provide support to the factories. Around 10% of engineering graduates in the US are employed in the industrial sector. We should carefully consider what would be expected if we were to follow the same idea as the US experienced regarding IT, big data, and AI: a society where information alone would overflow and zing all over the place, but possessing only a limited ability to manufacture products. If we ignore our tradition of "Monozukuri (making things)," ultimately Japan will not be able to manifest its unique strengths.

Since ancient times, the area near Nagoya has had a cultural tradition that made many historical inventors. For example, Soichiro Honda, the founder of Honda, and Sakichi Toyoda, the founder of Toyota, were born around this area. It is where Yamaha originated and is where the recent Nobel laureate in physics, Hiroshi Amano, was born. These examples clearly illustrate the characteristics and power of local culture. The important thing is to support community cohesion while maintaining diversity among the communities. In other words, there are regional strengths created by reaffirming each tradition and passing on the associated technologies to the next generation. A prominent example of this is the relocation of the Ise Jingu Shrine, which is repeated in my hometown of Ise every 20 years. Although it costs around 20 billion yen, the entire expense is covered by donations. The whole region operates on this 20-year cycle. Technical traditions are inherited as well. Even during rainfall, the Ise Jingu bridge remains watertight. This is due to the skills of the boat builders in the shipyard downstream of the Isuzu River, who possess skills handed down from generation to generation.

In September 2015 at the United Nation's Sustainable Development Summit, the 2030 Agenda for the Sustainable Development Goals (SDGs) was adopted, and 17 goals were fixed. I would say that many of them are already practiced in the system reform at the Ise Jingu Shrine every 20 years since the Edo period. To preserve certain ecosystems, remodeling takes place every 20 years, while continuing to nurture forests and make materials and parts to be used up to 100 or 200 years. This Japanese tradition of relocating the Ise Jingu Shrine certainly meets SDGs.

During the period of high growth in Japanese history, we experienced devastating environmental pollution. The rivers in Tokyo are cleaner today, but at their worst, fish could not live in them. Regulating gas emissions from diesel engine cars brought blue skies back to Tokyo. Through this tough experience, we, Japanese, created the current clean environment. Simultaneously, we have achieved a high standard of living. Moreover, everybody can receive the same technical standard of medical treatment, regardless of location. This is the society the Japanese people have created after World War II.

We have an obligation to represent our values to create our future society to be a desirable one. We should recognize these excellent values as well as analyze the problems in our culture. How best can we permeate S&T with values from the lifestyles of every ordinary person and the various regional cultures of Japan while pursuing cutting-edge technology? Today, we are confronting these issues head-on. These are my thoughts, which are built into the HAMAGUCHI Plan's "Contribution to regional revitalization." If we review our history, JST has engaged in various programs to support regional development to date. Undoubtedly, this work has left a strong legacy in JST. Nevertheless, if we check the individual programs carefully, some of them have finished incompletely. The reason why I have pointed out the importance of regional revitalization is to make good use of the uniqueness of each region as well as our experience through these programs, instead of doing the same thing as our operations in Tokyo, for our brighter future.

Need for Change in the Relationship between JST and Universities

Why is a network-based research institute necessary for JST? Since JST's launch of ERATO, which was

the first program in basic research promotion that drew attention, JST has struggled with the placement of its research site. In order to support researchers in national universities, we need to receive permission to use their university facilities. In that case, we have to make formal contracts with universities in future.

JST has reached its current state by way of the strenuous work of our predecessors. As I noted earlier, there is a strong feeling of fatigue among national universities, so that it is time for JST to step forward onto the frontlines to support researchers. The incorporation of national universities also means that they are becoming flexible enough to make their own decisions. Over the past ten years, universities have clearly recognized that they must open themselves to society. Nagoya University, as an example, believes this. We have certainly moved on from a time when universities were blamed as the "ivory tower." A suitable relationship between JST and national universities that fits the current era should not be a relaxed and ambiguous one, but rather a secure relationship governed by contractual obligations. The Internet has also encouraged universities to reform themselves. The university system, which has remained unchanged for a long time, seems to survive by selling its systematized knowledge piece by piece. However, in the Internet age, systematizing knowledge is no longer a task that survives many decades. Because of the Internet that makes knowledge systems to be fluid and flat, "yesterday's knowledge might be today's incorrect data." The traditional style of research, where information is restricted within universities and occasionally dribbled out to society to earn money, is out of date.

Now researchers instinctively feel that universities must renew themselves. We are living in an era of open science that induces competition for survival among universities. Under such circumstances, JST's existence becomes more and more significant for universities.

The Urgent Task to Reassemble Information Systems for Science and Technology

As all the successive JST presidents equally pointed out, JST's information business is lagging behind global trends. Right now, I am involved in research, although it needs time to complete. We are studying "research of research;" in other words, a meta-analysis of "research trends." This research aims to analyze and clarify the direction in which Japanese researchers as a whole are heading. We are trying to visualize what tasks they are performing and in which fields they are engaged. As JST does not have enough capability on its own, we are working together with external organizations to promote discussion. The aim is to make crisper proposals to the government based on "visible data" and to help politicians understand the reasons for when we say, "This is important." If we merely say, "Invest more in R&D. It is still not enough," it causes a strong argument insisting, "Aren't we already giving you enough?" I think that we should rather suggest specifically, "It is necessary to invest more in these young people as their research in this field is developing now."

In 2015, Reuters, the international news agency, ranked JST as the third most innovative national research institution in the world. This rank was

President Hamaguchi talking about the future of JST

based on data from the "Thomson Reuters" database. In addition to this ranking, every year, various overseas organizations publish global rankings of research institutions and universities based on the number of high-quality research papers they publish. However, there is a major problem we face with those databases: they do not portray a true and accurate profile of Japanese researchers. For example, when "M. HAMAGUCHI" is displayed, you may not know whether this is a man or a woman, and there is no way to discern whether the "M. HAMAGUCHI" at Nagoya University and the "M. HAMAGUCHI" at the Rockefeller University in the U.S. are the same person. The reason why it is so hard is the task we call "name aggregation" which is far from easy. It is impossible to get the data from any database about young researchers. It is also difficult to evaluate young talent. For example, it is not possible to search databases for researchers aged between 30 and 35 who may have published a paper on a unique topic.

Currently, we have started discussing completing "the Research Map" as a detailed map to address this gap. MEXT's Special Committee for Comprehensive Policy in its Council for Science and Technology is also discussing the production of an updated research map by using IT.

Changing the Role of JST: From the Supporting Side to the Front Lines

Since taking the position of President of JST, I have felt a clear difference in my responsibilities from my former job as the president of a national university. There are 86 national universities in Japan, but there is only one JST.

Despite JST's important role in Japan, I would say, JST employees are modest in a way. We must abandon the idea of "devoting ourselves as supporting staff." In the times of open science, JST is requested to step forward to the front lines. All JST employees should further cooperate with the people of universities and industries and work harder to fulfill their duties. We will promote S&T in Japan and strive to reform JST so that we can perform our role as the "innovation navigator" to serve Japan for the hope of the future.

Part 2 History

Let us trace the efforts made by JST through activities, program by program, over the last 20 years. We will cover the history in which JST broke away from being a funding agency devoted to a "supporting role" in the Basic Research Programs and the Projects for Science and Technology Information, through the time of the Japan Information Center of Science and Technology (JICST) and the Research Development Corporation of Japan (JRDC), to the Projects for Promoting Public Understanding of Science and Technology at the launch of JST, including the establishment of a think tank that provides political recommendations to the government. During this time JST has been actively leading S&T innovation.

Chapter 1

Creation of S&T Innovation

Section 1 | Promoting Strategic R&D

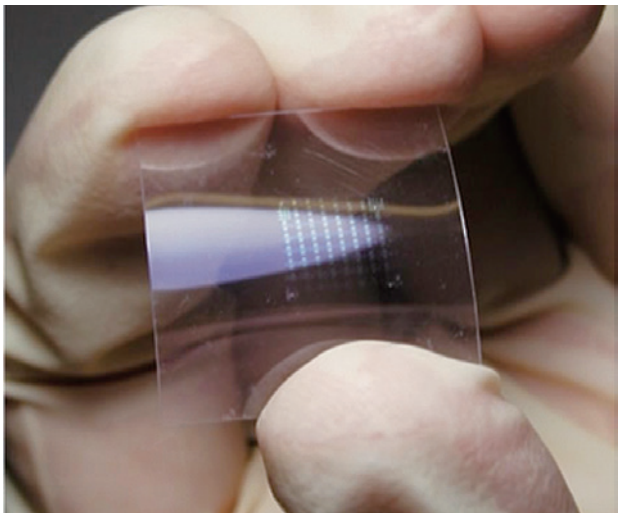
Since the launch of the Exploratory Research for Advanced Technology (ERATO) in 1981 by JRDC, the predecessor of JST, JST has led the strategic basic research of Japan in order to promote the advanced S&T-oriented nation, as well as contribute to the development of innovation.

The Precursory Research for Embryonic Science and Technology (PRESTO), established in 1991, and the Core Research for Evolutionary Science and Technology (CREST), established in 1995, were merged into the Strategic Basic Research Programs in 2002. JST has been serving as a competitive funding system designed to support strategic basic research.

Creating a New Direction for S&T through ERATO

Japan achieved high economic growth after the postwar reconstruction. The country continued to achieve fast-paced economic development through technological progress mainly by the acquisition of imported technologies from developed countries during the 1960s to the 1970s. However, technological innovation in developed European countries and the United States started to stagnate, and the introduction of technologies from overseas became more and more difficult. Thus, it became necessary for Japan to find a way out from its dependence on imported technologies, and to improve its own R&D capacities, so as to develop technological innovation.

Under these circumstances, ERATO was initiated in FY1981. The government authorized JPY 600 million in grants for creative research promotion, aimed at exploring the seeds of innovative technologies, and through the examination of the Council for Science and Technology, JRDC became its promotional nucleus.



Semiconductor IGZO-TFT, developed by Professor Hideo Hosono in his "Transparent ElectroActive Materials" project in ERATO

At the time of its launch, ERATO selected leading researchers and themes and determined a research implementation period for the purpose of creating Japan's own creative, new technological seeds. In addition, a basic research system was established whereby excellent researchers from both Japan and overseas were gathered and employed to tap into their creativity. JST nominated a Research Director, who served as the research leader and oversaw each project, and entrusted the project to him/her.

The construction of a personnel-based research system, the establishment of research implementation sites regardless of the existing framework of organizations, flexible employment of full-time researchers, formation of open-minded research groups, adaptable research management, and other aspects were adopted. As these were different from those of the traditional research promotion operations in Japan, the system had a large influence on subsequent policies and research systems. In addition, many valuable results were obtained under ERATO, which included the triggering of the discovery of the carbon nanotube by Professor Sumio Iijima, an achievement which led to Professor Ryoji Noyori being awarded the Nobel Prize in Chemistry and to the discovery of IGZO-TFT by Professor Hideo Hosono.

Thereafter, ERATO was integrated into Strategic Basic Research Programs (referred to later), and began a new start. A system was implemented whereby the Research Director took responsibility for the overall project. The selection process for Research Directors (reformed in FY2014) has been carried out by a panel officer, a standing manager responsible for applicant evaluations and

screening in conjunction with JST staff.

Bringing Out the Creative Ideas of Young Researchers through PRESTO

PRESTO, launched in FY1991, aimed to enable distinguished researchers with original creative ideas to pursue their individual basic research in order to develop science and technological seeds into future world pioneers. Researchers were sourced through public recruitment for each established research area, undergoing a rigorous selection of processes in order to discover outstanding individuals with truly original ideas. These individuals would be allowed to carry out research with a high degree of freedom for a certain period of time. At this stage, PRESTO was a groundbreaking system in which JST provided around JPY 10 million per year in grants to young researchers (no other grant system paid as much), and JST directly employed postdoctoral researchers who were not yet professionally conducting research, by guaranteeing their status and paying for their work. In addition, a Research Supervisor, who was assigned for each research area, not only selected research projects (PRESTO researchers), but also assumed the role of advisor (mentor) after the adoption of the projects to provide a variety of instructions, advice, and support to PRESTO researchers. As a result, PRESTO researchers who were rigorously selected from a large number of applicants, conducted research in a privileged environment and obtained many excellent research results under this system. Many postdoctoral PRESTO researchers have succeeded in obtaining posts in universities and other institutions, and thus the PRESTO system itself came to be regarded as a gateway for young researchers.

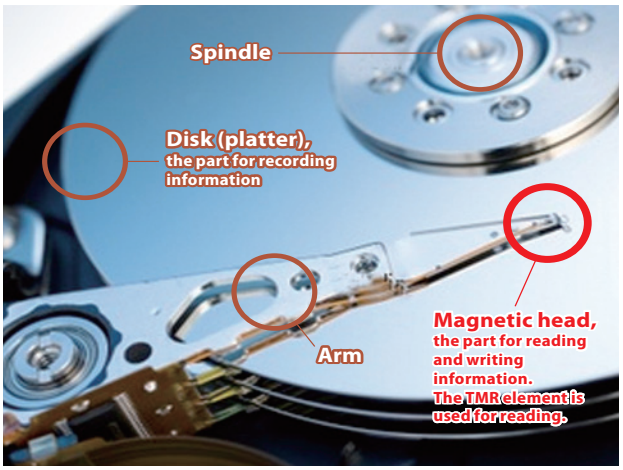
One other characteristic of PRESTO is the holding of camp-style meetings held by each research area. These meetings consist of a Research Supervisor, research area advisors (who assist the Research Supervisor), and PRESTO researchers who all gather overnight to discuss research in a focused manner. PRESTO researchers showed improvements by learning from others and boosted exchanges with peers from different fields, to build a network of human resources. In addition to creating results that served as a source for innovation, PRESTO developed a large number of researchers who went on to become the next generation of research leaders.

PRESTO has introduced new efforts. For example, exchange meetings have been regularly organized in recent years by inviting PRESTO researchers from different research areas to look for seeds of cooperation beyond the boundaries of research areas. The other example is the implementation of Science for Society (SciFoS), a program aimed at hypothesis verification in an interview format for the purpose of positioning each PRESTO researcher's scope in awareness of social needs.

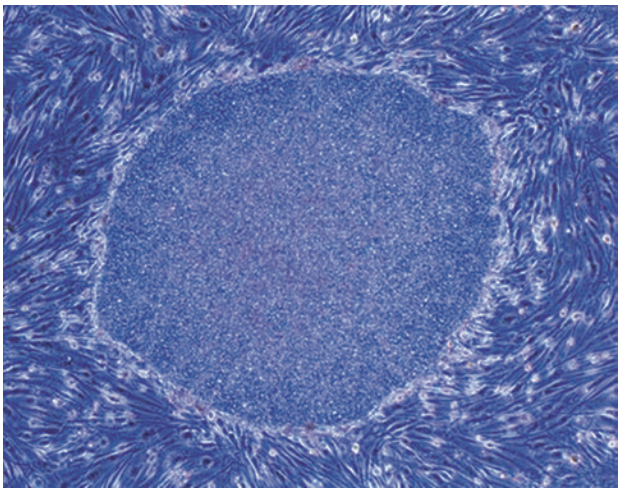
Creation of Revolutionary Technological Seeds for New Industries through CREST

After the collapse of the bubble economy in 1991, the government took reflation measures by focusing on public investment, but the economy did not improve at all. In these circumstances, the Science and Technology Basic Law, which aimed to rebuild the nation's economy through the promotion of leading science and technologies, was enacted in November 1995 as legislation submitted by House members.

CREST was initially budgeted for FY1996 as a new program. However, due to the urgent need for enhancements to the research environment for basic research, the program was incorporated into the supplementary budget of FY1995 and started in October.



Internal structure of the hard disk, which is provided with a large capacity through the "Nanostructure and Material Property" Research Area in PRESTO
Source: Shinji Yuasa, director of Spintronics Research Center, National Institute of Advanced Industrial Science and Technology



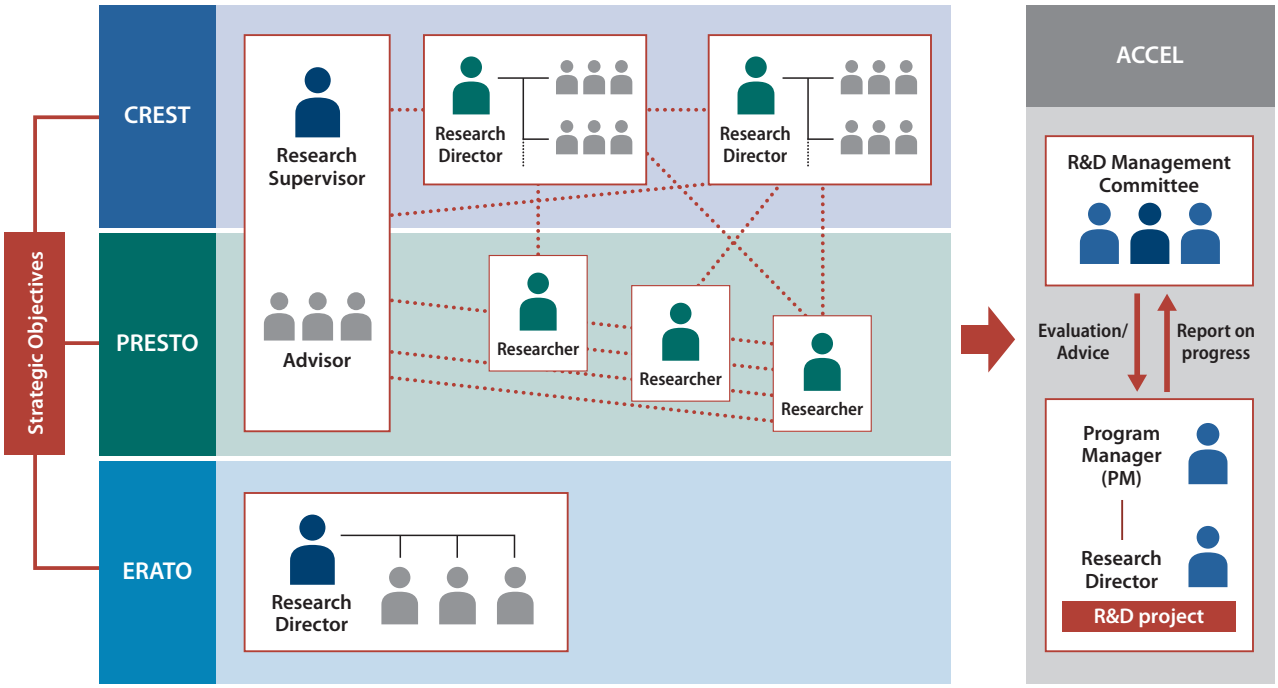
iPS cells generated from human skin cells in "Translational Research for Intractable Immune Disorders and Infectious Diseases" Research Area in CREST
Source: Center for iPS Cells Research and Application (CiRA), Kyoto University

CREST was specifically implemented as a mechanism for carrying out such measures as those adopted in the First Science and Technology Basic Plan, including (1) the expansion of the breadth and freedom of choice in research funds, (2) expansion of competitive funds that contribute to the formation of a competitive research environment, and (3) active promotion of basic research, among others. Its aims were to enable basic research that would surpass international standards and to create innovative technological seeds that would lead to the creation of intellectual properties and new industries. It was decided that the program would promote team-type research projects carried out under the strong leadership of Research Directors.

In CREST, based on strategic objectives set up by the government in light of social and economic needs, research areas and Research Supervisors are determined toward the realization of the objectives. The Research Supervisor selects projects (research teams) through public recruitment, and manages strategic basic research as a head of the research area. One of the characteristics of CREST is the presence of the Research Supervisors. It is possible for the Research Supervisor, through his or her judgment and strategy, to select a challenging research project from submitted proposals and manage the research area with a high degree of freedom. An example is the case of Professor Shinya Yamanaka who was selected in 2003 as a Research Director by Professor Tadamitsu Kishimoto of Osaka University. Professor Kishimoto was the Research Supervisor of the research area "Translational Research for Intractable Immune Disorders and Infectious Diseases." The research theme proposed by Dr. Yamanaka was about establishing iPS cells, which are capable of differentiation into various cells based on skin cells (which is not related to the theme of immunity or infectious disease in the research area); the production of human iPS cells was successfully achieved in 2007. This epoch-making research result caused a great impact not only in Japan but also the world as a whole. In order to accelerate iPS cell research, JST made extensively large research investment by launching the Yamanaka iPS Cells Project in 2008 and coordinating it with both CREST and PRESTO research areas which were newly established for iPS research.

In addition, CREST flexibly and effectively managed research areas according to their strategic objectives and characteristics. For example, instead of managing a research area singularly, CREST attempted to manage research areas in conjunction with others. Specifically, nine research areas related to nanotechnology established between FY2001 and FY2002 were combined with one research area of PRESTO to manage them comprehensively as a whole under the Nanotechnology Virtual Laboratory. In addition, one Research Supervisor concurrently performs research management of CREST and PRESTO in certain research areas, managing them as hybrid research areas with a view to creating strong interaction among participants in both systems. Moreover, in FY2012, a new research area was established, in which small-sized teams were initially adopted for carrying out R&D of various element technologies in different fields, and the teams were

Overview of the Strategic Basic Research Programs



subsequently reorganized into five strong teams. In FY2015, the other type of research area was established where the research period has been divided into two phases consisting of first and second halves. A research progress evaluation is performed at the end of the first half period, and in view of the results, new research teams are reorganized for the maximization of the research results.

Integration into the Strategic Basic Research Programs

The establishment of Strategic Basic Research Programs owe their success to the creation of the Incorporated Administrative Agency System in April of 2001, implemented as part of administrative reforms. As an incorporated administrative agency, JST was strongly asked to clarify the positioning of each program. Meanwhile, the strategic prioritization of S&T, promotion of basic research, and doubling of competitive research funds (clarification of the purpose of competitive funds of each ministry and agency, and consolidation of funding programs) were called for in the Second Science and Technology Basic Plan started in FY2001.

In light of these political considerations, Strategic Basic Research Programs were launched in FY2002 with the aim of reorganizing the conventional three programs of ERATO, PRESTO, and CREST, to promote strategic top-down basic research for the realization of strategic objectives defined by the government, provide appropriate research management, administer the system flexibly and effectively, and ensure appropriate evaluation and transparency.

The Solution-Oriented Research for Science and Technology (SORST), established in FY2000, was also shifted to the Strategic Basic Research Programs. SORST allowed research projects of ERATO, PRESTO, and CREST that were thought to produce key research results for S&T, or to be promising for their translation into practical application in the future to continue and provided them further research support (SORST ended in FY2010).

In addition, in the wake of the Nobel Prize in Chemistry being awarded to Professor Ei-ichi Negishi in 2010, JST launched "Creation of Advanced Catalytic Transformation for the Sustainable Manufacturing at Low Energy, Low Environmental Load (ACT-C)" in FY2012. ACT-C is being carried out as both individual and team type research, aiming at the creation of leading material conversion technology via catalysts as contribution to the solution for a variety of problems the world is currently facing, such as the realization of a low carbon society as well as sustained and developed production of pharmaceutical products and functional materials.

In 2016, the Japan Revitalization Strategy of the government deemed it an urgent task to engage in the R&D of artificial intelligence technology, which constitutes the core of the Fourth Industrial Revolution (Society 5.0), by industry–academia–government cooperation. The promotion system was established to involve the Ministry of Education, Culture, Sports, Science and Technology (MEXT), the Ministry of Economy, Trade and Industry (METI) and the Ministry of Internal Affairs and Communications (MIC). In the same year, MEXT launched the Advanced Integrated Intelligence Platform: AIP Project (Integrated project of artificial intelligence/big data/IoT/cyber security). As one of the two pillars of this AIP Project, JST is supporting creative researchers capable of innovation focused on artificial intelligence technology as part of Strategic Basic Research Programs. Related multiple research areas of CREST, PRESTO, and individual type research (ACT-I), which was newly established for younger researchers than those in PRESTO, are conducting coordinated research in the AIP Network Laboratory. It is designed to maximize the outcome of the AIP Project through integrated management with the newly established RIKEN Center for AIP.

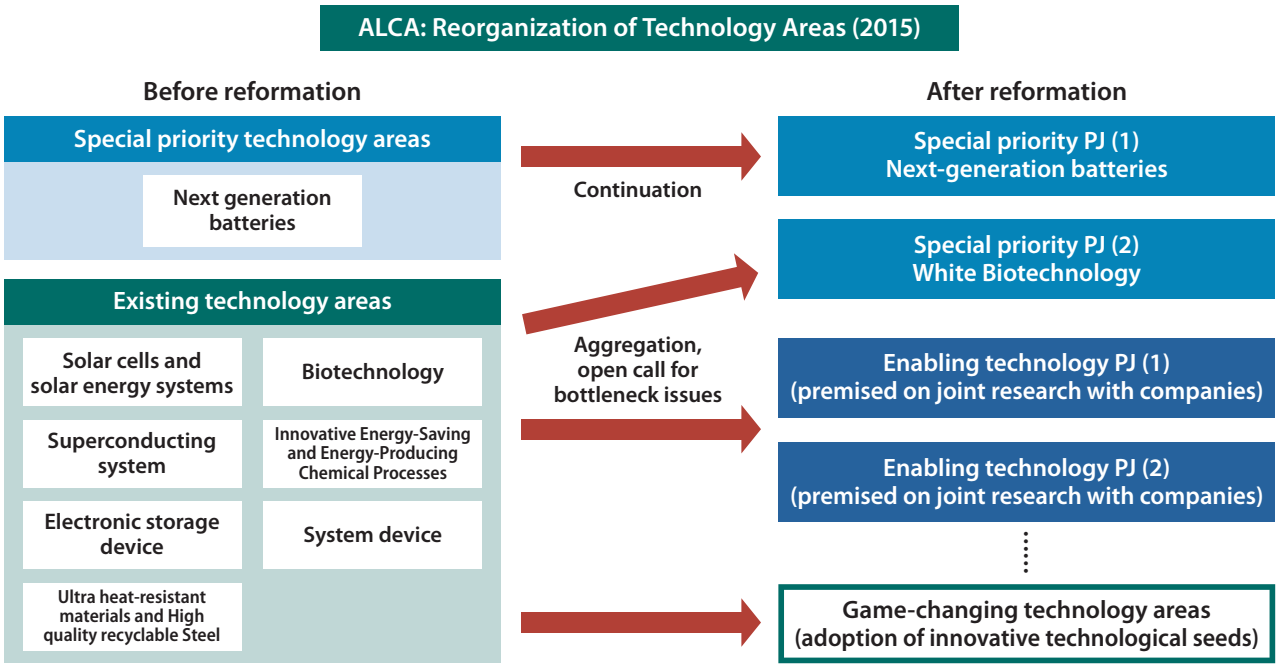
Promoting the Use of Basic Research Results for Industrial Applications through ACCEL

Translating research results generated at ERATO, PRESTO, CREST, and others into practical use for the creation of social and economic value is a big challenge. In particular, since the call for open innovation in recent years, the expectations for basic research by universities have been increasing gradually among industries. Thus, as a mechanism to promote the Proof of Concept (POC) and acquire appropriate intellectual property rights, the Accelerated Innovation Research Initiative Turning Top Science and Ideas into High-Impact Values (ACCEL) was established in FY2013 for research themes whose industrial applications are expected in the results of ERATO, PRESTO, CREST, and the other funding programs of JST.

ACCEL is to assign a Research Director and a Program Manager (PM) to each project. The PM takes the lead in the management of the project, including the progress of R&D, understanding the marketability of the outcome, exchanging information with companies for the development of findings, and securing intellectual property rights.

Realization of a Low-Carbon Society through ALCA

The massive consumption of fossil fuels since the Industrial Revolution has caused the excessive amount of carbon dioxide in the atmosphere, and global warming has emerged as a problem with a serious impact on humanity. In 2007, the Intergovernmental Panel on Climate Change (IPCC)



asked all nations in the world to take appropriate measures over the next few decades. With the Action Plan for the Achieving of a Low Carbon Society adopted by the government in July 2008 and the Research and Development Strategy for Creation of a Low Carbon Society formulated by MEXT in August 2009, JST started the Advanced Low Carbon Technology Research and Development Program (ALCA) in 2010 under the following policy of the government and MEXT: "Leading technological development aimed at the translation into practical use of technologies capable of dramatically enhancing efficiency and economic performance and technologies that are currently at the basic research stage will be implemented to contribute to the significant reduction of greenhouse gas emissions, in particular, carbon dioxide emissions, by 2030."

Under the strategic objective of developing a leading technology capable of significantly reducing greenhouse gas emissions toward the realization of a low carbon society, ALCA is engaged in the technological development of batteries, which are the core technology for electric vehicles and smart grid systems in terms of energy creation, energy storage, and energy saving, as well as of functional polymers resulting from biomass and heat-resistant materials for efficiency improvement in thermal power plants.

Through the adoption of a method that had never been applied in conventional basic research programs (e.g., focus on the adoption of challenging themes and stage gate evaluation to prioritize promising themes through strict evaluation) and implementation under a strong leadership of Program Directors, promising outcomes have been created for further acceleration, including the new solar cell "perovskite solar cell" made in Japan for the first time and "high quality and large-diameter gallium nitride crystal," a next-generation power semiconductor. In 2015, five years since the start of the project, the technical areas were reorganized to introduce a system aimed at the translation of research results into practical applications.

As a result of the accident at the Fukushima Daiichi Power Plant in the Great East Japan Earthquake of 2011 and the consequent stoppage of operations at many nuclear power plants, dependence on thermal power generation has increased in Japan. Thus, carbon dioxide emissions have also tended to increase. The Paris Agreement signed by 196 countries, including the U.S. and China, at the United Nations Framework Convention on Climate Change (COP 21) stated the adoption of "zero carbonization" aimed at turning global greenhouse gas emissions to zero in the latter half of this century. In these circumstances, the role of ALCA of comprehensively engaging in the development of technology to reduce greenhouse gas emissions will be more important.

RISTEX, Poised to Solve Problems Directly Linked to Our Society

The World Declaration on Science and the Use of Scientific Knowledge (the Budapest Declaration) was published at the World Conference on Science held in Budapest, Hungary, in June 1999. The declaration highlighted the role of S&T in the production of knowledge and the importance of "how to use it." In addition to "science for knowledge," three new principles of "science for peace," "science for development," and "science in and for society" were adopted. In the following year, the former Science and

Technology Agency established the Study Group on Research and Development for Science and Technology for Society (chaired by Dr. Hiroyuki Yoshikawa, the former President of Science Council of Japan) and compiled a report on the promotion of "Technologies to solve social problems," "Technologies harmonizing the natural sciences, and the humanities and social sciences," and "Technologies with which market mechanisms do not work easily" as "Science and technology for society."

Following the recommendation, JST and the Japan Atomic Energy Research Institute (JAERI, currently, the Japan Atomic Energy Agency) jointly established the former Research Institute of Science and Technology for Society (RISTEX) in 2001. JST launched three R&D focus areas of public recruitment ("Science and Technology for Society/ Social Systems," "Brain-Science and Education" and "Sustainable Society") as programs designed to delve into problems and solutions for research themes in a bottom-up manner. In addition, the RISTEX Forum was also established for coordination with JAERI and interaction with society. Thereafter, the responsible section of JAERI was transferred so that JST would implement the project solely, and the body was reorganized into the current RISTEX in 2005. In 2007, a change in the system was introduced consisting of (1) review of social problems, and expansion of exploration and extraction function of R&D focus areas in the planning stage; (2) full shift to public recruitment of project proposals; and (3) cooperation with stakeholders in R&D and placement of focus on social implementation.

Under the new system, the two R&D focus areas of "Protecting Children from Crime" and "Science Technology and Humanity (Interaction between S&T and Society)" were launched along with the Implementation-Support Program (Call for Proposal Type). Thereafter, a variety of R&D focus areas were launched, including "Community-Based Actions against Global Warming and Environmental Degradation" (2008), "Redesigning Communities for Aged Society" (2010), "Creating Community-Based Robust and Resilient Society" (2012), and "Designing a Sustainable Society through Intergenerational Co-creation" (2014). In addition, as R&D programs that identify the problems and fields to be addressed by JST, based on the principle of MEXT, "Service Science, Solutions and Foundation Integrated Research Program" (2010) and "Science of Science, Technology and Innovation Policy" (2011) were launched.

The "Miracle of Kamaishi" on March 11, 2011, in which scientific disaster prevention education was utilized
Source: Toshitaka Katada, Professor of Gunma University Graduate School

Results of Tsunami Disaster Prevention Awareness Activities and Early Diagnosis of Developmental Disorders

With the completion of two R&D focus areas in 2012, RISTEX reviewed its past efforts and results to determine the future direction of management and R&D to be addressed, and then formulated the "Policy for the Future Promotion of R&D on Science and Technology for Society" as well as the action plan for its realization in 2013.

In 2014, RISTEX created the Strategic Planning Unit as an organization to review and extract problems and then promote activities for the design of new R&D focus areas, as well as to implement efforts to analyze, classify, and schematize past results and efforts. In 2015, under this new system and its concept, "Creating a Safe and Secure Living Environment in the Changing Public and Private Spheres" was the first R&D focus area to be launched.

Previous remarkable achievements include the following. One, around 3,000 of all elementary and junior high school students who were at school in Kamaishi City on the day of the Great East Japan Earthquake could safely evacuate as a result of tsunami education using the Comprehensive Tsunami Disaster Scenario Simulator (Toshitaka Katada, Professor, Gunma University Graduate School). As another example, one item on the checklist of symptoms of infantile autism, prepared based on a research result on early diagnosis of children's developmental disorders, was incorporated in the revision of the maternity record book (Yoko Kamio, MD., Ph.D., Director, Department of Child and Adolescent Mental Health, National Institute of Mental Health, National Center of Neurology and Psychiatry).

RISTEX will continue to look for and establish models based on the knowledge and methodology of the overview/ extraction of social problems, setup of areas, R&D management, evaluation, social implementation, and then transmitting information to the public.

Section 2 | Designing R&D Strategy

In 2003, JST established the think tank Center for Research and Development Strategy (CRDS). Since then, in addition to the existing activities based on S&T policies, JST also was conferred the function of making policy recommendations.

Moreover, China Research Center (currently, China Research and Communication Center: CRCC) and Center for Low Carbon Society Strategy (LCS) were established in 2006 and 2009, respectively. Through these think tanks, JST continues to provide various recommendations on S&T policy and R&D strategy for Japan.

CRDS Strategic Proposals Leading the Nation's S&T policy

CRDS was established in July 2003 to contribute to the planning of Japan's R&D strategy by drastically enhancing JST's R&D planning function and also strengthening JST as a funding agency. Since its establishment, the Center has adopted a unique review process for strategic planning. CRDS takes an overview of R&D fields (panoramic view) to extract important issues and clarifying Japan's position on these issues through a comparative survey on international technologies, focuses on holding workshops (provides opportunities) in which not only leading researchers from academia, but also experts from companies and policymakers from the government participate. This methodology continues to be valid to this day.

A system consisting of units and teams was introduced in 2008. Permanent units were introduced to extract important themes (strategic scopes) taken from an overview of the R&D fields. Temporary teams were composed of a few suitable individuals (from various units) for each extracted strategic scope. CRDS established this functional and flexible structure by running both the permanent and temporary systems simultaneously aiming each team to work on the strategic proposal during one year. Units were formed to answer with flexibility to the needs of the society and policy. As of April 2016 there are six units ("environment and energy," "systems/information science and technology," "nanotechnology/materials," "life science and clinical research," "science, technology and innovation policy," and "overseas research").

In 2010, a methodology for strategic planning based on "encounters" was developed, where societal expectations are connected with R&D themes extracted from an overview of S&T fields. This initiative on societal expectations/encounters acted in concert with the Fourth Science and Technology Basic Plan (2011–), which focused on the role of S&T in society and on solution-oriented R&D, attracting the attention of stakeholders.

In 2011, the Center started to prepare a panoramic view report on R&D, which is an extensive summary of the overall activities of R&D fields and comparison surveys of international technologies that the Center has been compiling since its establishment. The first edition was issued in 2013. The panoramic view report is issued every two years and reflects the exchange of views, opinions and information provision of a cumulative total of over 1,500 researchers on the frontlines. In 2016, the "New Trends in Research and Development (2016)" report was issued to fill the intervening year. The panoramic view report is widely used not only for reviewing policies of relevant ministries and agencies but also by the industry and related think tanks.

Further, the Center provided timely recommendations on urgent issues, including emergency recommendations at the time of the successful production of iPS cells by Professor Shinya Yamanaka of Kyoto University, "Emergency Recommendations on the Great East Japan Earthquake Disaster" at the occurrence of the Great East Japan Earthquake, and "Looking Ahead to the 2020 Tokyo Olympic and Paralympics Games" when the holding of the Tokyo Olympic Games was decided.

As of the end of March 2016, CRDS has issued a total of 116 strategic proposals. We present here the strategic proposals "Elements Strategy" and "iPS Cells."

Looking towards the Future of Elements Strategy and iPS Research

The "Elements Strategy" originated from discussion among scientists and was released as a strategic proposal by CRDS in coordination with academic societies, universities, research institutions, and companies in the fields of chemistry, physics, metals, ceramics, iron and steel, etc., in order to specifically implement the vision of "maximizing the function of an element to realize ambitious new materials." Also, CRDS explained to relevant ministries and agencies the reason "Elements Strategy" was necessary. With the cooperation of various stakeholders in industry, academia, and the government, R&D started in 2007 at the MEXT, under the "Elements Strategy Project," in close collaboration with the METI's "Rare Metal Substitute Materials Development Project." It is the aim of the "Elements Strategy" to overcome the limits of resources, open up basic technology of new materials, and contribute to industries both inside and outside of Japan. The challenge still continues today.

On November 20, 2007, an epoch-making research

Emergency recommendations for the accelerated promotion of related research on stem cells in the wake of the successful creation of human iPS cells

Recommendations for solution-oriented R&D (1), (2), and (3)

result on iPS cells by Professor Shinya Yamanaka was published in the journal *Cell*. Immediately after the publication of the report, on December 7, CRDS issued an emergency recommendation, in which matters to be implemented (1) in FY2007 and (2) within five years from FY2008 were clearly stated. The emergency recommendation also included a guideline for the realization of regenerative medicine as soon as possible, which was presented as an appeal to the government. In 2008, strategic objectives were established, and basic research started in programs such as ERATO and PRESTO, followed by the establishment of the Center for iPS Cells Research and Application (CiRA) at Kyoto University. These initiatives provided the research a big boost of support.

Initiatives on Societal Expectations and Encounters

It is the basic principle of CRDS to respond to "what is expected by the society (societal expectations)" in planning a R&D strategy for S&T; thus, CRDS began to practice a new methodology in 2011. The following three solution-oriented strategy proposals were formulated by developing a series of processes that connect (encounter) the extraction of societal expectations with extracted specific R&D areas/issues (June 2014).

(1) Designing Japan's new energy supply–demand structure based on urban cities
(2) Study of integrated social infrastructure management system toward the realization of a strong and sustainable society
(3) Health maintenance strategy throughout life; in particular, the importance of preemptive medicine during the fetal and infancy periods

In the "solution-oriented approach," which is characteristic of the strategy proposals, it was possible to understand and recognize societal issues regardless of the perspective and framework of R&D fields and areas. Also, it was possible to find multiple areas that can contribute to solve the issues. However, since this method starts from finding how the problem can be solved, the projected image of the future society tended to be confined to a society where the issues are solved. For this reason, a new methodology called "future creative approach" was considered, in order to draw a new future-oriented and novel social image, which identified pioneering and advanced R&D themes. In this way, CRDS develops and implements a wide variety of methodologies for strategy planning in response to societal changes and trends within S&T innovation policies.

Initiatives of CRCC as a Think Tank for China Studies

China Research Center (CRC at the time) was established in 2006. In the beginning, as a division of CRDS, CRC conducted investigative research and information transmission on Chinese S&T as well as on education in China. In 2013, with the incorporation of a research exchange program, CRC was separated from CRDS and reorganized into the highly regarded China Research and Communication Center (CRCC).

In 2006, "the First Japan–China Symposium" was held. Since then, more than 200 audiences have gathered in symposiums held to facilitate highly regarded discussions with frontline experts on timely themes, including S&T policies and the economic issues of China.

In addition, the Center has made the "Chinese Paper Database (JST China)" available for free, which includes

papers extracted from 770 major academic journals issued in China with Japanese titles and abstracts (since 2007). About 100,000 papers a year and a total of more than 1.6 million Chinese bibliographic data are available, mainly used in the IP database of companies. Moreover, the "Database of China related Organization in Japan," which includes basic information as well events of research institutions related to China, has been also made available since 2014.

Furthermore, "Monthly China Study" is a lecture meeting by experts on the politics, economy, and S&T of China. As of June 2016, a total of 95 meetings have taken place to discuss timely themes with experts. These meetings continue today.

Moreover, the Japanese-language "Science Portal China" on the S&T and education of China was started in 2008 to provide information on recent research trends, mail magazines, People's Daily, and China Statistics Yearbook, all in Japanese. In addition, the portal site "Objective Japan" was created in 2011 to transmit an objective image of Japan in Chinese. The site also serves as an information hub between Japan and China by transmitting information on a wide variety of subjects, including the economy, industry, society, corporations, and exchange study programs of Japan.

Promoting Academic Exchange with China

In January 2010, JST held the "Japan–China University Fair and Forum in Tokyo," an academic exchange event in which universities, research institutions, and companies from both Japan and China gathered. The Third Fair and Forum scheduled for September 2012 was cancelled owing to unforeseen circumstances in China. However, with the dedication of related parties from both countries and a shared desire to prevent academic exchanges from being allowed to stagnate, JST called for the participation of

Symposium commemorating the inauguration of China Research Center

Top page of Science Portal China

Japanese universities in the "Chinese International Education Exhibition Tour" sponsored by the Study-Abroad Center under the Ministry of Education of the People's Republic of China in March 2013. 41 Japanese universities took part in the event.

In the wake of this opportunity, a high-level meeting was held between JST and China's Ministry of Education, the Ministry of Science and Technology, Chinese Academy of Sciences, and the National Natural Science Foundation of China to pave the road for the expansion of cooperation between Japan and China in the field of S&T. Thereafter, the event has been well-established as the "Japan–China University Fair and Forum in China." The event held in May 2016 in China marked the fourth time and largely contributed to the building of a high-level network between institution chiefs and officials of major academic institutions of both Japan and China. The event was restarted as the "Japan–China University Fair and Forum in Innovation Japan" in September 2014, in which 30 universities and research institutions from China participated. Representatives from 31 universities and research institutions from China and more than 200 experts took part in the fair and forum held in August 2015.

Through these exchange programs, JST concluded a comprehensive memorandum of understanding with major universities in China, including Peking University, Tsinghua University, Shanghai Jiao Tong University, Beijing Jiaotong University, Zhejiang University, Dalian University of Technology, and the University of Science and Technology of China, with the aim of fostering new collaboration with China in the field of S&T in the future.

In 2012, JST was awarded a letter of appreciation by the Executive Committee of the "China–Japan Friendship

Japan–China University Fair and Forum held in Beijing in 2016

Year for People to People Exchange" (Chairman: Hiromasa Yonekura). In addition, JST received a certificate for the Best Overseas Cooperation Institution from Chinese Service Center for Scholarly Exchange (CSCSE) of China's Ministry of Education for three consecutive years (2013, 2014, and 2015). This recognition is the result of achievements and efforts made by CRCC over a period of many years, which have been highly evaluated results by the government of China.

Realization of an Affluent Low Carbon Society through Center for Low Carbon Society Strategy

In December 2009, following the R&D strategy formulated by MEXT, JST established Center for Low Carbon Society Strategy (LCS) to contribute to the realization of "an affluent low carbon society" accompanied by sustainable development of Japan's economy and society based on S&T. LCS proposes a social scenario and strategy by drawing a desirable image of society in 2030 and 2050 and then promoting social scenario studies showing paths leading to realization of this image.

Specifically, LCS clarifies research themes leading to innovation based on a quantitative evaluation of future technology costs and carbon dioxide reduction effects, with consideration for current and future quantified low carbon technology and energy technology from their technological perspectives. It also proposes a scenario and strategy for technologies and systems that are expected to contribute to society owing to a reduction of costs in the future.

Thus, LCS conducts surveys and analyses of low-carbon technology and energy systems, such as solar cells, storage batteries, fuel cells, biomass, wind power generation, small and medium hydropower generation, geothermal power generation, and carbon dioxide capture and storage (CCS) to propose important research themes that may be essential for the realization of a low carbon society.

In July 2012, the "Comprehensive Strategies and Scenarios for the Realization of a Low Carbon Society" (Social Scenario 1) was published based on activities for the two years following the establishment of LCS. The entire picture of the social scenario study was shown in "Toward the Realization of Dynamic and Affluent Low Carbon Society: Summary Report 2014" (Social Scenario 2), published in June 2014.

LCS ensures the active transmission of results to policymakers, discourse and extraction of problems, and reflection into social scenarios by Japanese and foreign experts on the introduction of renewable energy in Japan at the international symposium organized together with the Science Council of Japan. It also runs program coordination in response to the SIP Project of the Cabinet Office and holds the "cost structure of renewable energies and measures for its reduction," a workshop co-organized with NEDO's Technology Strategy Center (TSC). In addition to participating in activities of "extraction of technological bottlenecks" of ALCA, LCS transmits information on results to the government, local governments, relevant institutions, and companies.

Dissemination of Research Results on Social Scenario

The social scenario study that has been conducted by LCS since its establishment has produced a variety of results, some of which are presented here.

To address the disruption of electricity supplies after the Great East Japan Earthquake, the Center developed and managed the system and network to calculate and predict the risk of major blackouts, calling for local governments to save electricity mainly under the supply area of Tokyo Electric Power. This "emergency blackout prevention system" initiative was turned into the social experiment "visualization of real-time electricity consumption in household," in cooperation with 23 local governments in FY2013.

In addition, LCS estimated and evaluated economic impacts on households in 2030, divided by income brackets, with respect to the three options on energy and environment published by the Energy and Environment Council of the government in 2012. The analysis results of the "Options on Energy and Environment" were addressed by a variety of media and received a great deal of attention and interest.

In proposing "Recovery scenario from the damage of the Great East Japan Earthquake through construction of a bright low carbon society" to Miyagi Prefecture, LCS suggested inviting a manufacturer of CIS thin film solar cells to set up a plant in the prefecture, which had a successful conclusion. This is a case where the cost evaluation and technological prospects by LCS matched the

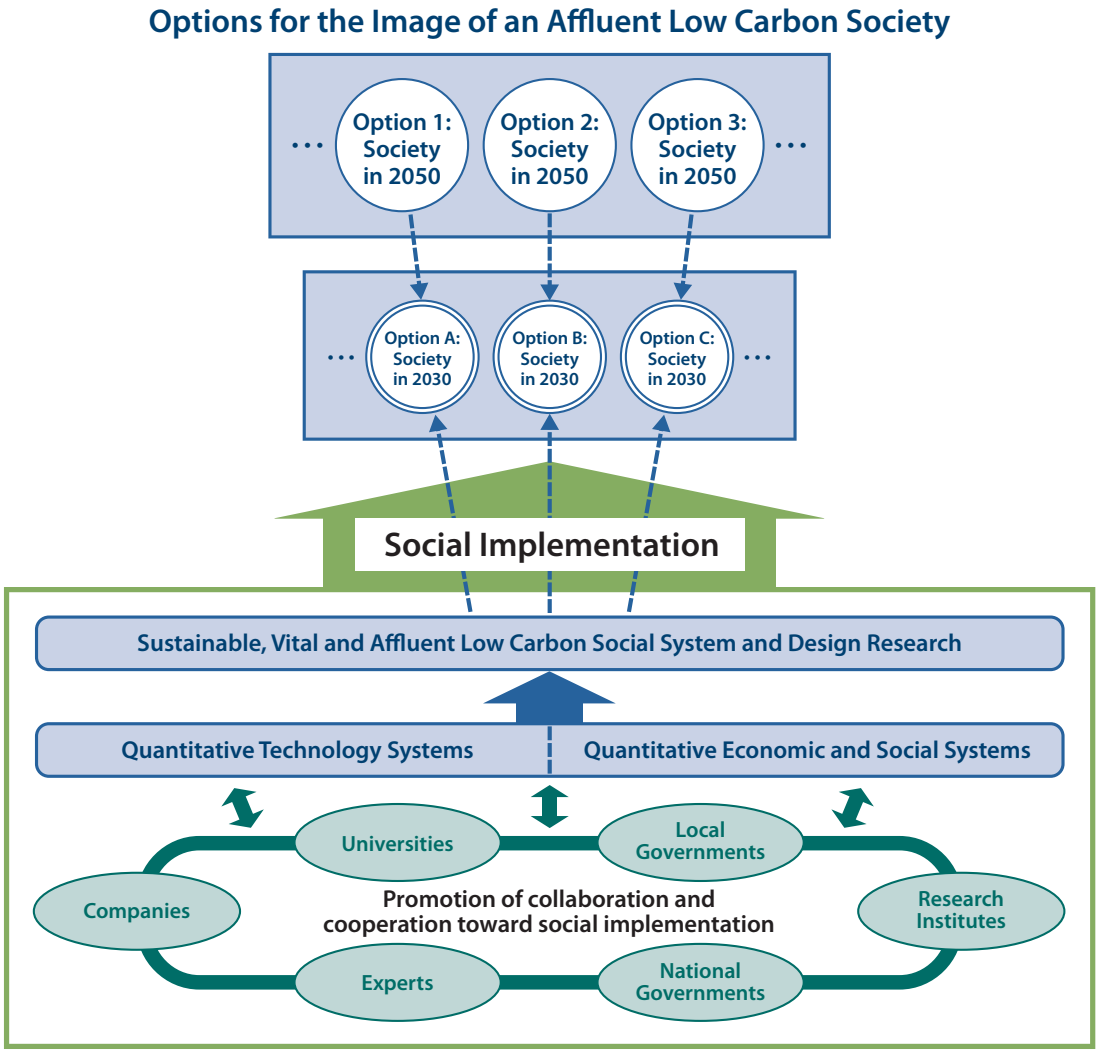
actual needs of industry.

LCS also provided knowledge and professional advice to Shimokawa-cho in Hokkaido and Adachi ward in Tokyo, which had been selected as "FutureCities" by the Cabinet Secretariat.

Global warming continues to be a threat that must be a common problem for all humanity, and thus, the importance of proposing a social scenario and strategy for the realization of a low carbon society, as well as of submitting options for the future image of a low carbon society, is increasing.

LCS will submit options for the period 2030 to 2050 to allow Japan to achieve its goal of an 80% reduction in greenhouse gas emissions by 2050 for the realization of a low carbon society. LCS will also continue to introduce the importance of promoting renewable energy and energy saving and how to manage the transition to a society that relies primarily on renewable energy.

Conceptual Diagram of Comprehensive Strategies and Scenarios for the Realization of a Low Carbon Society



Section 3 Development of R&D Assuming Social Implementation

R&D initiatives undertaken by universities and other institutions with a focus on social implementation have been ongoing since the establishment of the predecessor of JST, Research Development Corporation of Japan (later named JRDC). There were major policy changes, such as "the Act on the Promotion of Technology Transfer from Universities to Private Business Operators" in 1988, "the Law on Special Measures for Industrial Revitalization and Innovation" in 1999, "Intellectual Property Basic Law" in 2002, and "Incorporation of National Universities" in 2004. In light of these changes and in anticipation of social implementation of research results of universities and the like, JST has been developing a variety of initiatives, including the acquisition of patents and use thereof, review of research results obtained jointly with companies, acceleration of regional revitalization, and open innovation.

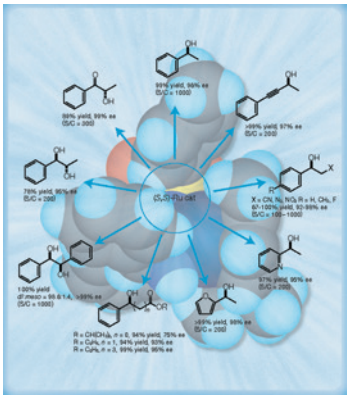
Toward the Acquisition of Intellectual Property Rights by Universities and Others and Promotion of Use Thereof

At the time of the establishment of JRDC, the practice of "Licensing" whereby the licenses of applied patents were offered for acquisition to disseminate research results generated by universities and public institutions, had already started. This practice was followed in 1967 (S42) with the "State-owned Patent Licensing Program," whereby JRDC solely conducted intermediation of patents owned by national universities. In addition, the "Usable patent scheme" was created in 1979, whereby the right to be granted a patent was most often transferred by a university researcher to the JRDC staff member who filed the invention for patent, as the applicant to acquire the rights.

Although these initiatives continued after the establishment of JST, the "Technology Transfer Support Center Project" that comprehensively supported the technology transfer activities of excellent research results produced by universities and others was started in FY2003 in response to the assignation of inventions made in national universities to the universities themselves. Patenting Support Services aiming to acquire foreign patents were created within the project. In FY2011, the project was renamed the "Intellectual Property Utilization Support Program (Foreign patent application support) and it began to provide financial support for application expenses when acquiring foreign patents. In addition, consultations on inventions as well as evaluation of patentability are provided by the chief patent investigator (currently Utilizing University IP to Drive Innovation [licensing support]).

About JPY 6 million is required for filing and registering an original patent for foreign patent protection (it is assumed that the application is filed in the U.S., Germany, the U.K., and France for cost calculation; maintenance fee is not included). This system plays an important role in patent acquisition, and about 40% of applications for inventions generated by universities rely on the support of this system for application filing and acquisition of patents.

Further, in FY2014, JST started the "System for Intensive Utilization of Important Intellectual Property (currently, the Utilizing University IP to Drive Innovation [packaging]), a new initiative for promoting activities both in Japan and overseas, whereby JST takes over and actively packages, for a fee, unused intellectual property, held by universities and other institutions, that is important in terms of national policy for translation into practical use. Since FY2000, JST has also been providing the "JST Science and Technology Research Result Database for Enterprise Development" (J-STORE), which publishes



Example of licensing outcome
Production method of optically active alcohol
Inventor: Ryoji Noyori (Noyori Molecular Catalyst Project in ERATO)
Production company: Kanto Chemical Co., Inc., Takasago International Corporation, etc.

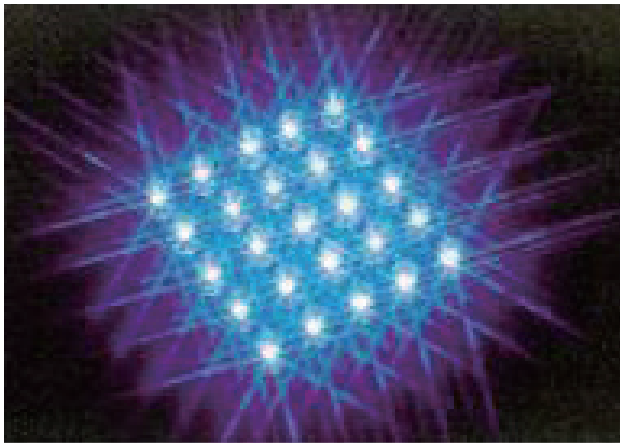
research results of universities and other institutions, including patents that can be licensed on the web for free with a goal of promoting the translation of research results into practical use through technology transfer to companies.

With the start of the Fifth Science and Technology Basic Plan in FY2016, the movement to strengthen and change universities' intellectual property management began. A new initiative to provide comprehensive support to intellectual property management by universities, including the provision of human resources support, was started by the Intellectual Property Utilization Support Program in FY2016.

Approach to R & D Assuming Social Implementation

In many cases, further R&D is required for the conversion of basic research results produced by universities and other institutions into practical use. Moreover, there are many cases in which technical issues and financial burdens pose an impediment to the process. Since the establishment of JRDC, the predecessor, JST has implemented the "Contract Development," whereby JST commissions a company to pursue R&D of a new technology based on university patents that were difficult to develop by the company alone, providing the technical guidance of universities as well as aiding with expenses for development. With this program, if the development is successfully accomplished, the company repays the development expenses; otherwise repayment will be exempted or hugely reduced. The program has been around to the present, through various revisions in details.

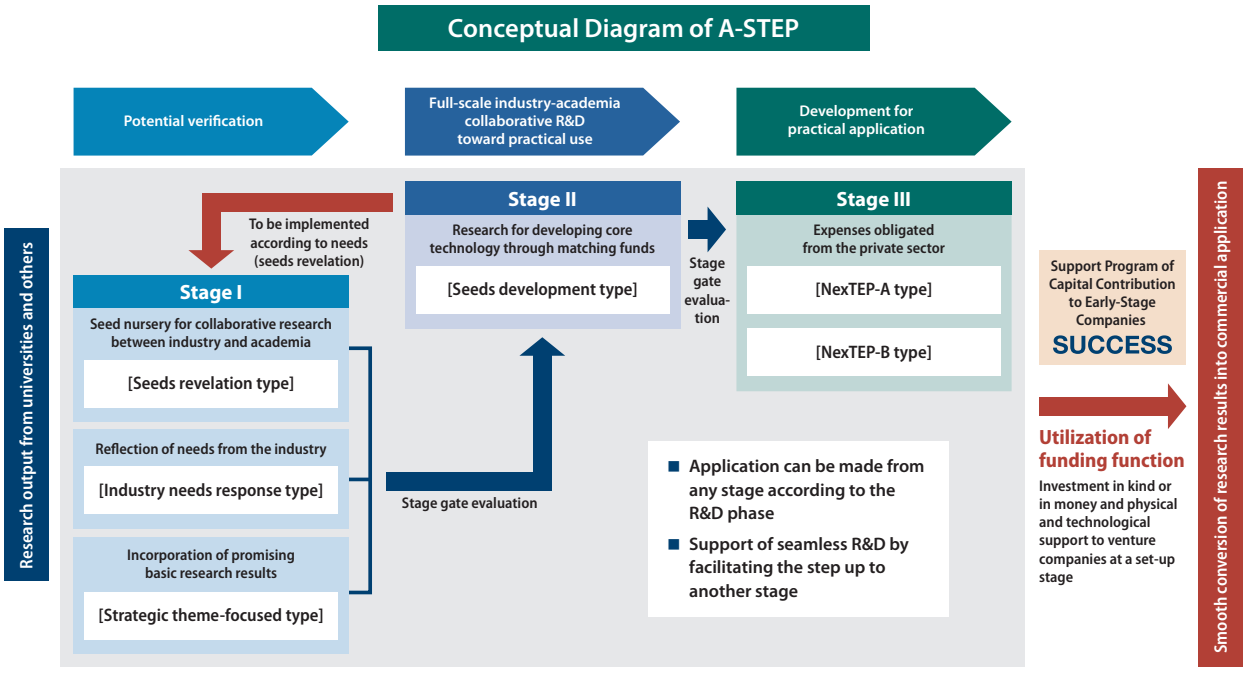
In addition, new programs were launched with the establishment of JST. Firstly, in FY1997, the "Modeling



Blue light-emitting diodes

Project for New Concept of Technology" was started, which (1) nurtured industry-academia collaborations based on the research results of universities and other institutions and (2) applied the commercializing concepts owned by small to medium R&D-oriented companies through development of prototypes and verification tests. Secondly, the "Collaborative Development of Innovative Seeds" that aimed to convert R&D basic results by universities and other institutions into commercial use was started in FY2006. In FY2009, these programs were reorganized as a part of the "Adaptable and Seamless Technology Transfer Program through Target-driven R & D (A-STEP)," which covers R&D phases ranging from verification of the potential of technological seeds of universities and other institutions to verification of commercialization, testing for commercialization development let by companies, and implementation of seamless R&D.

Regarding the activities assuming social



implementation of research results, in the Contract Development (currently, A-STEP NexTEP-A type), the cumulative income from licensing fees as a result of the implementation of new technologies amounted to about JPY 16.3 billion, which is equivalent to sales of about JPY 542.9 billion calculated at an average licensing fee rate of about 3%. Further, if we consider that research results are incorporated into other products, and new outcomes are produced, it is possible to assume that the program has contributed to the creation of a far greater economic impact.

One of the most noteworthy outcomes as a result of the use of the Contract Development is the R&D of blue light-emitting diodes, which was jointly conducted by Professor Isamu Akasaki of Nagoya University (then) and Toyoda Gosei Co., Ltd. The blue light-emitting diodes, which stated to be marketed in 1995, are currently used for a wide variety of purposes, including traffic signals, lighting, and the backlight of a display and others, generating sales of JPY 3.6 trillion in products and the employment of 32,000 people. In addition, JST has gained an income of around JPY 5.6 billion from implementation fees for the Contract Development up to FY2013. In 2014, in recognition of his contribution to the aforementioned GaN blue light-emitting diodes, Professor Akasaki was awarded the Nobel Prize in Physics jointly with Professors Hiroshi Amano of Nagoya University and Professor Shuji Nakamura of the University of California.

Creation of Regional S&T Innovation

The initiative to create innovations through S&T in the region was started simultaneously with the establishment of JST. The initiative was started in view of the enactment of the Science and Technology Basic Law and of "the Basic Guidelines for Boosting Regional Scientific and Technological Activities" at the Council for Science and Technology in 1995 and the First Science and Technology Basic Plan.

The "Regional Science Promotion Program (RSP)" was established in FY1996. In RSP, to promote industry–academia–government exchange in the region, "new technology coordinators" (later renamed "science and technology coordinators") were stationed at incorporated foundations in prefectures to scout for outstanding R&D personnel, region by region, and build a network of human resources. RSP then shifted its focus to unearthing and fostering research seeds in the region. This role ended in FY2005.

JST created the "Collaboration of Regional Entities for the Advancement of Technological Excellence Program" in FY1997. This was a joint research program between industry, academia, and the government, designed to implement individual R&D themes with high needs for industrialization in the region in a concentrated manner and focused on development of regional Centers Of Excellence (COEs) that would continue to develop research in the area and use the results thereof. In FY2005, the program focused on the creation of new projects and industries (new projects were adopted up to FY2008), and in FY2009, as the "Japan Regional Innovation Strategy Program by the Excellence," which was made up of an all-star team who conducted outstanding research, that aimed to create industries in specific areas was implemented (ended in FY2013). In FY2013, the initiative to build the "Super Cluster Program" based on wide range collaboration with high global competitiveness was started by making use of research results of the Regional Science and Technology Promotion measures of MEXT, and the initiative is still in progress.

In addition, as the base for the creation of regional innovation, JST established Innovation Plaza (renamed thereafter as JST Innovation Plaza, hereinafter called "Plaza") that facilitated industry–academia–government exchange in eight places, and JST Satellite (renamed thereafter as JST Innovation Satellite, hereinafter called "Satellite") in eight places in 2001, as the base for promoting seamless collaboration activities between industry and academia according to the regional needs.

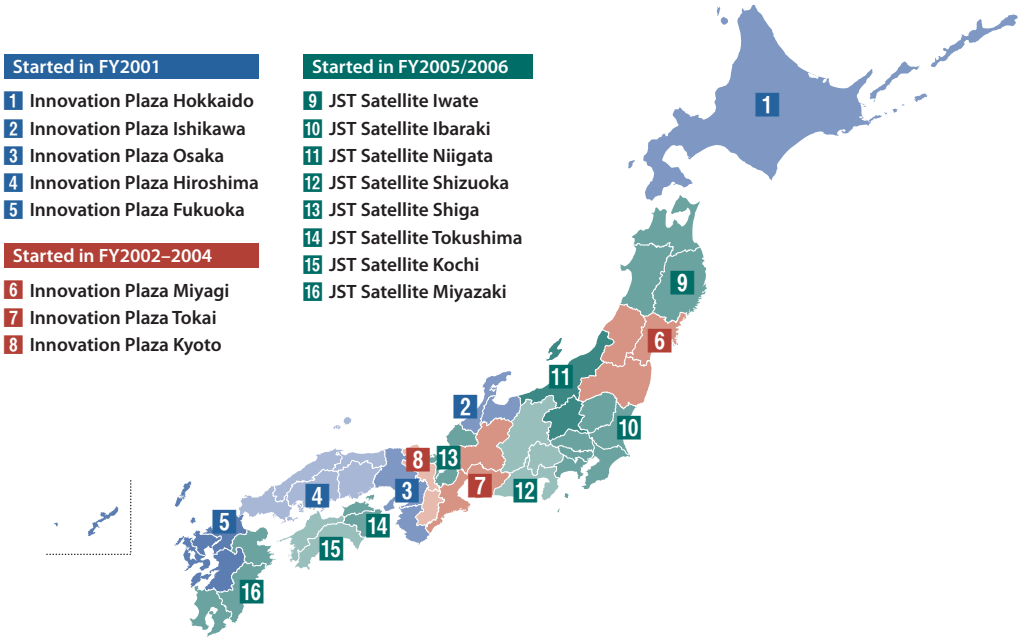
Great Impact on Regional Industry–Academia–Government Collaboration

To facilitate "exchange among the industries, academia, and government in the region," S&T coordinators were stationed at each Plaza and Satellite to implement a variety of efforts, including holding seminars, forums, and research meetings, as well as the collection and matching of information on technical seeds of universities and corporate needs to build a regional industry–academia–government network.

In addition, JST promoted the fostering and commercialization of research results in the region in a comprehensive manner through a seamless R&D program,

President Kazuki Okimura presenting his compliments on the inauguration ceremony of the Innovation Plaza Kyoto

Diagram of the locations of Innovation Plazas and JST Satellites



from the unearthing of universities' technological seeds to commercialization development. Plazas and Satellites provided researchers, universities, research institutions, and enterprises with a variety of information serving not only to create research results and build a regional network but also to connect the government within the region. However, both Plazas and Satellites were closed in 2011, having played their historical role.

These efforts aimed at the promotion of S&T enhanced the commercialization of universities' technological seeds in the region, and also played an important role in regional industry–academia–government collaboration, including the building of regional industry-academia-government networks and COEs, transmission of knowledge generated through the fostering of human resources, and business creation.

In 2014, the "Act on Overcoming Population Decline and Vitalizing Local Economy in Japan" was enacted to promote efforts based on regional plans. In the wake of its enactment, two programs were started in FY2015 as efforts for local revitalization: (1) the "Matching Planner Program," which aimed to match companies' technical issues that required a solution with technological seeds from universities and other institutions, in which professional matching planners visit companies for individual consultation, and (2) the "Research Complex Program," whereby industry, academia, and the government, as well as financial institutions, jointly developed foundations to promote complex innovations to facilitate leading R&D, commercialization of results, and fostering of human resources in an integrated and comprehensive manner through interdisciplinary collaboration between Japanese and foreign experts.

Promotion of Industry–Academia–Government Matching

Another initiative started after the establishment of JST was the promotion of technology transfer through industry–academia–government matching. In FY1997, "New Technology Presentation Meetings" were started to explain new technologies based on patents and results generated in each program JST published by research fields. With the incorporation of national universities in FY2004, however, the objective of the program shifted to promote the technological transfer of research results of universities. This initiative is highly regarded both by industry and academia,

Innovation Japan 2004

and around 80 meetings are held every year.

Japan's largest industry–academia matching event "Innovation JAPAN: University Technology Exhibitions" has been held since FY2004. In FY2015, a total of 401 technological seeds from universities and other institutions were exhibited, and a total of around 20,000 people visited the venue over two days. In FY2008, the industry implemented "Presentations from Industry to Academia," designed to explain technological problems and needs to universities and other institutions. The matching rate stands at about 25% in each of the initiatives, which is a high success rate.

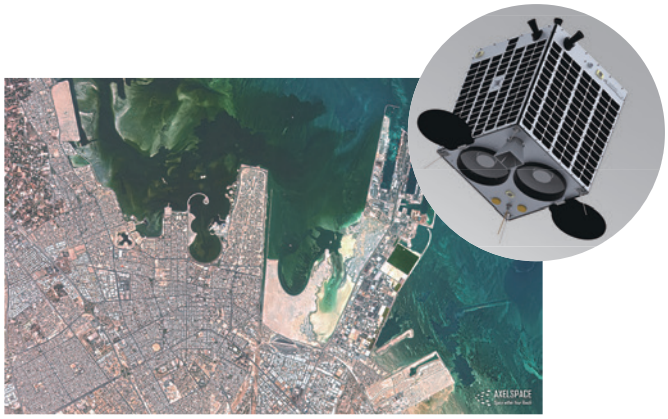
In addition, to cultivate personnel to support industry–academia–government collaboration and promote activities, JST implements a training program designed to train astute individuals for these activities. Moreover, JST manages the "Portal Site for Industry–Academia–Government Collaboration," a portal site to provide information on industry–academia–government collaboration and implement efforts to manage journals/databases.

Toward the Creation of University-Originated Start-up Companies

As a driving force for innovation, university-originated start-ups play an important role in creating new industries, transforming industrial structures, and utilizing results of research from universities and other institutions that in turn give back to society. In Japan, measures have been taken to promote the transfer of research results to private business operators through the Act on the Promotion of Technology Transfer from Universities to Private Business Operators in 1998; in 2000, faculty members of national universities were allowed to work concurrently for a company that utilizes their results. In 2001, METI published the "Hiranuma Plan," which set up the policy objective of increasing the number of university-originated start-up companies to a cumulative total of 1,000 in three years to heighten the momentum toward strengthening efforts in the creation of university-originated start-up companies.

In FY1999, JST started the "New Techno-Venture Oriented Research and Development Program" (later renamed Pre-Venture Project), which supports R&D and investigations to translate excellent research results from universities and public institutions to starting up a business. Thereafter, a revision was made, and the project became the "Supporting Program for Creation University Ventures" in 2002.

Moreover, the system was reorganized into A-STEP in FY2009 to allow seamless promotion from the potential verification of a research seed's start-up value through pre-venture project development stage and to verification of commercialization (after the setting up of the business); recruitment continued until FY2014. A total of 296 venture companies were created by FY2014 using the results of JST, and 155 companies were created through the aforementioned system, thereby contributing to the creation and development of university-originated ventures in Japan.



Nanosatellite developed at a low cost and in a short period for new space exploration

From the perspective of Japan as a whole, despite the high risk of technologies of university-originated start-up companies, owing to their incipient development stage, investment in them has been increasing, and further promotion is required for innovation acceleration. The system was reviewed taking these points into consideration, and JST has implemented two new initiatives.

The first initiative was the "Program for Creating STart-ups from Advanced Research and Technology (START)" started by MEXT in FY2012; the Program has been implemented by JST since FY2015. In the program, a business promoter with know-how on product commercialization, such as a venture capital, and a researcher, jointly formulate an optimal R&D and commercialization plan for the development of a technological seed. They then perform R&D as well as proceed with project development at a pre-venture stage in light of market needs.

The second initiative was the fact that with the revision of the Act on Enhancement of Research and Development Capacity, it became possible for JST to invest in cash and in kind in companies that make use of its own research results. In response to this, JST started the "SUpport program of Capital Contribution to Early-Stage companieS (SUCCESS)" in FY2014 to make direct investments in venture companies that developed their business based on R&D results supported by JST as well as to provide human resources and technological assistance for business development. The program was started with a capital of JPY 2.5 billion; seven companies received investment from JST in two years as of FY2015.

Promotion of Theme- or Field-Focused R&D by Industry and Academia

To foster innovation effectively, one measure is to establish a theme or field for industry and academia and form a

platform to conduct focused R&D.

JST implements development of advanced measurement and analysis systems and equipment following the government policy as well as theme-focused R&D based on industry–academia dialogue.

To conduct and establish leading R&D and production technology, corresponding measurement and analysis technologies are indispensable, and it is notable that Japan has a high dependence on foreign products. In the wake of the awarding of the Nobel Prize in Chemistry to Dr. Koichi Tanaka of the Shimadzu Corporation in 2002, recognition of the importance for development was enhanced, and the "Program for Development of Advanced Measurement and Analysis Systems" was started in FY 2004.

This program specializes in the development of a wide range of measurement analysis technologies, such as high-performance microscopes, mass spectrometers and separator devices, developed jointly through industry and academia. The main characteristic of the program is consistent implementation, from creating new technologies which dramatically improve measurement and analysis concept, through applied developing prototypes of novel measurement and analysis apparatus and systems, up to verification using a prototype. Subsequently, a development type corresponding to a development phase is set, enabling transference to the next development type based on the evaluation if the development is successful. In addition, the "priority development areas" that define targets were established in FY 2012 to implement R&D in response to demands from society, including the launch of the "radiation measurement area" to respond quickly to environmental contamination caused by radioactive substances released after the accident of the Tokyo Electric Power Company's Fukushima Daiichi Nuclear Power Station.

Three-dimensional anterior segment OCT developed through the Development of Advanced Measurement and Analysis Systems

In this program, more than 350 development themes have been adopted since the start of the program in FY2004, of which more than 50 R&D projects have been converted into commercial use with a total sales amount of more than JPY 70 billion (as of 2016).

As a theme and field-focused initiative, the "Strategic Promotion of Innovative Research and Development Program (S-Innovation)" was launched in FY2009, whereby R&D themes were designed based on results of basic research programs of JST to promote R&D consistently and seamlessly toward practical use. In addition, in FY2010, the "Collaborative Research Programs Based on Industrial Demand" was started, whereby technical themes were developed from the basic research to help solve technical issues in the industrial sector. This aims to promote basic research carried out in universities and other institutions, with industrial viewpoints through open innovation between industry and the academia, which is the "place of industry-academia collaboration." Although results are being achieved in both programs, JST is now promoting new themes of R&D by establishing new support types (support focused on Industrial needs response type and Strategic theme-focused type) based on the concept of both programs at the review of A-STEP in FY2015.

Support for Reconstruction After the Great East Japan Earthquake

On March 11, 2011, the Great East Japan Earthquake occurred with an epicenter off the Sanriku coast, causing unprecedented damage to the country.

In April 2012, one year after the disaster, JST established "JST Center for Revitalization Promotion" to start the "Program for Revitalization Promotion" as a reconstruction project from the Great East Japan Earthquake. To conduct activities closely related to affected areas, three offices were established in the three most severely affected prefectures of Iwate (Morioka), Miyagi (Sendai), and Fukushima (Koriyama), with the head office at Sendai. A total of 18 matching planners were stationed in each office as technical experts.

The Program for Revitalization Promotion consisted of three support programs of "Matching Promotion," "A-STEP," and "Collaborative Research Programs Based on Industrial Demand," with the main focus on the first. For reconstruction following the Great East Japan

Development of a new molding technology with amber, specialty product of Kuji City through Revitalization Promotion Program

Earthquake, it was necessary to take measures not only to "return" to the original state but also to "revitalize" ahead of the recovery, in particular, measures for the recovery of affected areas in terms of industry and economy and for further development.

The Matching Promotion is a program to support joint R&D between companies in affected areas that wish to convert new products into commercial application and universities across the country to rebuild the economy and industry of affected areas. Matching planners stationed at each office provide meticulous support, identifying the wide-ranging needs of small to medium sized enterprises in affected areas, such as in manufacturing, fishery and food processing, agricultural, and other industries, applying for the program, starting and completing R&D, and ensuring product commercialization.

In the three years following the start of the program, more than 1,100 enquiries were received from companies in affected areas, and 676 proposals were successfully applied through the program. A total of 288 applications were approved, and about JPY 6.4 billion of research funds were allocated by FY2015. About 80 cases have been commercialized and marketed (including potential cases), and more than 300 people have been employed by approved companies in affected areas (as of March 2016). A total of JPY 14.47 billion worth of business is expected to be created by FY2017.

Further, this program has enhanced the motivation of companies in affected areas (mainly subcontractors of major companies) to put more focus on R&D, opening up opportunities to change their attitudes, including efforts to challenge the development of new products and start-up of new business which differ from their core business, and promote market entry.

Promotion of Open Innovations

In response, under the Comprehensive Strategy on Science, Technology and Innovation and Japanese Revitalization Strategy of 2013, MEXT started the "Center of Innovation Science and Technology based Radical Innovation and Entrepreneurship Program (COI STREAM)" in FY2013. Based on the awareness of the problems "how people will change" and "how society will change," COI STREAM established the three visions of (1) "ensuring sustainability as an advanced nation with ageing society and low birthrate," (2) "thriving and becoming a respected nation by building an affluent living environment," and (3) "building a vigorous and sustainable society." Under these visions, JST established a "visionary team" centered on a visionary leader with a wealth of experience in the industrial circles to promote R&D as a COI program.

In a COI program, issues for R&D are identified using a back-casting method with a view to realizing a social image (vision) in 10 years' time. A COI program also provides support to R&D conducted consistently by a large-scale joint industry–academia research teams, ranging from basic research to social implementation on interdisciplinary and cooperative fundamental themes that may pose high risks but have a large social impact. It is the aim of the COI program to not only realize radical innovation that is difficult to be accomplished by the industry or academia alone but also to develop an "innovation platform" capable of creating innovations in a continuous manner in Japan. Thus far, 18 bases have been established. In addition, in the program, high risk research is accommodated in such a manner so as to improve research management as well as to integrate and review research themes are performed after the start of research under the leadership of the visionary leader.

To strengthen the function of the national R&D agencies, to demonstrate an advantage in the global competitive environment, and for R&D agencies to play the necessary role of core base for the enhancement of research capacity and personnel capacity of Japan, JST started a program in FY2015 to promote the building of an "Innovation Hub." This hub would serve as an international base for each national R&D agency according to their respective mission and role and as a place for coordination with related organization both in Japan and overseas.

In addition, in FY2016, the "Program on Open Innovation Platform with Enterprises, Research Institutes, and the Academia," which expands industry–academia partnerships concerning basic research and human resources development towards the development of new core industries, was started under the cooperation of the industries. This program was institutionalized in response to a proposal by the industry. The program aims to establish a new form of Japan's industry–academia collaboration such that basic research is conducted jointly by companies and universities.

Chapter 2

Promotion of Global Research Activities

During the 1980s, there was intense trade friction between Japan, Europe, and the U.S., especially against the backdrop of Japan's breakthroughs in its semiconductor industry. Japan was heavily criticized for the industrial policy led by the government and for its "basic research freeloading," and demands for symmetrical access were on the rise.

With increased momentum to promote the exchange of international research in S&T and to contribute to the development of these fields globally, in cooperation with other countries, the Promotion and Support for International Research Collaboration of the Research Development Corporation of Japan (JRDC) was launched in October 1989.

The International Cooperative Research Project (ICORP), STA Fellowship Program, Cooperative Research Fellowship, and Research Exchange Support Program (including the Housing for Foreign Researchers) served subsequently as the basis for JST's international exchange programs.

ICORP: Researchers from Two Countries Gathering to Work Together

The International Cooperative Research Project (ICORP) differed from conventional international collaborative programs in that it involved a "research support institution" providing support to organizations to which researchers of the partner country belonged. In an ICORP project, JRDC and the institution from the partner country engaged in a joint research agreement, and a research team from both countries worked together on a single project under the agreement.

ICORP was modeled after the Exploratory Research for Advanced Technology (ERATO), whereby an independent off-site research center was established separately from both research institutions. This off-site center was where researchers from both institutions gathered to pursue their studies. In addition, for each project, JRDC built a project office in which an administrative manager and staff were stationed on a full-time basis, and JRDC directly conducted the research project.

In 1996, the momentum promoting international research heightened, putting great emphasis on Asia in response to the government policy. Given these circumstances, under the guidance of the Science and Technology Agency (at the time), the Asia type ICORP was additionally created, and the conventional ICORP was named as "Advanced Country type."

The Asia type ICORP had the same promotion system as that of the Advanced Country type ICORP. However, since it was based on the principle that "the researchers were dispatched to carry out the projects in the real research fields," the Japan side projects were also set up in the local area, including the project offices.

Southeast Asian countries at that time were accustomed to ODA, and partner countries expected to receive funds for research. The principle of equal partnership, whereby partner countries would also bear the cost of their own research based on the agreement, was not

Members of the joint symposium of the Japan-France Joint Research Project

understood. Therefore, execution of the agreement took a considerable amount of time. This presented a different kind of difficulty from that of the Advanced Country type.

Afterward, the Strategic Basic Research Programs into which ICORP, ERATO, CREST and PRESTO had been integrated were initiated in 2002 in order to lead basic research towards achieving national strategic targets in light of the Second Science and Technology Basic Plan and the promotion strategy of the Council for Science and Technology. This project was named Strategic Basic Research Programs' ICORP International Cooperative Research Project.

At the time, there was a big change in the project in that research areas were to be set up according to strategic objectives defined by the government. In the case of ICORP or ERATO, a project was equivalent to a Research Area of CREST or PRESTO, and a Research Director of ERATO directly conducted research activities and supervised the project. Researchers both from Japan and overseas, with different fields of expertise and from different institutions, were expected to work on a research concept led by the Research Director. Moreover, researchers were expected to brush up on their research skills in an environment in which they were brought into contact with different ideas and philosophies, thereby playing an active role in shaping international research areas.

New calls for proposals for ICORP were terminated in 2006. However, its budget was incorporated into ERATO. From 2007 "ERATO-International" started to promote international joint research; the idea of ICORP has also been passed on accordingly. The Research Directors were stationed in their respective countries. ICORP served as a cornerstone for the Strategic International Research Cooperative Program (SICP) and the Strategic International Collaborative Research Program (SICORP) which will be mentioned later.

The photo on the previous page shows ICORP members at a joint symposium on the Japan-France Joint Research "Nanotubelites Project," with Professor Sumio Iijima as the Research Director on the Japanese side and Dr. Christian Colliex as the Research Director on the French side. In addition to nanotubelites, Professor Iijima's discovery of nanohorns was an outcome of this ICORP project.

STA Fellowship Program: Designed to Foster Overseas Young Researchers

The STA Fellowship Program took place between FY1988 and FY2001 to grant fellowships to young overseas researchers and provide them opportunities to work at Japanese national research institutions. The program was established by the then Science and Technology Agency (STA); for this reason, "STA" was used in the title of the program.

In the year following the launch, the STA Fellowship Program together with its budget was transferred to JRDC, and its successor JST continued the program. One of the policies aimed toward promoting international exchanges included the numerical target to "increase the current number of STA fellowships from 340 to 1,000." This was part of the First Science and Technology Basic Plan, which was formulated the year before JST was established. Research exchanges, including the STA fellowship, was one of the five pillars of JST's operation.

This program was premised on the use of national research institutions as accepting institutions on the Japanese side. However, it was difficult for the national research institutions to accept foreign researchers over the assigned quota. Under these circumstances, the STA Fellowship Program made a great contribution to the promotion of international exchange of the national research institutions. During the 14 years from the launch of the program to its end, a total of 3,678 foreign researchers were granted fellowships to perform research.

In this program, researchers coming from foreign countries were provided not only with the opportunity to conduct research in Japan but also with additional services such as help learning the Japanese language and culture, support securing residences, and counseling on life in Japan. These services were highly appreciated by researchers and their accompanying family members as well as by accepting institutions that lacked facilities and know-how on accommodating foreign researchers.

In December 2000, "The first recommendation based on the administrative inquests on S&T" from the Ministry of Public Management, Home Affairs, Posts and Telecommunications (at the time) reported instances of overlap and commonality between the STA Fellowship Program and comparable programs of the Japan Society for the Promotion of Science (JSPS). Thereafter, the STA Fellowship Program was transferred to JSPS following the merger of the STA and the Ministry of Education, Science

Ninomiya House

Evening forum held at the Ninomiya House

and Culture in 2001.

Construction and Management of Residence for Foreign Researchers: Takezono and Ninomiya Houses

The construction of the Tsukuba Science City was decided by the Cabinet Office in September 1963 and was completed with the transfer and new construction of the planned national research institutions and universities by 1980. It later became the largest R&D center in Japan with active participation from private companies.

In order to support the life of foreign researchers and their families in the Tsukuba Science City, JST built the Takezono House (36 rooms) in 1991 and the Ninomiya House (184 rooms) in 2001 as residences for foreign researchers; they are still under the management of JST. In the first year after the opening of the Takezono House, a total of 74 researchers and their families from 25 countries were accepted, including people from Western countries such as the U.S., the U.K., France, Germany, and Italy as well as people from Asian countries such as China, Korea, and India.

Thereafter, the number of accepted researchers and the number of accepted countries increased year by year, with a temporary drastic decrease in the number of residents in both Houses after the East Japan Great Earthquake, as researchers and their families followed instructions from their embassies along with their own decision to go back home or to evacuate to the Kansai area. However, the situation later improved, and as of 2015 JST has accepted a total of 756 researchers from 59 countries in response to the requests of 22 host institutions, providing fine-grained support to research activities in the area.

In addition, JST provides a variety of support services that allow foreign researchers and their families staying at the Takezono and Ninomiya Houses to live comfortably. For example, JST provides resources to help with handling enrollment procedures, moving the children of foreign researchers in or out of school, and accompanying researchers and their families to administrative agencies for resident registration and acquisition of long-term residence permits. JST also provides necessary information, contact, and counseling regarding hospitals, shopping, and transport.

Moreover, in order to deepen exchanges among the foreign researchers and their families living in the House, host research institutions, university members, and local inhabitants, JST holds events for cultural exchange, including evening forums, candlelight discussions, cooking classes, Japanese language classes, summer festivals, and more.

In addition, JST accepted a total of 221 high school students selected from each country around the world to the House in response to a request from the event organizer of the "International Biology Olympiad" held in 2009.

From SICP to SICORP: Support International Collaborative Research through a Variety of Forms and Policies

With today's rapid globalization, a number of problems exist across borders, including those involving the environment, energy, natural disasters, and infectious diseases. In order to deal with these problems, the Strategic International Research Cooperative Program (SICP) was launched in 2003. This program is poised to actively promote exchanges between researchers from different countries, regions, and fields based on a bilateral government agreement. Under an equal partnership, JST and the relevant institution of the partner country support the partner country's researchers.

Thereafter, since cooperation among researchers, a fusion of fields, and a further breakthrough in research based on new ideas were required for solving common issues in S&T in an increasingly international competitive environment, the Strategic International Collaborative Research Program (SICORP) was launched in FY2009 with 10 times as much support as that of SICP, enabling more strategic international cooperative research.

In the "Fourth Science and Technology Basic Plan" formulated in FY2011, SICORP was highly expected to become a useful tool for developing S&T diplomacy and for strategically promoting international activities that contributed to the creation of S&T innovation. In 2014, in response to this analysis, SICP was integrated into SICORP to promote the program with a variety of forms and methods. It is expected to contribute to the realization of open innovations through strategic and accurate guidance for international cooperative research with a director that oversees the whole program.

Additionally, the "Collaboration Hubs for International Research Program" was established in FY2015. This program is poised to form an open

Signing ceremony of a Memorandum on Research Cooperation with a partner country institution for SICORP (rear side: Prime Minister Abe and Prime Minister Netanyahu of Israel)

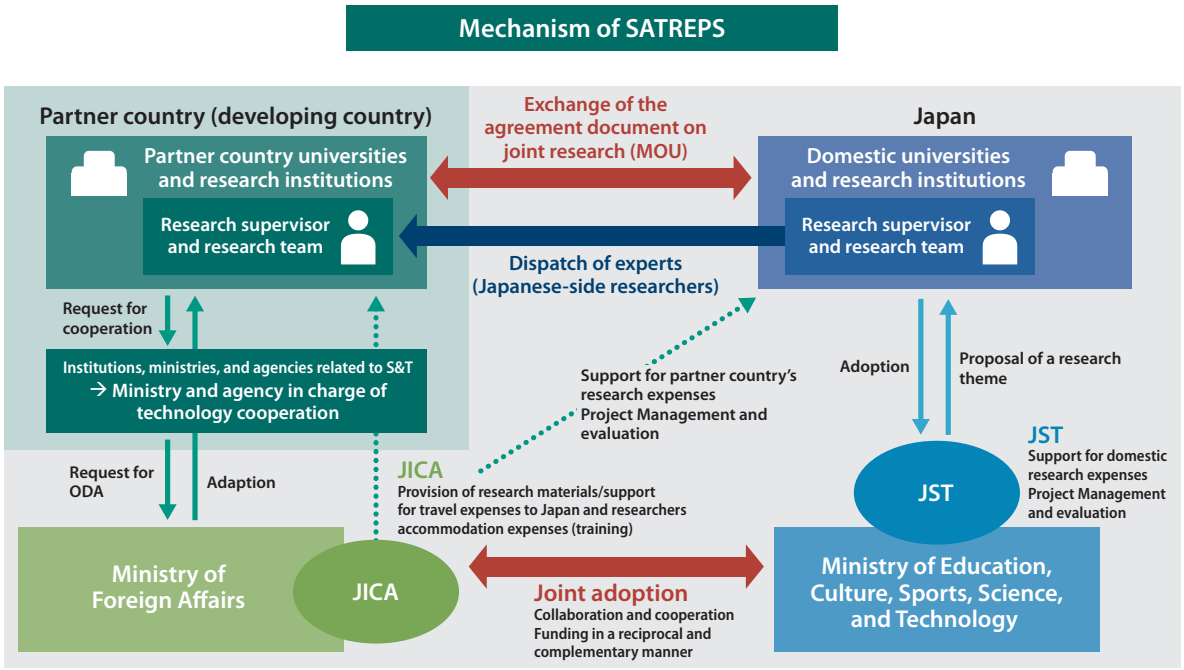
innovation center in a partner country and a region with which Japan has an important relationship in S&T diplomacy, with an aim to successfully organize joint research and disseminate its results. Premised on the commitment of the partner country's government and by making use of results of the conventional research cooperation and network to develop new collaborative research and lead to social implementation, it is expected that the program will enable Japan to pursue "visible" and sustained research cooperation.

Activities of SATREPS towards addressing Global Issues

In 2004, immediately after JST's Center for Research and Development Strategy (CRDS) was established, an examination of the idea of collaborative research with developing countries towards addressing global issues was conducted. Initially, collaborative research with Asian countries with rapid economic growth was considered from the perspective of resolving environmental and energy issues. However, in FY2005, the research areas were expanded to include natural disasters and infectious diseases in cooperation with those related S&T policies, and Special Coordination Funds for Promoting S&T were assigned to a project called "the Promotion of Science and Technology and Utilization of Results in Asia."

During the three-year project, the "Asian Science and Technology Forum" was held annually in Japan to exchange views and opinions with experts of each country on the overall idea of collaborative research. In addition, the "Asian Science and Technology Seminar" was held in various Asian countries by research area, in order to conduct in-depth discussions about specific research themes and promotion policies. In the meantime, the idea of "Science and Technology Diplomacy" was formed mainly by the Council for Science and Technology Policy and efforts to give shape to the policies were made by the government and other relevant agencies, including MEXT, the Ministry of Foreign Affairs (MOFA), and the Japan International Cooperation Agency (JICA).

In FY2008, Science and Technology Research Partnership for Sustainable Development (SATREPS), which is jointly promoted by JST and JICA, began by increasing the number of partner countries for collaborative research to ODA recipients. The greatest feature of SATREPS is the mechanism whereby JICA makes use of the ODA Technical cooperation to support the research of universities and research institutions of



SATREPS
Conducting a leading research project on underground storage and monitoring of CO_2 in Indonesia

partner countries and JST separately supports Japanese researchers.

A project is requested to MOFA of Japan for an ODA Technical cooperation through a partner country's government, while Japanese researchers submit research proposals to JST looking for competitive research funding. MOFA and JICA then review each project from the perspective of the ODA, while MEXT and JST review the project in terms of science merit from international collaborative research and eventually make a decision on whether to adopt or reject the project.

In the selection process, the budget details, feasibility, and both regional and national balances are taken into consideration along with effects on S&T and social implications. The research duration is three to five years and research expenditure is less than about JPY 100 million per year, of which JICA pays about two-thirds as an ODA and JST about one-third as a competitive research fund. This mechanism has drawn attention from Europe and the U.S. as a successful example of inter-ministerial programs.

The target research fields and areas are environment and energy, bioresources, disaster prevention and mitigation, and infectious diseases control, of which research on infectious diseases control has been transferred to the newly established Japan Agency for Medical Research and Development (AMED) as of FY2015. A total of 99 projects (101 if projects approved by AMED of FY2015 are included) with 43 countries were approved and implemented by FY2015. The number of applications is about 7 to 10 times the number of approved projects every year.

Nine years have passed since SATREPS was established. With the remarkable growth in developing countries and improvement in the levels of S&T during that period, the needs and expectations of SATREPS are changing. In addition to the social implementation of previously obtained results and application to third countries, SATREPS is expected to promote its program strategically and with flexible management, so as to meet the needs and adapt to the circumstances of partner countries.

Attempts of the e-ASIA JRP to Promote R&D and Research Human Capability in Asia

In order to implement the idea of the "East Asia Science and Innovation Area" listed in "the Fourth Science and Technology Basic Plan (2011)," e-Asia Joint Research Program (e-ASIA JRP) was launched in FY2012.

The eligible institutions to the program are the public funding organizations such as funding agencies, ministries and research councils etc. of the participating countries in the East Asia Summit (EAS), namely the ten ASEAN member countries plus Japan, China, Korea, India, Australia, New Zealand, the U.S., and Russia. Initially, 8 countries and 9 organizations among 18 countries announced their participation. The circle of cooperation soon expanded, and as of August 2015 the number of participants has risen to 12 countries and 17 organizations. More organizations from countries that have not yet participated are considering to participate. From Japan, in addition to JST, AMED joined as a member organization in April 2015.

The main activities of the e-ASIA JRP include supporting collaborative research through open calls for proposals among member organizations of more than three countries, promoting the exchange of researchers through events such as workshops, and inviting students studying abroad from countries of e-ASIA JRP member organizations using the Japanese Government Scholarship Program. In particular, collaborative research implemented with the support of public funding organizations from more than three countries is a unique characteristic of this program. This is a very ambitious initiative for a funding organizations from a country with little experience in bilateral collaborative research. However, the fact that institutions of each country can gain universal knowledge by conducting international research cooperation will contribute to the progress of international research cooperation in this region in the future, through the process of overcoming these difficulties.

The e-ASIA JRP is based on an equal partnership, and thus the responsibility of participating funding organizations is equal. As a result, they are expected to contribute in the same manner to the funding of research. Through the matching fund system, each funding organization supports researchers of its own country and the research theme agreed upon by all. In five collaborative fields ("nanotechnology and materials," "biomass and plant science," "health research," "disaster prevention," and "advanced interdisciplinary"), a total of 11 collaborative

research projects (nanotechnology and materials: 3, biomass and plant science: 1, health research: 7) have been approved as of May 2015. In addition, workshops in these five fields have been held in Singapore, Indonesia, Laos, Myanmar, Japan, and the Philippines. Although this program is more focused on the support of collaborative research, it is also an urgent task to foster human resources among the younger generation of S&T students in this region. Japan has started an initiative whereby JST and AMED, in collaboration with MEXT, accept students from research institutions participating in the program based on research themes supported by the e-ASIA JRP. These students are able to obtain a doctoral degree while contributing to the theme (Japanese Government Scholarships in the e-ASIA Joint Research Program framework). It is necessary for JST to encourage other participating countries to develop such a system in their countries. This would allow the reciprocal exchange of students among each of the participating countries.

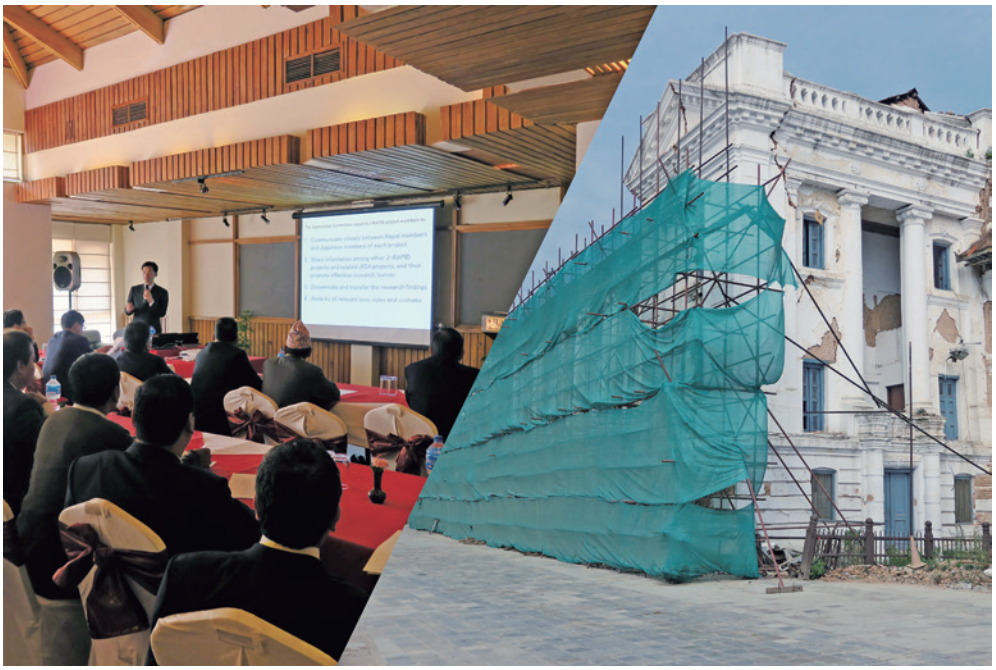
Activities of J-RAPID: Emergency Support for Unanticipated Events

After the Great East Japan Earthquake in 2011, researchers in the U.S. conducted investigations into the damage caused by the earthquake and the subsequent tsunami in response to the call for the implementation of an emergency research and investigation support program, Rapid Response Research (RAPID), by the National Science Foundation (NSF). JST established a program to support Japanese-side researchers in such initiatives. This new program was named "J-RAPID," based on the NSF's RAPID program.

This program targeted disaster prevention for earthquake and tsunami and safety of nuclear power and radiation. The J-RAPID program is characterized by quick decision making on funding, within a month or so after the application, and close cooperation with overseas research teams. With respect to the Great East Japan Earthquake, a total of 33 projects were approved after joint recruitment with the U.S., and later with France, Indonesia, and the U.K., to support Japanese researchers who were conducting research investigations in collaboration with researchers from the partner country. The program was subsequently used following the Kumamoto Earthquake, which occurred in April 2016.

The J-RAPID program was established in the wake of the Great East Japan Earthquake. However, due to recognition of its importance, the program became permanent. J-RAPID offers swift support in response to disasters occurring in other countries also, as well as undertaking any necessary research and investigation into emergencies involved natural disasters, human disasters, and outbreaks of infectious disease. When cooperating with foreign governmental agencies, JST provides support to collaborative research and investigation projects, such as after the flooding disaster that occurred along Thailand's Chao Phraya River in 2011, the Typhoon 30 that struck the Philippines in November 2013, and the Nepal earthquake that occurred in April 2015.

J-RAPID plays very important roles in gaining valuable amounts of data from disasters, proposing reconstruction plans for the devastated areas and other areas. J-RAPID projects begin quickly after a disaster and act as a bridge-builder until a full-scale research project is implemented or reconstruction work begins.



J-RAPID
Left: Workshop held in Kathmandu, the capital of Nepal, in October 2015
Right: Structure located in Durbar Square, a world heritage site that was damaged by an earthquake

Chapter 3

Connecting S&T with Society and Cultivating Human Resources

The Promotion of Public Understanding of Science and Technology was a new initiative established at around the same time as JST's launch in 1996. In the beginning, it was engaged in enhancing places for providing information on S&T extensively, and National Museum of Emerging Science and Innovation (Miraikan) was opened in 2001 as the base for this initiative. Thereafter, the focus of its activities was shifted towards the promotion of S&T communication and promotion of the "Science Agora," started in 2006 as a "square opened to all people to connect science with society." In addition, it implements a variety of initiatives for fostering the human resources of the next generation through promotion of science and mathematics learning, such as the support given to the "Support for Super Science High School (SSH)" and the "Supporting Student Contests in Science and Technology." Moreover, JST encompasses a wide variety of initiatives including the "SAKURA Science Plan," an exchange program in the field of S&T for young people of Asian countries, and a program to train program managers who will go on to play a central role in open innovation, among others.

The Promotion of Public Understanding on Science and Technology Provides a Variety of Opportunities to Support Familiarity with S&T

The "White Paper on Science and Technology – Youth and Science and Technology in 1993 edition," published in 1994, discussed the alienation of Japan's youth from S&T based on several survey results. The paper voiced concerns about the deficiency in human resources in the field of S&T from a long-term perspective, and the decrease of public interest in S&T was pointed out. Thereafter, the "enlightenment and dissemination of knowledge on science and technology" was stipulated in the Science and Technology Basic Law, enacted in 1995, and the "provision of a wide variety of opportunities to be familiar with S&T" and "promoting of the understanding of science and technology and raising interests" were shown in the First Science and Technology Basic Plan in 1996.

Under these circumstances, a plan "to disseminate knowledge and promote people's interest and understanding on S&T" was added to the act for the establishment of the JST in a new operational area. In 1996, JST established Department of Public understanding of Science and Technology and to start Projects for Promoting Public Understanding of Science and Technology, and in 2000, The program was strengthened its efforts.

When the program was first established, one of its main pillars was to create places where young people could get in touch with S&T, including the development of science museums, S&T experimental lectures, dialogues with researchers on research sites, and experimental S&T. In order to support the initiative of science museums across the country, JST implemented various efforts, such as collecting display ideas and manufacturing prototypes for museum exhibitions. Since 2002, JST has supported the development of a new exhibition method as well as programs and teaching materials, with a specific aim to promote cooperation between science museums and local schools. Through these efforts, JST promoted and strengthened the activities of science museums in Japan.

The "Science Ranger" was an initiative implemented to enhance experimental S&T lectures from the establishment of the program. Human resources versed in S&T, such as teachers and researchers, were registered as science rangers and were dispatched to science museums and schools in response to requests to provide experimental classes across Japan. These efforts were led by local

Science and technology lecture given by a Science Ranger

Science Channel Website

governments beginning in 2001, and JST supported the activities of science volunteers who gave lectures at experimental classes.

Since 1995, the (then) Science and Technology Agency runs the "Science Camp (for High School Students)" in which students receive direct instructions on experiments and apprenticeship training as well as lectures from researchers in a "training camp" style at its nine national research institutions. In 1997, in the wake of the expansion of efforts to national research institutions of other ministries and agencies, JST joined the program.

Starting in 1997, JST held the "Science and Technology Lectures" at which distinguished scientists introduced leading S&T to young people. This program later evolved into the "Science Discourse and Concert," a cultural fusion of science and music.

Moreover, a new initiative was introduced to enhance interests and awareness in S&T by providing content on these subjects to people of all ages and making use of new forms of media, such as the internet and satellite broadcasting.

The most representative initiative of this kind is the "Science Channel," which was designed to produce a variety of programs on S&T and disseminate them through satellite broadcasting and the internet. The Science Channel was trial-broadcasted using a communications satellite in 1998, with actual broadcasting beginning in 2000. In addition, internet streaming delivery began in 1999 (with broadband delivery starting in 2002). A series of popular programs were produced, including "The Making," which showed the technology used to make familiar products to convey the relationship between the origin of an object and S&T, as well as "Science News," which presented the latest topics on S&T. Since 2010, new programs have been produced, the majority with a duration of less than five minutes so that they are suitable for internet viewing.

From the Promotion of the Public Understanding of S&T to S&T Communication

The themes of "science for knowledge: knowledge for progress," "science for peace," "science for development," and "science in society and science for society" were incorporated as the responsibilities of science of the 21st century in the "Budapest Declaration," which was published at the World Conference on Science in 1999. Taking this into account, it was stipulated in the Second Science and Technology Basic Plan from 2001 that a channel would be built between S&T and society. Thus, JST opened National Museum of Emerging Science and Innovation (Miraikan) to serve as a base to connect people with S&T.

In the Third Science and Technology Basic Plan from 2006, the strengthening of accountability of S&T and information transmission, the promotion of the active participation of people in S&T, and the heightening of public awareness of S&T were proposed.

In order to share know-how through a network of people and organizations involved in science communication, as well as activities in various parts of Japan, JST shifted its focus from the conventional one-way information transmission to S&T communication activities in which a variety of people and organizations transmitted information bilaterally and would cooperate with each other. This transition was facilitated through the launch of the "Science Agora" in 2006.

In order to strengthen cooperation with a variety of people and organizations, JST reorganized "Department of Public Understanding of Science and Technology" into "Department of Science in Society Network" in 2009.

In the Fourth Science and Technology Basic Plan, greater focus was directed towards the relationship between S&T and society. JST established Center for Science Communication (CSC) in 2012 to conduct the program strategically from a longer perspective to suit the new initiative for science communication. CSC has conducted activities designed to allow a variety of people, including citizens, scientists, business operators, the media, and administrators to "create" a better society through dialogue and cooperation, in addition to the past activities aimed to "convey." CSC has also implemented efforts to in gain in society.

The "Science Window," launched in 2007, is a scientific magazine that aims to answer children's questions of "why?" and allow teachers and adults to think together, learn, and teach with fun. Currently, about 85,000 copies are distributed for free to elementary schools, junior high schools, high schools, special support schools, science museums, and other museums across Japan. In addition, the magazine can be browsed on the internet.

"Open Your Eyes to Science" and "See a Whole New World" through National Museum of Emerging Science and Innovation (Miraikan)

The development of attractive science museums and strengthening of museum networks, the publication of results of R&D, and the establishment of discussions to increase social interest were incorporated in the First Science and Technology Basic Plan from 1996. Taking this into consideration, three administrative organizations, the (then) Ministry of Education, Ministry of International Trade and Industry, and Science and Technology Agency jointly decided to build the "Tokyo Academic Park" in the area of the Tokyo Waterfront City in 1998. It was decided that JST would develop facilities to transmit information on S&T through the exhibition of leading S&T within the Academic Park, as well as assist with the development of exhibition methods and the exchange of researchers. In 2000, the "Center for Public Understanding of Science and Technology and the General Supervising Committee (tentative name)," composed of experts with Hiroyuki Yoshikawa (the then President of the Science Council of Japan) as the chairman of the committee, was established to conduct specific studies of the facilities, exhibition plans, and activity policies. On July 9, 2001, Miraikan was opened as the base to connect leading S&T with people.

Its slogan, "Open your eyes to science: See a whole new world" accurately reflects the attitude of Miraikan. The slogan does not only imply that science is learned for understanding by "opening your eyes to science," but also that people start to look at things from different angles by getting in touch with "new knowledge" from leading S&T. This is one of the concepts of "open your eyes to science."

To "see a whole new world" suggests that the world around you begins to look different after exposure to new knowledge, giving you the power to move the world towards prosperity. This slogan embraces the attitude of Miraikan to create a society in which people live wisely with "new knowledge." Its activities include fostering science communicators who connect leading S&T with society, and

National Museum of Emerging Science and Innovation (Miraikan)

Experiment workshop performed by Professor Hideki Shirakawa at Miraikan

who conduct cooperative activities between schools and science museums from both Japan and overseas. The activities consist of the following three main areas:

- **Science Communication** – The transmission of information on leading S&T and the developing methods for communication.
  A variety of methods, such as permanent exhibitions, special exhibitions, talk sessions, experimental classes, websites, publications, and videos are used to transmit leading S&T. At the same time, easy-to-understand methods of expression or communication are being developed in order to arouse interest of the general public in sophisticated and specialized S&T.
- **Fostering personnel** – Fostering of science communicators.
  Science communicators inside and outside of Miraikan are trained and fostered through original human resources fostering systems, based on "transmit science" hands on activities.
- **Creating connections** – Formation of eight networks.
  Researchers and engineers, the media, volunteers, Club Miraikan and visitors thereto, administrative agencies, schools, science museums of both Japan and overseas, and the industry are considered interfaces with which to build networks through activities between Miraikan and society.

Science Agora: Aiming for Science to Coexist with Society

In 2006, ten years after the start of the Projects for Promoting Public Understanding of Science and Technology, a number of lecture courses designed to foster science communicators were started in universities and science museums, and a variety of efforts were made by various organizations, including NPOs and companies. In order to give continuity to the efforts and contribute to the sound development of science and society in Japan, Science

Agora was established as the base for these overall activities. The past history of Science Agora is divided mainly into three phases.

The first phase was "the pioneering period," during which efforts were made to gain acknowledgement of the science communication idea and Science Agora from the general public. In 2006, at the time of Science Agora's establishment, the focus was on gathering together groups and individuals working independently across Japan to establish a system calling for proposals publicly, with applications chosen through a screening process. With a view of creating a space where, on one side, people related to science communication, policymakers of S&T, researchers, business people, NPO, individuals, and families were connected vertically; on the other side, where science communicators acting across Japan were connected horizontally, efforts were made to diversify participants, and a total of 1,500 to 2,000 people participated. Thereafter, energy was put towards internationalizing the event. In 2009, the event period was increased to four days and the number of participants increased to 8,705 people (since 2010, the event has been held for three days).

The second phase was "the first reform period," during which efforts were made to increase the diversity of participants. In 2010, with the intention of holding events throughout the year and regionally, JST held a smaller scale Science Agora on trial both in Osaka and Tokyo, with publicly recruited planning committee members aiming at opening up access to Science Agora. The following year, after the 2011 Great East Japan Earthquake, the role of Science Agora was reconfirmed as an event to enhance public trust in S&T, create a better society, and raise awareness of the mission of S&T.

The third phase was "the second reform period," during which there was a need to call for the further participation of scientists and the science community. The third phase is still ongoing as of 2016. In 2015, the vision of "Let us build a society harmonized with science" was adopted as that of Science Agora in order to clarify the requirements for embodying the vision.

In addition, JST reviewed the plan to hold the event throughout the year, which had previously been attempted in 2010, and started to prepare to hold the Science Agora throughout the year and connect it with other activities held across Japan. The event to be held in Odaiba in autumn was positioned as the annual event to promote dialogue and cooperation (co-creation) among a diverse group of stakeholders, with a view of creating a better society. The number of participants in 2015 was 9,145.

Since 2016, promotion of coordination between major science communication activities across Japan and Science Agora have been strengthened. JST started funding to the creation of local activities for science communication and for fostering human resources in 2007 and is currently

10 years since the establishment of Science Agora

focused on supporting multiyear activities to form networks between local governments, science museums, universities, and companies. Since 2014, JST has led the creation of activities in which certain stakeholders gather together to solve problems. As a result, promising regional bases are being developed. It is the aim of JST to promote the continuity and development possibilities of the respective activities by organically coordinating these bases and Science Agora.

In addition, nationwide organizations that manage and implement science communication share the vision of the Science Agora and support each other's activities to tackle issues. The program is aimed towards creating a framework for sustainable cooperation and coordination that allows related people to participate and provide support at any time.

Promoting Science and Mathematics Learning and Fostering the Next Generation of Human Resources

The "Promotion of Public Understanding of S&T" and the "Promotion of Learning on Science and Technology" were stipulated in the Science and Technology Basic Law of 1995 and in the First Science and Technology Basic Plan from 1996. The Guidelines for the Course of Study for elementary and junior high schools in 1998 (implemented since FY2002) and for high schools in 1999 (implemented since FY2003) were revised in order to shift education towards fostering "zest for life" in children and to let them learn and think by themselves. In addition, it was stipulated in the Second Science and Technology Basic Plan from 2001 to promote learning of S&T whereby children familiarize themselves with S&T with intellectual curiosity and a spirit of inquiry on their own account as well as acquire the ability to investigate, to perceive and think about things scientifically, and to understand the basic principles of S&T by conducting observation, experiments, and hands-on learning with a sense of purpose.

With the rise of momentum for the political promotion

of science and mathematics learning, MEXT was established as a result of the ministerial reorganization in 2001. In 2002, in order to make the most of the merits of the ministerial reorganization, MEXT's newly created "Plan to Become Fond of Science and Technology" was launched to comprehensively and integrally promote policies on the learning of S&T as well as science and mathematics.

Following these plans, the Support for Super Science High School (SSH) aimed to implement advanced science and mathematics learning and foster international human resources for S&T. Moreover, the Science Partnership Program (SPP) was designed to support learning through hands-on problem-solving activities, including observation, experiments, and training on science, technology, and mathematics.

JST launched the "Rika Network" initiative in 2001 to develop advanced digital content for S&T and science education tools for schools. On the other hand, in the wake of the transfer of support of SSH and SPP to JST (in 2003 and 2006 respectively), JST started an initiative to promote science and mathematics learning in earnest. In 2004, JST provided opportunities for developmental learning to children and students who were interested in S&T as well as science and mathematics. JST also began the Supporting Student Contests in Science and Technology with the goal of stirring up enthusiasm, improving competence, and fostering human resources capable of global operations in the field of S&T.

In addition, in the "Program for International Student Assessment (the second PISA)" of OECD, published in 2004, there was a shocking result in that both the rankings and scores of students fell far behind previous scores. Under such circumstances, it was stipulated in the Third Science and Technology Basic Plan from 2006 to implement the initiative from both viewpoints to foster children full of intellectual curiosity and improve the personality and competence of talented children. Since 2007, JST began initiatives, such as the "Science Education Assistant Program" and the "Program to promote scientific activities of junior high and high school students," for further enhancement of science and mathematics education in schools. JST also created the "Course to train future scientists," designed to strengthen personnel's capabilities and develop human resources who will bear the future, and the "Support for female Students in Choosing Science Courses," designed to foster female students' awareness in science.

In the Fourth Science and Technology Basic Plan from 2011, it was also stipulated to consistently promote the initiative to (1) increase the number of children who are fond of science and mathematics and (2) identify children with high potential and improve their competence. The "Japan High School Science Championships," in which nationwide high school students who are good at science gather to compete, and the "Japan Junior High School Science Championship," for junior high school students, were started in 2011 and 2013, respectively.

In 2014, the "Global Science Campus" was started as a new initiative specializing in identifying and improving the competence of students with outstanding talent. In this program, universities have developed and implemented sophisticated and systematic science and mathematics education programs with the cooperation of the region's community, including international activities that foster outstanding human resources for S&T who will play an active part in the world. In 2015, Promotion of Pre-University Research Activities in Science was created, whereby a plurality of programs for students and teachers, including SPP, were reviewed and reorganized for the promotion of active learning. Boards of Education and universities collaborated and cooperated in order to facilitate teachers and students proactively learning in a mutual relationship.

JST has promoted these programs while reviewing their implementation structure. In 2006, Department for Science Education Support was newly created to strongly promote programs for implementing measures to enhance S&T education and foster the next generation of human resources. These efforts were conducted independent of Department for Promoting Public Understanding of Science and Technology. In 2007, Center for Promotion of Science Education was established, and in order to demonstrate its role more effectively, aimed to explore necessary ways of supporting science education and to make use of its support program based on the actual conditions and needs of education and learning.

The Center has carried out investigative research on the basic ideas and necessary support for providing science education support as well as a mechanism to discover talents for science and mathematics. Thereafter, in 2012, in order to conduct an investigative research for fostering the next generation of human resources and to promote the efforts to support science and mathematics education in an integrated manner, Center for Science Education Support, which integrates Department for Science Education Support and Center for Promotion of Science Education, were established. From the perspective of focusing on the planning and implementation of programs, Center for Science Education Support was reorganized further in 2015 to create Department for Promotion of Science Education.

Department for Promotion of Science Education places focus on the further improvement of students with outstanding scientific thinking and spirit of inquiry as well as the strengthening of the "connection with the society," "globalization," and "best use of ICT," all in order to flexibly respond to abilities required by the era and to expand diversity.

"Support for Super Science High School" Aims to Foster Future Human Resources for S&T

The Support for Super Science High School (SSH) program is targeted at high schools and combined junior and senior high schools that focus on advanced science and mathematics education, as designated by MEXT. The program is designed to foster human resources for S&T that are endowed with a high level of creativity and expected to play an active role in the world through a variety of initiatives, including the development and practice of a curriculum focused on science and mathematics beyond the framework of the Guidelines for the Course of Study, promotion of task-oriented research, coordination and connection between high schools and universities, and the fostering of an international perspective.

At the time of the program's establishment in FY2002, a total of 26 schools were designated for a period of three years. However, in order to strengthen the initiative, the designation period was extended to five years from FY2005. The number of designated schools also increased to 100 in FY2007 and to over 200 in FY2013. As of 2016, 200 schools have been designated. In addition, a framework to promote key activities in a region (priority framework) was established in 2008, and 14 schools were designated. The priority framework continues despite changes in its form, and as of 2016, 17 schools have been designated to be included in the priority framework, which is designed to foster human resources for S&T as nodes in their respective regions.

Specific results have been achieved through these efforts. In 2015, SSH students implemented R&D in cooperation not only with universities, but also with high schools both in Japan and overseas; the results were published in an overseas research journal. In addition, the percentage of research projects in the SSH schools that are selected for final screening in task-oriented research contests such as the Japan Student Science Award and the Japan Science & Engineering Challenge (JSEC) is increasing. Moreover, the program has an influence on the career-path selection and the interest and enthusiasm of the SSH students. These students' likelihoods of enrolling in science and engineering-oriented universities as well as in graduate schools are generally higher in comparison with the average rate of non-SSH students.

The initiative to promote the fostering of an international perspective through exchanges between the SSH schools and overseas schools is active. Currently, a number of designated schools focus on English education as part of their R&D activities to actively implement overseas training, exchanges with high schools and universities overseas, and joint meetings for reading research papers and exchanging views and opinions.

The most outstanding school at the first SSH student presentation competition (2004)

Supporting the Science Olympiads through International S&T Contests

International S&T contests, including the Science Olympiads, are aimed at enhancing young people's interest, enthusiasm, and abilities in relation to S&T and nurturing outstanding human resources capable of playing a role in the world by allowing young people who excel in the field of S&T to compete in a global environment. The "Supporting Student Contests in Science and Technology," started in 2004, aimed to support these science and technology contests. JST selects the contests through open recruitment and provides support to implementing organizations for holding the contests nationwide and for participating in international contests.

Up to 2004, Japan had only participated in the international Science Olympiads in the fields of mathematics and chemistry; however, with JST's support in strengthening the participation structure in other subjects, it became possible to hold national contests in 7 major subjects, including physics, biology, information, earth science, and geography, and to send the representative students to international contests. In the meantime, the number of participants in the national contests of each Science Olympiad increased: over 19,000 students participated in the seven subjects. Nearly all Japanese students won medals in international contests, and it was a great feat for all 31 students to win medals, including eight gold medals, in 2015.

In addition, with increased interest, enthusiasm, and support from host organizations, such as academic societies, Japan itself began hosting the Science Olympiads. International competitions in biology, chemistry, geography and earth science were held in 2009, 2010, 2013 and 2016, respectively, for the first time in Japan. Representative from each country gathered together in the competitions and the events attracted social attention. International contests in information, biology, chemistry, and physics are scheduled

Won a gold medal and 3 silver medals were won in the International Biology Olympiads held in Japan in 2009

Urawa High School winning the first Japan High School Science Championships

to be held in Japan in 2018, 2020, 2021 and 2022, respectively.

"Japan High School Science Championships" Enable Nationwide High School Students to Compete with Each Other

In order to foster the human resources of the next generation for S&T, JST started the "Japan High School Science Championships" in FY2011. This program was established based on the record of its launch in the "New Growth Strategy Roadmap" of 2010. The program aimed to gather together high school students from across the country who were fond of science to compete in order to widen their perspectives and to contribute to the enhancement of their abilities through mutual improvement in a highly competitive environment.

This championship game is open to first and second year high school students. Representative teams that won the tournament held in 47 prefectures nationwide play against schools in competitions across multiple subjects such as S&T, science, and mathematics, and compete for the team's total score.

The Japan High School Science Championships is held in cooperation with the Board of Education, and the national championship is held jointly with the local government at the venue (Hyogo Prefecture and Ibaraki Prefecture). Prefectural competitions are organized by the respective prefectural Board of Education to thereby contribute to the expansion of perspectives of students who are fond of science. The number of participants has been increasing year by year, from about 5,700 in the first championship to about 8,300 in the fifth championship in FY2015.

In the wake of the success of the "Japan High School Science Championships," the "Japan Junior High School Science Championships" was held for junior high school students in FY2013. The Japan Junior High School Science Championships is held in close cooperation with the Board of Education, and prefectural championships are organized by the respective prefectural Boards of Education in the same manner as the Japan High School Science Championships. The number of participants has been increasing year by year and the number of participants, which was about 16,000 in the first championship, increased to about 23,000 in the third championship in FY2015.

Japan-Asia Youth Exchange Program in Science (SAKURA Science Plan)

As Japan pursues to lead the world in the field of S&T alongside with the rapidly growing Asian countries, it is vital for Japan to enhance exchanges and friendship with Asian counterparts, thus attracting promising human resources which tend to be lured to Europe and the U.S. as well as widening the network of human resources.

Further the government's initiative "300,000 International Students Plan" in "the 4th S&T Basic Plan (2011-2015)" stipulates a comprehensive initiative to acquire outstanding exchange students in a strategic manner.

Against a backdrop of these governmental moves, a short-term invitational program centering on S&T, the "Japan-Asia Youth Exchange Program in Science (SAKURA Science Plan)" started in FY2014. The program aims to contribute to the development of S&T in Asia and Japan by inspiring the interest of Asian youth in Japan's leading S&T and fostering outstanding human resources.

The program sets the age eligibility at 40 years old or younger and the program invitee include high school students, undergraduates, graduates, postdoctoral researchers, young teachers and professors.

In 2014, the first fiscal year of the program, the program welcomed aspiring youth from 10 ASEAN countries and China, Republic of Korea, Mongolia, and Taiwan. In 2015 India was added as a new eligible country

making the total number of eligible countries at 15. In 2016, the scope of eligible countries was expanded in response to the diplomatic policies of the government, and 20 countries were welcomed to the program, embracing 35 eligible countries and regions in Southeast Asia, Central Asia, and the Pacific regions.

As invitation results, in FY2014, a total of 2,945 people were invited. In FY2015, the number of people invited to the program amounted to a total of 4,226 people from 901 institutions. 391open application programs of exchange through public recruitment were approved and a total of 3,476 young people from a total of 507 institutions of Asia were accepted by 140 universities and research institutions across the country to deepen exchanges in each region of the program. Also JST directly invited 750 high school students and young officers and researchers.

People invited were almost fully satisfied with the program. In addition, 99.5% of accepting institutions considered them "outstanding," allowing some of them to come back to Japan for their studies. JST is poised to deepen exchanges with Asian youth and contribute to the development of S&T in Asia in the future.

Fostering Program Managers

In order to achieve innovation, it is indispensable to foster program managers (PM) in charge of the planning and management of R&D project. In the U.S., PMs play a leading role in programs in the Defense Advanced Research Projects Agency (DARPA) that produced innovative results such as the internet, while in Japan, PMs are being used in Impulsing Paradigm Change through Disruptive Technologies Program (ImPACT) started in 2015 by the Cabinet Office.

In the Industrial Competitiveness Council in 2014, several issues were raised as urgent, including strengthening of the "bridging" function, which rapidly converts innovative technological seeds obtained through open innovation from industry, academia, and government collaboration into commercialization by private companies, the fostering of PMs to serve as the bridge, and the formation of career paths.

In order to respond to demands and expectations, JST has started "Advanced Program for Program Manager's Candidate Hub," with the goal of nurturing PMs. This program is designed so that trainees recruited and selected from industry, academia, and the government can acquire necessary knowledge and skills in order to plan and implement a R&D program with advice from instructors (mentors). This is not a program designed to distribute simple knowledge, but a practical program to foster PMs.

In the Fifth Science and Technology Basic Plan from 2016, it is stipulated to introduce PMs in R&D management as a specific initiative to disseminate and expand an appropriate method for the promotion of challenging R&D, and JST will enhance and strengthen the program to achieve this objective in the future.

Sakura Science High School Program Participants (2016)

Chapter 4

Information Infrastructure for Innovation Creation

Spanning 60 years since the establishment of the predecessor of JST, the Japan Information Center of Science and Technology (JICST), JST has been engaged in the collection, development, and distribution of S&T information. Starting from the rapid and accurate provision of S&T information both inside and outside the country at the beginning of its establishment, JST has gradually expanded its services to the promotion and distribution of domestic academic journals in digital forms and the provision of a variety of information on research and expert knowledge, and has upgraded its provision methods, such as publication on the internet. In recent years, JST has contributed to the introduction of innovation in research institutions and industry and to the planning of S&T policies and R&D strategies by integrating information inside and outside JST and providing analyzed information. From now onwards, JST continues to develop services and programs in the context of the trend of open science.

JOIS, which Covers S&T Literature Information

Immediately after the establishment of the Science and Technology Agency in 1956, the industry sector and universities strongly appealed for the need to acquire and use S&T information from developed countries in order to develop Japan's industry and economy. Taking this into consideration, it was planned to establish an expert institution on S&T information and the Japan Information Center of Science and Technology (JICST), the predecessor of JST, was established in 1957. As the core institution of S&T information in Japan, JICST provided S&T information inside and outside Japan rapidly and accurately and contributed to the promotion and development of S&T in the country.

To start with, the "Current Bibliography on Science and Technology" was issued in 1958 based on information from academic society journals focused on fields in science and engineering inside and outside of Japan, with collections of conference papers and preliminary drafts, corporate research, technology information journals, and public materials as information sources.

Symposium Commemorating the 50th Anniversary of JST Information Programs

Secondary information on S&T provided by JICST served as an important information source and contributed to the strengthening of Japan's R&D capacity during a period of high economic growth.

The "JST Online Information System (JOIS)," a system for searching information prepared by "Current Bibliography on Science and Technology" online, was initiated in 1976. In the development of JOIS, the processing of Chinese characters by an electronic computer was successfully achieved and acted as a pathfinder for large-scale Chinese character databases. Thereafter, the amount of data was increased and resulted in the one of the largest S&T literature databases in Japan. Improvements in terms of functionality also continuously played a role in leading the development of an information system using a mainframe computer.

JICST also dealt with information provision through an international cooperation and opened the Tokyo Service Center of the STN International in 1987 to provide the world's major database through STN. STN is an international information network for S&T jointly operated by the U.S. (CAS: Chemical Abstracts Service), Germany (FIZ–K: Fachinformationszentrum Karlsruhe), and Japan (JICST), based on the online search system developed by CAS, the information service unit of the American Chemical Society.

In the 1990s, with the arrival of the Internet age resulting from the concept of the U.S.'s Information Superhighway, momentum increased worldwide for the development of information communication infrastructures. Along with the remarkable progress and dissemination of the Internet, information technology rapidly advanced. The age arrived in which the database

search service was provided on the web overseas. In 1997, in addition to the past command-based search, JOIS started a service whereby searches could be made on the screen through web browsers.

Since the start of the service in 1976, JOIS provided its service for 27 years based on the system developed independently by JST. It was renewed as a service to provide the database using the search system of STN through cooperation with CAS in April 2003.

JDream: New Development of S&T Literature Information

The provision of "JDream" was started in 2003 as a document retrieval system for users at educational and medical institutions such as universities and hospitals. In 2004, the system was expanded for use by public libraries and small to medium enterprises. In 2006, JOIS and JDream were integrated and developed into "JDream II," with dramatically improved functionality. With the start of the JDream II, JST transferred the STN service to the Japan Association for International Chemical Information (JAICI) in 2007 to reduce costs and improve business efficiency.

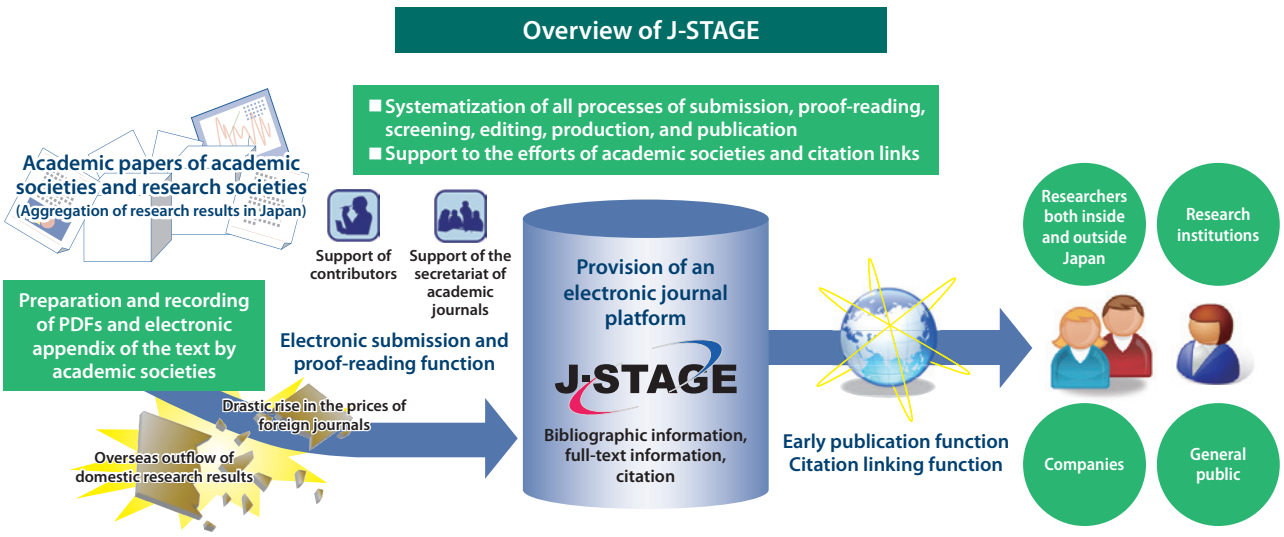
According to the "Review and Prioritization of Government Programs" implemented by the Government Revitalization Unit in April 2010, the services that provided document information, including JDream II, were transferred to the private sector. As a result, since March 2013, a new management system has been introduced wherein JST continues to prepare the contents of the database, while the private business operator G-Search Limited provides the database service under the title "JDream III."

Since JICST was established, JST has provided secondary information by compiling bibliographical details, including the title of the original paper, the name of the author, and the abstract (which is a summary of the paper) to contribute to the progress of R&D in S&T. In addition, in recent years, JST has focused on preparing a database where information is integrated and analyzed through inclusion of papers' citation information and developing of technique for identifying papers' authors. Taking advantage of its leading position, JST will introduce new technologies such as machine translation and automatic indexing for the preparation of databases in order to increase the number of provided contents and improve users' convenience.

J-STAGE Has Enabled New Provisions and Uses of Academic Information

S&T journals of Japanese academic societies were mainly published in paper media, and the advent of digitizing publications in Japan lagged far behind that of Europe and the U.S. Although the academic level of Japan was among the highest in the world, the country's information dissemination ability was weak. Due to these circumstances, the Japanese government employed a policy for information transmission and rapid distribution via electronic journals in 1998. Under the policy, the Japan Science and Technology Corporation (currently JST) developed a system whereby a continuous flow, from the submission of papers through proof-reading and review to publication on the Internet, is performed electronically. This is "J-STAGE," the Japan Science and Technology Aggregator, Electronic. J-STAGE is highly valued as Japan's largest platform for S&T information both inside and outside of Japan.

The operation of J-STAGE began in October 1999 and had gathered a total of 1,887 journals and about 2.7 million articles by September 2015. In 2005, an electronic archive program was launched in order to store past published papers that were considered valuable academic assets, including the research results of Nobel Prize laureates, as



well as to transmit information and strengthen distribution. The program was published on the "Journal@rchive." This is currently integrated into the J-STAGE 3, and all issues from the first to the latest issue are available for browsing in one site.

Moreover, in addition to the digitization and publication of academic journals, J-STAGE has a variety of functions, including the registration of DOIs (Digital Object Identifiers), which is the international content identifier, linkages with electronic journal sites and databases both inside and outside of Japan, linking citations, and an optional function of the electronic appendix. With these functions, J-STAGE plays a contributing role in innovation creation through the broad development of S&T article information and publishing and promoting the use of research results.

After J-STAGE's operation began, in response to the demand for system improvements, such as cost reduction, process rationalization, submission, proof-reading, and editing, the system was renewed and upgraded to "J-STAGE 2" in 2003. In addition, in light of the survey on the digitization of academic society journals of the 1,767 societies in Japan conducted by JST in 2011, a variety of improvements were made, including improvements to usability, further enhancement and reinforcement of the information dissemination ability in the world, renewal of design/user interface, transfer of database format into the XML-based international standard format, strengthening of subscription and sales management, and reduction in man hours required in the operation of academic societies. Following these improvements to the system, J-STAGE3 was inaugurated beginning in May 2012.

In the 21st century, the progress made in S&T and the internationalization of industry has advanced more rapidly than ever. In such a situation, it has become important to transmit Japan's outstanding research results to the world more quickly. This calls for a dissemination ability comparable to that of leading overseas S&T journals and academic journals. In particular, the importance of cooperation with Asian countries and globalization, a response to the oligopoly status of overseas publishing companies, the development of top journals made in Japan, the promotion of the use of the J-STAGE in the industry, and support for the independence of academic societies have been pointed out as subjects that require attention. It is a pressing issue to strengthen the global information dissemination ability of Japan's S&T papers as part of the promotion of open science, and JST strives to build a stronger open access platform equipped with advanced technology.

J-GLOBAL as a Base of Aggregate Knowledge

The "JST General Link Center of Basic Information for All Science and Technology (J-GLOBAL)" is a new service started in 2009 with the slogan of "connecting, spreading and inspiring." J-GLOBAL is designed to connect scattered S&T information in order to provide information tailored to the requests of the person using a search engine.

In addition to the S&T literature databases and patent information databases represented by the JOIS and JDream, J-GLOBAL recorded S&T information that provides resources owned by JST other than literature, such as persons (authors and inventors), institutions (institutions to which authors belong and patent applicants), S&T terminologies, and chemical substances. This fact responds to the "leading technology survey in R&D" and "search for partners in collaborative research and commissioned research," which rank high in a questionnaire asking for the desired purpose of use. J-GLOBAL also serves as a base for information analysis to promote the aggregation of knowledge beyond the boundaries of conventional fields and types of businesses, which is considered important for innovation creation.

In addition, J-GLOBAL does not only display whether authors or inventors recorded in a number of database are identical or not, but also enables the mechanic identification of co-authors, affiliated institutions and literature contents (keywords in titles). Furthermore, it allows associated achievement information such as papers registered by authors themselves and data recorded in research themes with literature, patents, persons, and institutions.

J-GLOBAL provides its function on the Internet, which enables contents recorded therein to be mechanically acquired (WebAPI) for other sites. The number of users shows a stable growth in coordination with the NDL search of the National Diet Library and Industrial Property Right Information as well as the J-PlatPat of the National Center for Industrial Property Information and Training (INPIT). The use of the J-GLOBAL via the WebAPI is also increasing.

Moreover, J-GLOBAL has links with a large number of institutional sites both inside and outside of Japan, which provide valuable scientific resources, including full-text electronic journals in cooperation with the J-STAGE and Japan Link Center (JaLC), full text patents in cooperation with private patent service vendors, chemical substance information (website of Japan Chemical Substance Dictionary), and genetic information (NBDC: the National Bioscience Database Center).

Another aim of JST is to build a new information analysis base, which is used in policy planning and R&D strategy by studying of all kinds of information assets owned by JST based on J-GLOBAL and publishing "J-GLOBAL foresight," which has proposed analytical methods and tools in a trial manner since 2011.

In addition, "J-GLOBAL knowledge" was released as a trial version in 2015 to incorporate a variety of S&T

information associated with the J-GLOBAL into the RDF (Resource Description Framework) by converting them into machine-readable open data that allows for easy use, greater cooperation with other institutions, and other analysis purposes.

JaLC for Connecting Academic Contents

The "Japan Link Center (JaLC)" was established in 2012 to encourage the use of domestic academic content by collecting bibliographic information (journals, authors, titles, etc.) of Japanese academic contents and improving the environment through which Japanese research results can be accessed from foreign countries. JaLC is the only Japanese institution accredited by the International DOI Foundation that manages DOIs (Digital Object Identifiers), which are the international identifiers assigned to electronic data. As of December 2015, a total 26 institutions and 1,080 institutions are registered as regular members and non-regular members, respectively, and a total of 3,140,873 documents, mainly academic papers, are registered with DOIs.

In addition, since the 1990s it was often difficult for researchers to acquire academic information due to the increased prices of overseas academic journals. Therefore, in order to promote open access generated in response to the diffusion of the internet and electronic journals, the idea of establishing the Japan Link Center was proposed in 2008 with the goal of building an interlinking structure mainly for academic papers. In June 2012, the Steering Committee, composed of JST, the National Institute for Materials Science (NIMS), the National Institute of Informatics (NII), and the National Diet Library (NDL), was set up to establish a joint management system, and the NIMS, NII, NDL, and JST began the project to jointly manage the JaLC in February 2013.

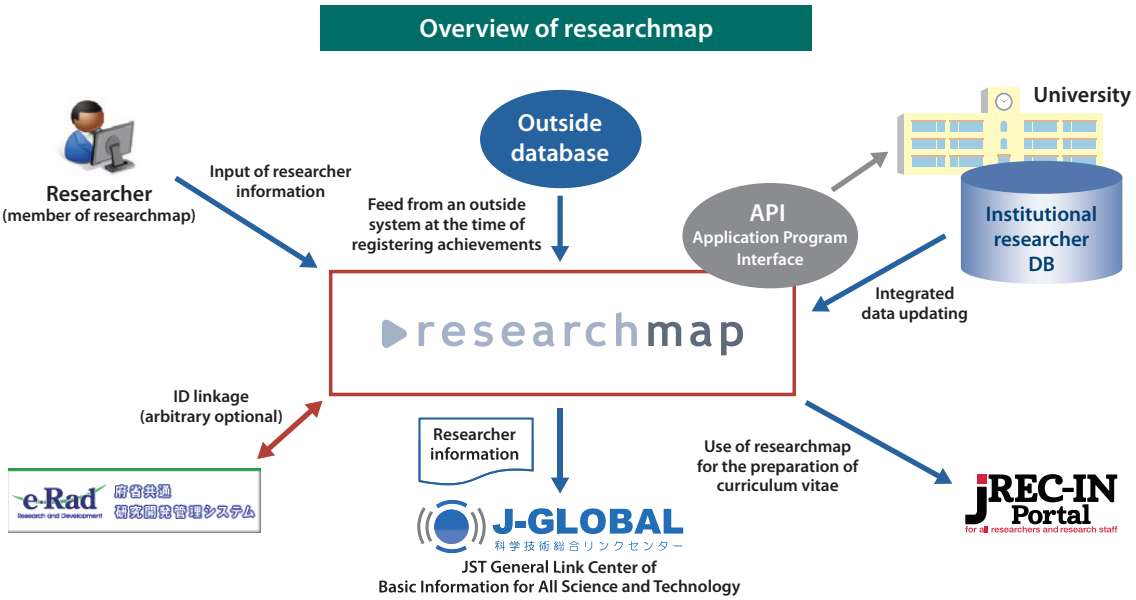
In 2014, in addition to academic papers, books, e-Learning materials, and research data were to be registered with the DOI with expansion of the system. Moreover, following the "Experimental Project of DOI Registration for Research Data" between October 2014 and October 2015 and in view of DOI registration tests by nine domestic research institutions and discussion at eight meetings, the "Guidelines for Registering DOIs for Research Data" were compiled.

A number of stakeholders and communities are involved in the JaLC. As a result, it is important to share the significance of DOI and the role to be played by the JaLC with them and search for a new use of DOIs.

"researchmap" – Comprehensive Database of Japanese Researchers

The "researchmap" is a comprehensive information sharing platform that covers the researchers of Japan, possessing information on a total of 3,381 research institutions and a total of 247,773 research documents as of April 1, 2016. This platform is widely used as an unparalleled free website in Japan that allows browsing of researchers' achievements. The operation of "researchmap" (ReaD & Researchmap at the time) began in 2011 as a registration/updating system for researcher information by integrating the Directory Database of Research and Development Activities (ReaD) and opened to the public in 1998. "researchmap" of the Research Organization of Information and Systems (ROIS) and NII started operations in 2009. In 2014, the name was changed to "researchmap."

This tool allows a researcher (or the affiliated institution) to update achievement information on "researchmap" as well as to register such achievement



information easily by making use of a feeding function that incorporates information already registered by an external database. As a result of cooperation with The Cross-ministerial Research and Development Management System (e-Rad) in 2013 and with the JREC-IN Portal in 2014, a total of 12 outside databases can currently be referenced. In addition, it also provides support for reciprocal provision of registered information and the compilation of a comprehensive researchers' list.

Furthermore, since "researchmap" allows linking to a university faculty members' database, it is possible for linked institutions to either use their own database (DB) as the master DB or to use "researchmap" as the master DB without owning their own DB. As of March 2016, a total of 176 institutions use the former option and a total of 87 institutions use the latter option.

"researchmap" will continue to improve coverage and enhance achievement information further using the information base owned by JST in order to serve as the master database of researcher information and an analysis base.

JREC-IN Portal to Expand Career Paths of Research-Related Human Resources

The "Japan REsearch Career Information Network Portal" (JREC-IN Portal) is a service aimed at developing the capacities of researchers and research-related human resources, such as research supporters and engineers, as well as supporting their careers. One challenge the JREC-IN Portal service faced was a S&T job shortage following the initiative to produce 10,000 post-doctorates, as put forward in the First Science and Technology Basic Plan from 1996. To overcome this and achieve the advanced S&T-oriented nation set out in the Second Science and Technology Basic Plan, there was an increased focus on the exploration of career-paths that would enable research-related human resources with high levels of education to play an active part in all scenarios related to R&D.

As a means to this end, JREC-IN, a site that provides information for recruitment of research-related human resources, was created in 2001. JREC-IN is based on the information for recruitment of research-related human resources of universities and Inter-University Research Institute Corporations from the National Center for Science Information Systems of the then Ministry of Education, as well as information for the recruitment of research-related human resources of national and public research institutions through Directory Database of Research and Development Activities (ReaD) of JST.

Thereafter, JREC-IN Portal was started anew in October 2014 as a portal site that puts together related information useful for career building of research-related human resources, including career support contents, research grant information, and information on events such as career seminars. As of March 2016, a total of over 105,000 users are registered and the number of newly listed positions exceeds 17,000 a year as a result of improvements in convenience of use by reflecting users' needs, including the function to enable a user to apply for a post on the web and use of linked ID with "researchmap."

Since it is required to disseminate and promote the fixed-term appointment system and public recruitment system in research jobs of universities and public research institutions, JREC-IN Portal is the only site in Japan whereby it is possible to obtain public recruitment information for research jobs in universities and public research institutions in Japan in a comprehensive and integrated manner. Additionally, with the diversification of human resources surrounding the research environment, information for research-related jobs such as research, research support and education in private companies, elementary, junior high, and high schools, overseas research institutions, and international institutions are listed.

From now onwards, the JREC-IN Portal is poised to develop and expand the system and data to contribute to integrated data analysis by further strengthening cooperation with related institutions both inside and outside of Japan and generating new added values and benefits as a part of knowledge infrastructure provided by JST.

From BIRD to NBDC: Integration of Life Science Databases

In June 2000, the sequence of the human genome was deciphered, and the genome sequences of many other organisms were also deciphered around the same time. As a consequence, post-genome-sequence research was intensified under immense international competition. Given these international trends, the then Panel on Life Science of the Council for Science and Technology discussed the strategy of genome informatics in Japan and recommended promotion policies of three issues: the fostering of human resources for genome informatics, the promotion of R&D, and database development strategy. Following these recommendations, JST launched Institute for Bioinformatics Research and Development (BIRD) in 2001 with the intent to promote development of databases and technologies for information analysis. In order to promote genome informatics by organizing a vast and wide variety of research data and finding useful knowledge from them, BIRD undertook efforts towards advancement and standardization of biological databases, and engage in creative R&D based on integrated knowledge of biology and informatics. Since many more databases than predicted were created at that time, in 2006 the working group on the database development strategy of the Life Science

Committee of the Council for Science and Technology compiled the development strategy of databases in the life science field. Taking this into consideration, MEXT launched the "Integrated Database Project" and established the "Database Center for Life Science" in the Research Organization of Information and Systems (ROIS) to deal with the planning of database development strategy, launch and operation of a portal site, and R&D for database integration.

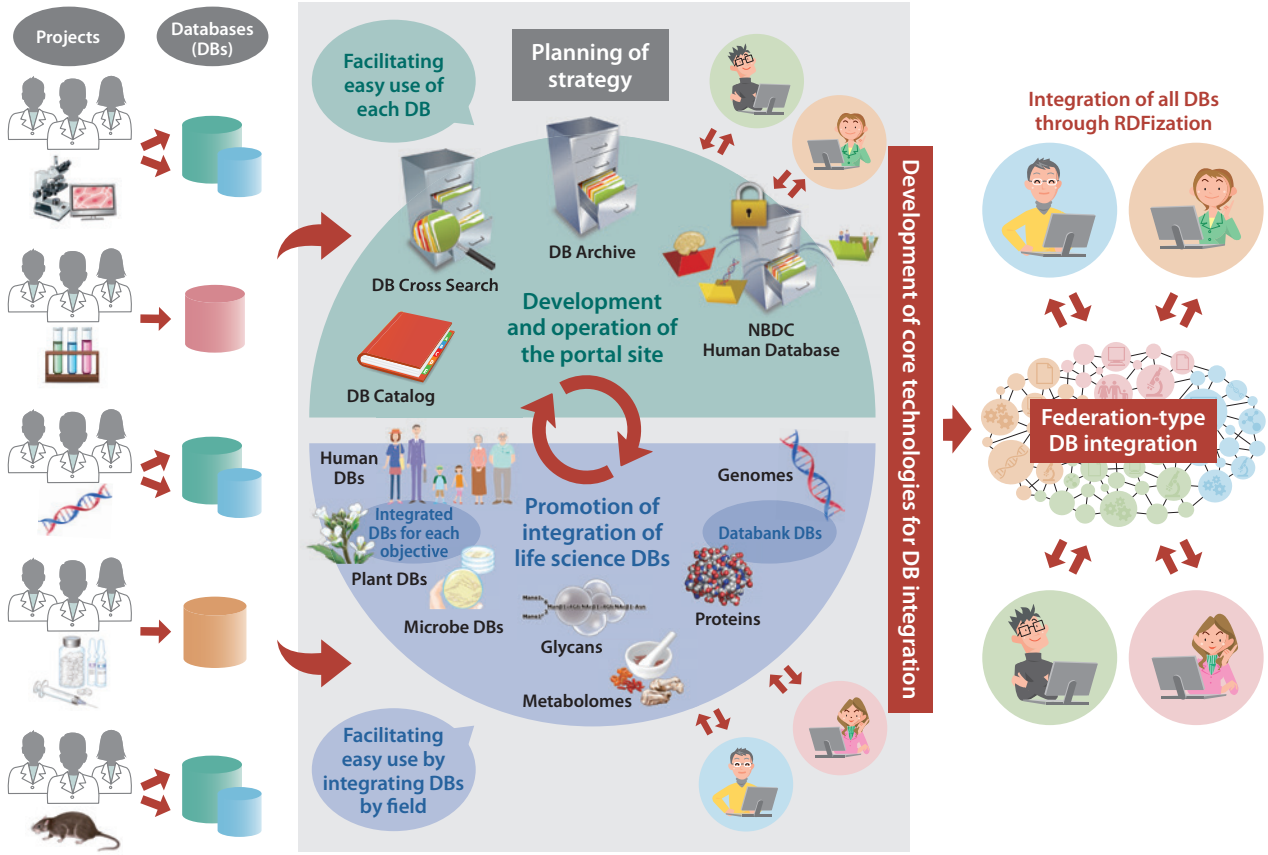
In 2009, the Life Science Project Team of the Council for Science and Technology Policy discussed the role of databases in the life science field and compiled the "Integrated Database Taskforce Report." JST established "National Bioscience Database Center" (NBDC) as a continuation of the BIRD program and the Integrated Database Project of MEXT in 2011. NBDC aims to develop fundamental technologies for database integration in order to build a comprehensive platform that allows for easy use of data generated by various research institutions related to life science. NBDC also aims for federation-type database integration that enables a unified use of scattered data and databases.

To date, JST has developed and provided (1) a database catalogue that summarizes the whereabouts information (URL) of domestic and foreign databases and various attributes (metadata) such as biological species, (2) database cross search that allows one-stop search across scattered databases, (3) a database archive which clearly shows terms of use to allow users to download databases without anxiety, and (4) guidelines and a human database to share human genome and other human-related information generated in major projects in Japan, while protecting personal sensitive information.

In addition, JST supported the construction of integrated databases that serve as the cores for each field of life science. Examples of supported databases include the Protein Data Bank Japan (PDBj), which constitutes the Worldwide Protein Structure Data Bank (wwPDB) as a member of the three poles of Japan, the U.S., and Europe, and the Kyoto Encyclopedia of Genes and Genomes (KEGG), which extracts information from literatures on molecular interaction networks that connects biological systems and is used worldwide as a high-quality integrated database.

In the future, JST will promote the further integration and use of databases so that life science data may be used in a unified manner to contribute to Life Innovation and Green Innovation, such as medicine, agriculture, and environment, in order to turn research results into social benefits.

Overview of the NBDC



Documents & Materials

List of Executive Official Terms

Operating Budgets by Fiscal Year

List of Major Completed Programs

List of Major Commissioned Programs

Report on Symposium Commemorating JST's 20th Anniversary

Chronological Timeline of JST Projects

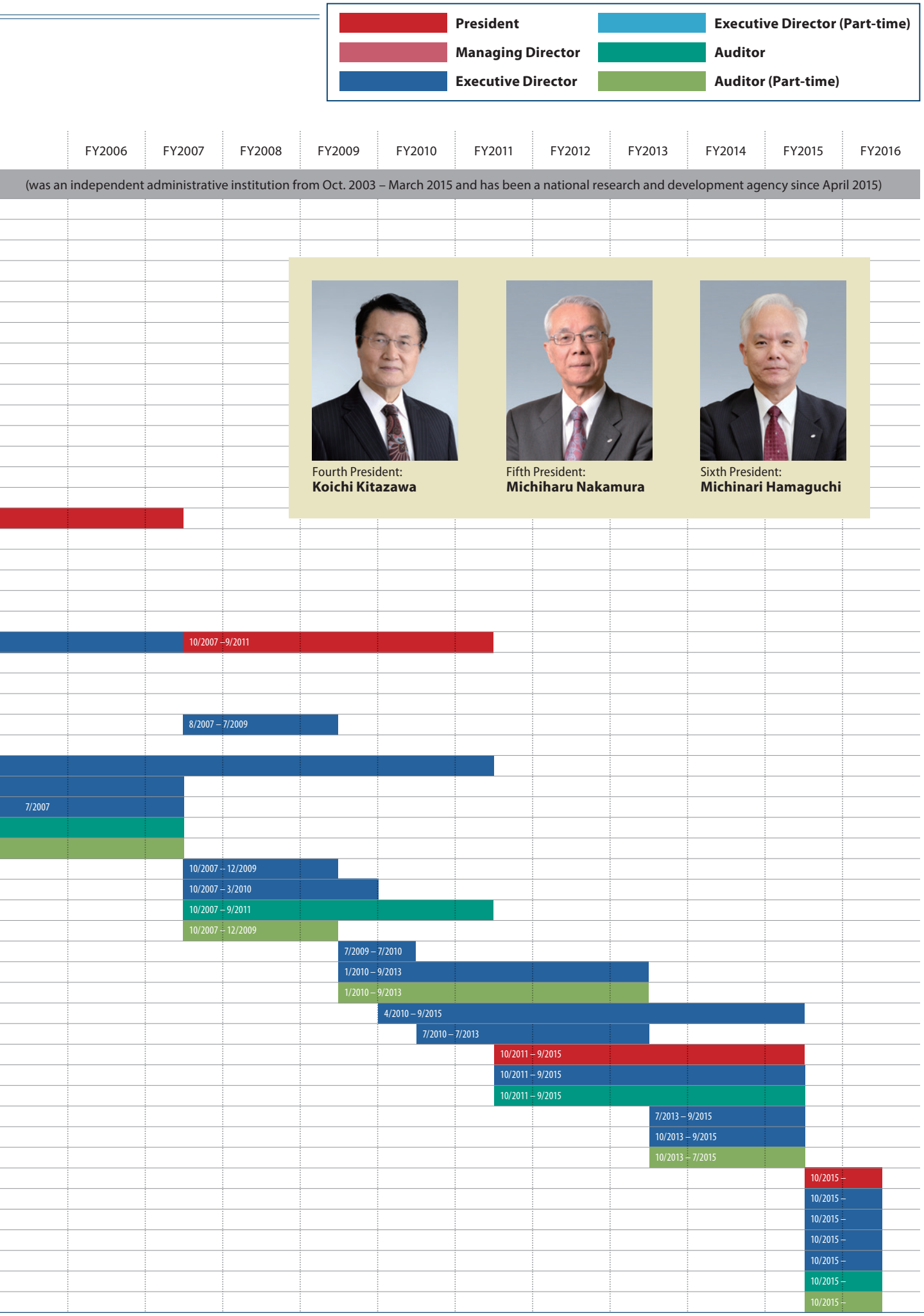
List of Executive Official Terms

	FY1996	FY1997	FY1998	FY1999	FY2000	FY2001	FY2002	FY2003	FY2004	FY2005
	Japan Science and Technology Corporation (Oct. 1996 – Sept. 2003)								Japan Science and Technology Agency	
Moritaka Nakamura	10/1996 – 12/1999									
Sumio Horiuchi	10/1996 – 4/1998									
Kazuo Saito	10/1996 – 12/1997	1/1998 – 5/1999								
Kohji Utsuno	10/1996 – 5/1999			5/1999 – 5/2002						
Yasuhiko Yasuda	10/1996 – 9/2003									
Masahiro Kawasaki	10/1996 – 12/1997			1/2000 – 7/2001						
Genya Chiba	10/1996 – 9/1998									
Yasuhiko Ezaki	10/1996 – 9/1998									
Mitsuyoshi Matsuo	10/1996 – 12/1997	1/1998 – 4/1998	5/1998 – 8/1999							
Mikio Murota	10/1996 – 9/2000									
Michio Ishiou	10/1996 – 9/2000									
Makane Shimizu		1/1998 – 9/2003								
Junichi Yamaji			5/1998 – 6/2000							
Kunihiro Inoue			10/1998 – 9/2002							
Yoshizo Inomata			10/1998 – 9/2003							
Kazuki Okimura				9/1999 – 7/2001	Corporation: 7/2001 – 9/2003; Agency: 10/2003 – 9/2007					
Rihei Nakamura				5/1999 – 5/2003						
Jiro Shibata					7/2000 – 9/2003					
Isao Usui					10/2000 – 9/2002					
Taizo Nishimuro					10/2000 – 9/2003			10/2003 – 9/2005		
Naotaka Oki						7/2001 – 9/2003				
Koichi Kitazawa							5/2002 – 9/2003	10/2003 – 9/2007		
Takeharu Takazono							10/2002 – 9/2003			
Takashi Sahara							Corporation: 10/2002 – 9/2003; Agency: 10/2003 – 9/2005			
Takashi Nitto							Corporation: 5/2003 – 9/2003; Agency: 10/2003 – 9/2005			
Minoru Kuniya								10/2003 – 3/2006		
Shunichi Hayashi								10/2003 – 9/2005		
Masahiro Fujiwara										10/2005 – 9/2011
Takao Hosoe										10/2005 – 9/2007
Hiroshi Nagano										3/2006 –
Kazuhiko Itayama										10/2005 – 9/2007
Yoshio Tateishi										10/2005 – 9/2007
Kenkichi Hirose										
Masayuki Mizukami										
Kimihiko Saito										
Hiroshi Kuwahara										
Shin Aoyama										
Takayoshi Mamine										
Mutsutake Otsuka										
Michio Obara										
Nobuaki Kawakami										
Michiharu Nakamura										
Noriaki Kamono										
Hiromi Hattori										
Satoru Otake										
Shoichiro Tonomura										
Norio Sasaki										
Michinari Hamaguchi										
Yoshiaki Ando										
Yoshimasa Goto										
Akira Koda										
Yoshiko Shirokizawa										
Shigeru Ishimasa										
Ryo Tokunaga										

First President:
Moritaka Nakamura

Second President:
Masahiro Kawasaki

Third President:
Kazuki Okimura


President
Managing Director
Executive Director
Executive Director (Part-time)
Auditor
Auditor (Part-time)
FY2006
FY2007
FY2008
FY2009
FY2010
FY2011
FY2012
FY2013
FY2014
FY2015
FY2016
(was an independent administrative institution from Oct. 2003 – March 2015 and has been a national research and development agency since April 2015)
Fourth President:
Koichi Kitazawa
Fifth President:
Michiharu Nakamura
Sixth President:
Michinari Hamaguchi
10/2007 – 9/2011
8/2007 – 7/2009
7/2007
10/2007 – 12/2009
10/2007 – 3/2010
10/2007 – 9/2011
10/2007 – 12/2009
7/2009 – 7/2010
1/2010 – 9/2013
1/2010 – 9/2013
4/2010 – 9/2015
7/2010 – 7/2013
10/2011 – 9/2015
10/2011 – 9/2015
10/2011 – 9/2015
7/2013 – 9/2015
10/2013 – 9/2015
10/2013 – 7/2015
10/2015 –
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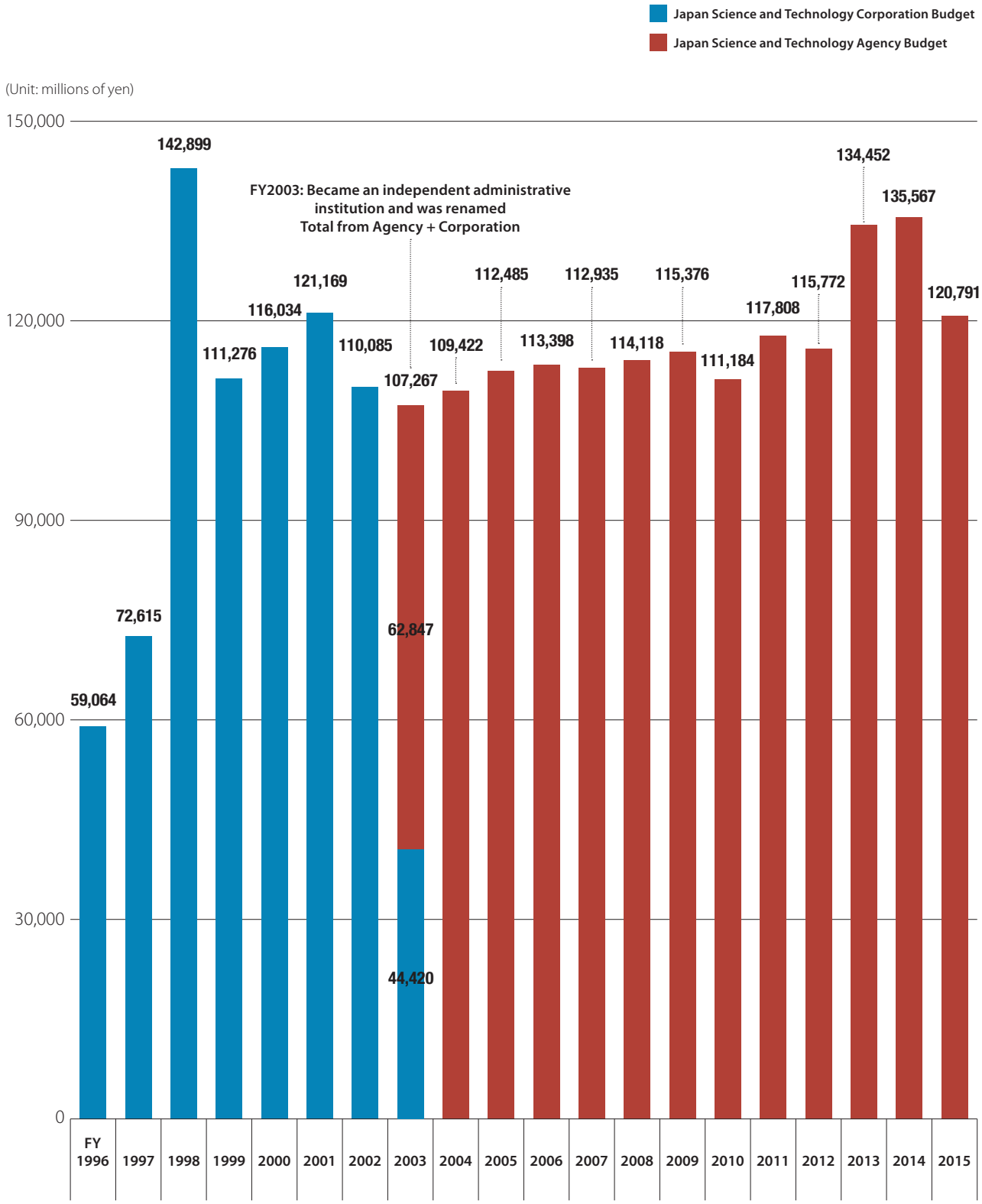
10/2015 –
10/2015 –
10/2015 –

Operating Budgets by Fiscal Year (Unit: millions of yen)



List of Major Completed Programs

Program Name	Program Period Years listed in parenthesis are the fiscal years during which JST's involvement in the program began
■ StrategicBasic Research Programs	
JST-CIRM Collaborative Research Program	FY2008 – FY2013
Yamanaka iPS Cell Project	FY2008 – FY2012
Transformative Research Project on Iron Pinictides (TRiP)	FY2008 – FY2011
International Cooperative Research Project (ICORP)	FY2000 – FY2014
Solution-Oriented Research for Science and Technology (SORST)	FY2002 – FY2010
Research Seeds Quest Program	FY2009 – FY2011
Virtual Laboratory in Nanotechnology Areas	FY2003 – FY2007
■ Research and Development for Supporting Humanitarian Demining of Antipersonnel Mines	FY2002 – FY2007
■ Research and Development for Applying Advanced Computational Science and Technology (ACT-JST)	FY1998 – FY2004
■ Cooperative System for Supporting Priority Research	FY1995 – FY2008
■ Modeling Project for New Concept of Technology	FY1997 – FY2008
■ Experiments for the Acquisition of Various Patent Rights	FY2000 – FY2005
■ Research Program on Development of Innovative Technology	FY2004 – FY2009
■ Intellectual Property Utilization Support Program	
Promoting Technology Transfer and Innovation	FY2010 – FY2012
Linking mechanism of research results to practical application	FY2007 – FY2009
■ Collaborative Development of Innovative Seeds	FY2006 – FY2008
■ Business Related to Cabinet Office	
Funding Program for World-Leading Innovative R&D on Science and Technology (FIRST)	FY2009 – FY2013
■ Industry-Academia Collaborative R&D Programs (Formerly Comprehensive Support Programs for Creation of Regional Innovation)	
Regional Science Promotion Program (RSP) Network Formation Model	FY1996 – FY2003
Regional Science Promotion Program (RSP) Research Result Training Model	FY1999 – FY2005
Research for Promoting Technological Seed	FY2005 – FY2009
Local Needs Response Model	FY2008 – FY2010
Practical Application Research	FY2001 – FY2011
Regional Research and Development Resources Utilization Type	FY2006 – FY2011
Innovation Plaza JST Satellite	FY2001 – FY2011
Collaboration Regional Entities for the Advancement of Technological Excellence	FY1997 – FY2004
Collaboration Regional Entities for the Advancement of Technological Excellence	FY2005 – FY2013
Japan Regional Innovation Strategy Program by the Excellence (J-RISE)	FY2009 – FY2013
■ Programs to Promote Science and Technology Information	
Standards for Information of Science and Technology (SIST)	FY1973 (FY1978) – FY2011
■ Project for Bioinformatics Research and Development	
Institute for Bioinformatics Research and Development (BIRD)	FY2001 – FY2011
■ Fostering Next-Generation Human Resources	
Science Camp	FY1995 (2006) – FY2014
Development of Science and Mathematics Education Program Linking to Society	FY2009 – FY2009
Future Scientist Program	FY2008 – FY2013
Regional Model Project for Fostering Children's Fundamental Science Literacy	FY2005 – FY2008
Science Education Assistant	FY2007 – FY2012
Science Partnership Program (SPP/Science classes for secondary schools)	FY2002 (MEXT) – FY2006 (JST) – FY2014
Project to Encourage Science Students	FY2007 (MEXT) – FY2013 (JST) – FY2013
Support for Training Science Students	FY2011 (MEXT) – FY2013 (JST) – FY2015
Project to Train Practical Research Leaders	FY2010 (MEXT) – FY2013 (JST) – FY2014
Science Teacher Training	FY2007 – FY2009
Establishing Training Centers for Core Science Teachers (CST)	FY2009 – FY2015
■ Programs for Promoting Science Communication	
Contest for Science Exhibits and Experiments	FY1996 – FY2001
Science Ranger	FY1996 – FY2000 (training for Science Rangers was carried out through FY2014)
JST Science& Technology Lecture	FY1997 – FY2000
Pilot Programs for Multimedia Application and Deveropment	FY1998 – FY2000
Science Discourse and Concert (in FY2009 the name was changed to Science Discourse and Arts)	FY2003 – FY2009
Support for National Networks	FY2009
GrassRoots Programs	FY1999 – FY2001, FY2010 – FY2011
Supporting Development of Science Centers	FY2007
Research Program for Public Understanding	FY2007
Support Program for Science Centers	FY2001 – FY2006
Developing Menus on Studying Robots and Science Experiments	FY2002 – FY2006
Rikadaisuki Volunteer	FY2003 – FY2007
Support Program for Researcher Outreach Activities	FY2005 – FY2006
Many Fascinating Teaching Materials (developing and disseminating enhanced materials in partnership with science museums and schools)	FY2001 – FY2004

List of Major Commissioned Programs

Program Name	Program Period
Emprical Study of Designing Specification for Food Composition Database	FY1996 – FY1998
Research on Databases for Data on the Properties of Chemical Substances on Ecosystems	FY1996 – FY1998
Survey on Expanding Research Results	FY1996 – FY1999
Consigned Operations via Special Accounting for Promoting the Development of Power Resources	FY1996 – FY2000
Basic R&D for Creating Databases and Network System of Biological Research Materials	FY1996 – FY2001
Preparation for the Initial Research Sight for Newly Establihing the Okinawa Institute of Science and Technology Graduate University	FY2003 – FY2005
Production of Nuclear Power Related Media Program	FY2003 – FY2005
Preserving and Providing Mutant Strains in Relation to Early Embryonic Development	FY2003 – FY2006
Distribution of Science Channel	FY2003 – FY2009
Support for Evaluations of the Special Coordination Funds for Promoting Science and Technology	FY2003 – FY2009
Support in Research on Future Key Technology	FY2005 – FY2007
Coordination Program for Science and Technology Projects	FY2005 – FY2008
Fukushima Top-Level United Center for Renewable Energy Research – Photovoltaics Innovation	FY2005 – FY2008
Support for Screening Consignment Fees for Innovative Nuclear R&D Program	FY2006 – FY2010
R&D on Japanese-Chinese/Chinese-Japanese Language Processing Technology (Special Coordination Funds for Promoting Science and Technology)	FY2006 – FY2010
Promoting Research for the S&T Project for Safe and Secure	FY2007 – FY2010
Funding Program for World-Leading Innovative R&D on Science and Technology (FIRST)	FY2010 – FY2013
Connection and Coordinating European Research and Development with Japan (CONCERT-Japan)	FY2012 – FY2013
Supporting the Promotion of Programs Related to Reforming S&T Systems	FY2012 – FY2013
The Center of World Intelligence Project for Nuclear S&T and Human Resource Development	FY2012 – FY2013
Program for Creating Start-ups from Advanced Research and Technology (START Program)	FY2012 – FY2014
Nanotechnology Platform	FY2012 – FY2021

Reports on Symposia Commemorating JST's 20th Anniversary

As part of the celebration of JST's 20th anniversary, we held five events (four commemorative symposia and a public dialogue) across Japan starting in 2015, on the theme of challenges facing S&T in Japan. These discussions elucidated the important indicators for JST in considering the future of S&T in Japan moving forward. We would like to extend our heartfelt gratitude to everyone who took the podium during the events.

Public Dialogue Commemorating JST's 20th Anniversary

Advice from Nobel Prize- Laireates Scientists to the Younger Generation: Paving the Way for the Next Era of S&T

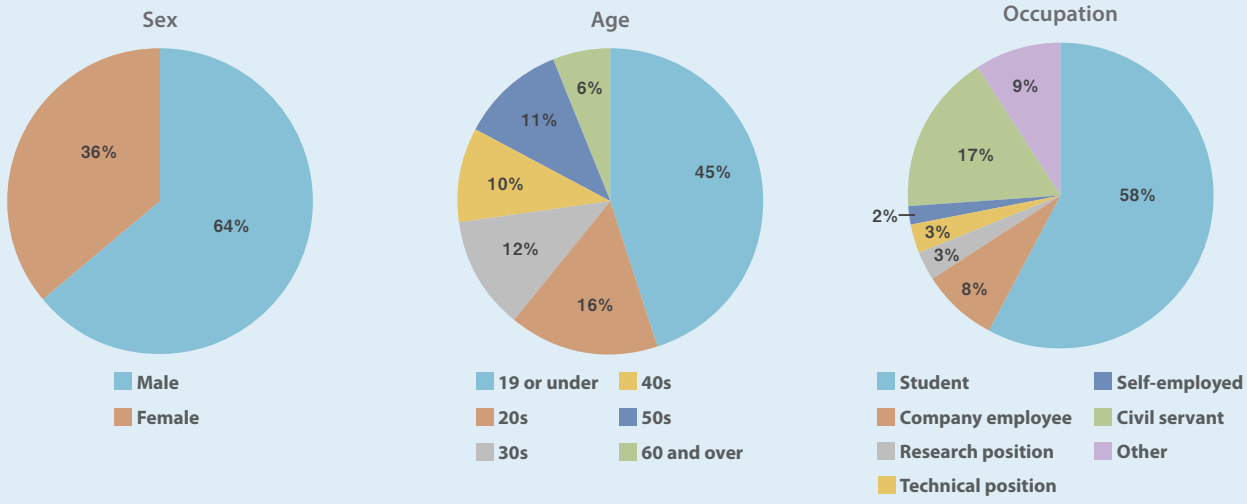
On January 9, 2016, JST invited Isamu Akasaki and Shinya Yamanaka, Nobel Prize- laureates scientists, to the Nagoya Marriott Associa Hotel to discuss their passionate ideas for the younger generation that will lead the coming era. The venue was packed with a crowd of more than 700 people, mainly from the younger generation, who enthusiastically listened to the two speakers with rapt attention.

To start, President Michinari Hamaguchi of JST greeted the crowd, saying, "S&T is indispensable for Japan. The future of Japan is in the hands of young people like yourselves." Continuing from this, the science journalist Atsuko Tsuji, who served as the facilitator kicked off the dialogue.

Both Nobel laureates have somewhat unique career histories. For instance, while many researchers perform research at universities in an unbroken succession, Professor Akasaki decided to become a researcher only after first working at a private company. Professor Yamanaka was first a clinician before becoming a researcher. The audience enthusiastically listened to their accounts of how they harnessed these experiences to attain the highest honors as researchers. Lastly, the two professors responded to questions from the young people at the venue, emphasizing the importance of "continuing on without quitting" and "having one's own unique point of view." Their messages full of hope for the younger generation deeply moved the crowd at the venue.

The dialogue was broadcast live on the internet via Niconico, where it was viewed by more than 20,000 people from around the country. Broad-based public understanding is crucial for laying the groundwork for S&T. The ways in which JST continues to promote its intermediary role between the general public and scientists will serve as a challenge for the future.

Results of a questionnaire distributed to the participants of the Public Dialogue Commemorating JST's 20th Anniversary

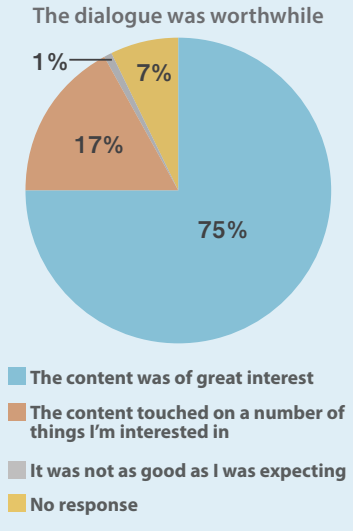


Public dialogue
Shinya Yamanaka, Director of the Center for iPS Cell Research and Application (CiRA), Kyoto University, and Professor at Kyoto University

Public dialogue
Isamu Akasaki, Tenured Professor at Meijo University / Professor Emeritus and Distinguished Professor at Nagoya University

Professor Yamanaka and Professor Akasaki responding to participants' questions.

Participants listening with rapt attention



Feedback from attendees (unaltered text of freely written responses)

Did listening to the dialogue change your way of thinking?

- Before hearing the dialogue, I was under the impression that Professor Yamanaka and Professor Akasaki had been researchers from the beginning and had performed research for a number of years, but I learned that Professor Yamanaka joined this profession after being a surgeon and Professor Akasaki joined from Fujitsu, where they accumulated many different experiences. I realized that it's important for me to go about accumulating lots of experiences as well. (Teens)
- I'm enrolled in a doctoral course as an adult student. The difficulty of balancing work and schoolwork makes me feel as though I'm being torn in half, but listening to this dialogue has made me think of making a fresh start and renewing my efforts once again. (20s)
- I learned the importance of thinking about what I truly want to do. From time to time, I'll ask myself this question and think about what the answer may be. (30s)
- I have been busy raising my children, but this made me realize each person should pursue something that interests them. (30s)
- I work as a teacher at a high school. I think of teaching as "sowing seeds." Today not only were the students given a "seed," but I was too. It furnished me with even greater boldness for performing my work from tomorrow on. (40s)

The two professors having a friendly discussion

A high school student asking a question

Professor Isamu Akasaki and Professor Shinya Yamanaka surrounded by the high school students that attended the public dialogue

A partial sampling of the opinions of participants

(unaltered text of freely written responses)

Were there any words or episodes from the dialogue that inspired you?

- The episode in which Professor Yamanaka became extremely excited when he got completely unexpected results in his experiments. (Teens)
- The idea of "learning conventional ways to be unconventional and break the conventionality" left an impression on me. (Teens)
- "Each and every one of the veils concealing the truth are equally important" (Professor Yamanaka). I studied humanities, and my occupation is civil service. The world of civil service is similar to science in that it takes time to do anything, yet these words made me realize that the time spent on these processes is not wasted time. (20s)
- I was impressed when Professor Akasaki said that, during his time at Matsushita, he met production engineering staff during meetings to discuss safety matters. (30s)
- Both professors shared the same way of thinking: following their curiosity without fear of failure. I have reaffirmed this as the way I should be when dealing with both my subordinates and my son. (40s)

Did you learn anything new regarding science and technology after listening to the dialogue?

- I learned that being a researcher takes more than simply conducting research in a university laboratory. (Teens)
- The fact that they performed research, not to receive a Nobel Prize, but were awarded the prize as a result of their efforts, resonated with me. (Teens)
- Organizing one's thinking when performing research can lead to even better results. (20s)
- I realized that the science is composed of numerous factors. (20s)
- Advances in S&T flourish as a result of incessant curiosity and a spirit of inquiry. We must all pursue these two attitudes, regardless of our age or gender. (60s)

Your opinions, if any, regarding the dialogue as a whole.

- Hearing their behind-the-scenes stories about receiving the Nobel Prize was interesting. I also thought that the discussion that immediately followed provided useful guidelines for how to act. (Teens)
- This will serve as a useful reference for me in performing my own research. I have continued to carry out the same research for more than a year and a half without producing any results that stand out. I envied the people around me that successfully completed their research projects one after another. Hearing today's lecture motivated me to keep on working a little further without giving up. (Teens)
- I feel that it boosted my awareness as one who will embark on future research. Listening to the professors' talk was a truly wonderful experience. (20s)
- It provided advice concerning not only S&T, but life in general. (40s)

First Symposium Commemorating JST's 20th Anniversary

New Challenges for Overcoming the Barriers between Companies and Universities: Aiming to Develop the Human Resources that Will Drive Society and Industry

The event was held on Friday, July 24, 2015, with a crowd of about 230 people gathering at the Marunouchi Building Hall & Conference Square in Tokyo. In the opening address, President Michiharu Nakamura of JST demonstrated an aim for the commemorative symposium as a whole, saying, "We will search for the subjects of JST with a focus on the next 20 years." A theme of the first symposium was "Cultivation of human resources." In his guest speaker address, Deputy Minister of MEXT Sadayuki Tsuchiya said, "Human resource cultivation is an extremely relevant theme," and he expressed his hopes for the symposium. Professor Eiichi Yamaguchi from Kyoto University Graduate School, who was a member of the planning committee for the symposium, talked about the symposium as a whole, while Professor Toru Asahi from the Faculty of Science and Engineering, Waseda University explained the panel discussion.

◉Keynote address

Human Resources in a Period of Transformation

Koichi Takanami (Executive Vice President, Dai Nippon Printing Co., Ltd.)

◉Panel discussion

(Panelists)

Tomomi Arakawa (Vic President, IBM Japan Ltd)

Keiji Kojima (Senior Vice President and Executive Officer, Hitachi, Ltd.)

Tetsuji Morino (Senior Managing Director, Dai Nippon Printing Co., Ltd.)

Shuichi Kawai (Specially Appointed Professor, Kyoto University Graduate School)

Shuji Hashimoto (Senior Executive Vice President for Academic Affairs & Provost, Waseda University)

(Moderator)

Takahiro Ueyama (Vice President, National Graduate Institute for Policy Studies)

Nowadays, as globalization is accelerating, new human resources are needed to lead the world by moving beyond the successful models of the past. These human resources must not only be furnished with outstanding expertise in specialized fields, but also broad-ranging knowledge and well-balanced refinement. Supportive measures are needed in order to develop these sorts of human resources in universities and in society.

Keynote lecture
Koichi Takanami, Executive Vice President, Dai Nippon Printing Co., Ltd. (DNP).

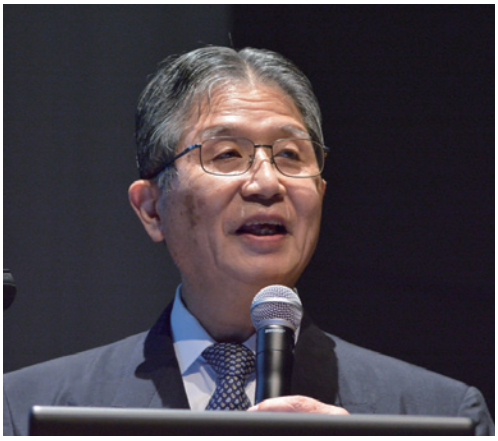
Panel discussion

A scene from the venue

Second Symposium Commemorating JST's 20th Anniversary

Discussing Innovation: What Are the Roles of Companies, Universities, and Public Research Institutions?

This event was held on Thursday, August 27, 2015, with a crowd of about 300 people gathering at Reception Hall A in the meeting room complex at Tokyo Big Sight in Ariake, Tokyo. In his greeting, President Michiharu Nakamura of JST said, "We would like to hold a discussion with representatives of every sector on development of innovation." The guest speaker, Director-General of Policy Planning (in charge of Science, Technology, and Innovation) Koichi Morimoto of the Cabinet Office once again emphasized the importance of innovation and the enormous role JST should play.



Keynote lecture
Akira Fujishima, President, Tokyo University of Science

◉Keynote address

Learn from Great People, and Create New Science!
Akira Fujishima (President, Tokyo University of Science)

◉Panel discussion

(Panelists)
Makoto Kimura (President, Nikon Corporation)
Hideko Kono (Professor, Graduate School, Yokohama National University)
Akira Fujishima (President, Tokyo University of Science)
Ryoji Chubachi (President, National Institute of Advanced Industrial Science and Technology (AIST))
Michiharu Nakamura (President, JST)
(Moderator)
Eiichi Yamaguchi (Professor, Kyoto University Graduate School)

For the sake of innovations that reform economic and social values, it is important to first reassess existing values and achieve a comprehensive alignment of trajectories towards the creation of new values. In order to achieve this, Pursuing knowledge and utilizing it are critical to achieve this. In order to make increasingly sophisticated and complex technologies produce innovations, systems that combine the wisdom of industry, academia, and the government will be necessary rather than counting on the individual organizations. It was reaffirmed that the mechanisms for continuously producing innovations must be examined as well as the measurements of support its realization should be reconsidered.

A scene from the venue

Panel discussion

Third Symposium Commemorating JST's 20th Anniversary

Aspiring to Take Great Strides into the Future: Venture Companies Will Save Japan

The third symposium was held on Tuesday, March 1, 2016, with about 300 participants at the Knowledge Capital Congrès Convention Center in the North Building of Grand Front Osaka. Following opening remarks by Executive Director Yoshiaki Ando of JST, Director-General Yoichi Ito of the Science and Technology Policy Bureau at MEXT gave a guest speaker address in which he said, "The Fifth Science and Technology Basic Plan emphasizes the importance of R&D designed to bring about disruptive innovation. It will most certainly be the venture companies that save Japan." He also gave his hopes for the discussion at the symposia.

A scene from the venue


Panel discussion


Keynote a lecture
Shojiro Nishio, President, Osaka University

◉Keynote address

Starting Up University4.0: Osaka University Vision Based on Openness

Shojiro Nishio (President, Osaka University)

◉Panel discussion

Venture Companies Will Save Japan: Challenges and Solutions

(Panelists)

Tsuyoshi Ito (President, Beyond Next Ventures Inc.)

Kiichi Kubota (President/CEO, PeptiDream Inc.)

Shinji Sogo (President & Representative Director, AdInte Co., Ltd.)

Yasunori Tsukahara (CSO, Microwave Chemical Co., Ltd.)

Mariko Tamura (Secretary General, The Japan Academic Society for Ventures and Entrepreneurs)

(Moderator)

Hideki Toyotama (Full-time Auditor, NAKANISHI Inc.)

Venture companies hold the key to connecting the new business environment with social needs and creating new industries. Such a new business environment is created by the change of social systems prompted by technological progress as well as by the new seeds found in research laboratories. In order to further expand and invigorate Japanese venture companies, we must establish concentrated initiatives that give total support to uncovering next-generation seeds and to young entrepreneurs.

Fourth Symposium Commemorating JST's 20th Anniversary

A Future Vision for Reconstruction Created by the Youth: How Should S&T Be Involved in Reconstruction?

The fourth commemorative symposium was held in the multipurpose hall of Corasse Fukushima, Fukushima City on Saturday, May 29, 2016, where it was a rousing success in that it was attended by a full house of 300 people. It has been five years since the Great East Japan Earthquake. Those involved in the reconstruction and local youths were invited from the regions of Tohoku, where reconstruction is still ongoing, to seek answers to the question of how S&T should be involved in the reconstruction.

In his opening address, President Michinari Hamaguchi of JST said, "If this symposium convinces even just one person here to work hard for reconstruction, then it will be a success." Director-General Yoichi Ito of the Science and Technology Policy Bureau at MEXT gave a guest speaker address in which he made reference to the Kumamoto Earthquakes by saying, "Rather than waiting for the future to arrive, we must create it," thereby placing his hopes in the younger generation. In addition, in a guest speech Vice Governor Toshiyuki Hata of Fukushima Prefecture said, "In 2020 we will advertise the recovery of Fukushima to the world." Governor Takuya Tasso of Iwate Prefecture and Governor Yoshihiro Murai of Miyagi Prefecture both delivered special video messages for the symposium, in which they spoke encouragingly of their initiatives for the reconstruction.

◉Special dialogue

Science 5, 50, and 500 Years in the Future: Considering Another Reconstruction

Toshihide Maskawa (Director General, Kobayashi-Maskawa Institute for the Origin of Particles and the Universe (KMI), Nagoya University)

Yoshihito Ozawa (Executive Director and Vice President, Fukushima University)

◉Keynote address

Global Reach via Support for Disaster-stricken Regions: Driving Social and Industrial Reforms through First-of-their-kind Innovations

Yoshiyuki Sankai (Professor, Institute of Systems & Engineering at the University of Tsukuba / Director, Center for Cybernics Research / President and CEO of CYBERDYNE, Inc.)

Special dialogue
Yoshihito Ozawa, Director and Vice President, Fukushima University

Keynote lecture
Yoshiyuki Sankai, Professor, Institute of Systems & Engineering at the University of Tsukuba / Director, Center for Cybernics Research / President and CEO, CYBERDYNE, Inc.

Special dialogue
Toshihide Maskawa Director General, Kobayashi-Maskawa Institute for the Origin of Particles and the Universe (KMI), Nagoya University

◉Speeches by high school students

Our Future Visions for Reconstruction

(Speakers)

Kaori Suda
Third-year student, Miyagi Prefectural Furukawa Reimei Senior High School

Yuta Kusaka
Second-year student, Fukushima Prefectural Futaba Future School

Yuki Watanabe
Second-year student, Fukushima Prefectural Asaka Reimei High School

Saki Anzai
Third-year student, Fukushima Prefectural Fukushima High School

Honoka Tamaki
Third-year student, Iwate Prefectural Morioka Daisan High School

(Moderator)

Tsutomu Okada (Professor, Fukushima University, Center for Research and Development of Education)

Rei Kato (Teacher, The Elementary School Attached to Fukushima University)

◉Panel discussion

The Near Future of Reconstruction and Beyond: Youth's Dreams Staked on S&T and Responding to Their Hopes for Reconstruction

(Panelists)

Yoshinobu Asao (President, Fukushima Gainax Co. Ltd.)

Minoru Saito (Representative of Minamisoma Science Labo)

Yasuhiro Nogayama (Teacher, Kyoto Junior School attached to Kyoto University of Education)

Keigo Hakozaki (2nd year grad student in the Graduate School of Science and Technology, Meiji University)

Rieko Hiradate (Director, KAI OTSUCHI Co. Ltd.)

(Moderator)

Yoshihito Ozawa (Director and Vice President, Fukushima University)

Panel discussion

◉Ending

String quartet comprised of four students from the Fukushima Prefectural Asaka High School Orchestra Club

The reconstruction of disaster-stricken regions has been a monumental task for Japan that has been carried out over a long period. Therefore, a discussion was promoted in which those involved in reconstruction in multiple different capacities can come together by placing emphasis on the young people who will serve as the driving force for this reconstruction.

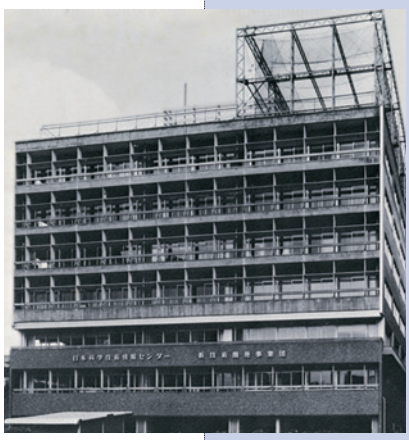
As part of this, support designed to widen the circle of new cooperation to include various people involved in the reconstruction will be needed. By touching on the enthusiasm that the younger generation in particular brings to reconstruction, the forum reaffirmed the importance of dialogue with the youth and of education in S&T. The finale consisted of a lively musical performance by high school students who volunteered, which was received enthusiastically.

This symposium was broadcast live on the internet via Niconico, where it was viewed by 27,000 people nationwide.

Professor Toshihide Masukawa and Professor Yoshiyuki Sankai surrounded by the high school students who attended the symposium

Chronological Timeline of JST Programs

FY	Organization	President	Program developments
FY 1996	Japan Science and Technology Corporation (Special public corporation)	Moritaka Nakamura (Oct. 1996 – Dec. 1999)	**Oct. 1996 - March 1997** • The Japan Science and Technology Corporation (JST) founded through the merger of the Japan Information Center of Science and Technology (JICST) and the Research Development Corporation of Japan (JRDC) • Overseas Research Fellowship launched • Project to Develop New Concept of Technology (Modeling project for New Concept of Technology) and Regional Science Promotion (RSP) Program launched • Projects for Promoting Public Understanding of Science and Technology (Science Rangers, science exhibitions, experiment demonstrations and idea contests, etc.) launched • Database Development Program launched • JOIS and STN services launched via the internet
FY 1997			**April 1997 - March 1998** • Comprehensive Database for the Creation of New Industries (ReaD, etc.) launched • Collaboration of Regional Entities for the Advancement of Technological Excellence (CREATE) launched • Patenting Support Services launched • Inter-Ministry Research Information Network (IMnet) Promotion System began operations • JOIS-IV service and JOIS with STN service launched • Malaysia Representative Office established • First New Technology Fair held in Tokyo
FY 1998			**April 1998 - March 1999** • Japan Science and Technology Information Aggregator, Electronic (J-STAGE), launched • Test broadcasts of Science Channel • DB of science and technology literature surpasses 12 million entries • First Japanese-American Frontiers of Science Symposium held (California, U.S.) • Research and Development for Applying Advanced Computational Science and Technology (ACT-JST) launched • JST Virtual Science Museum made available via the internet • Directory Database of Research and Development Activities (ReaD) opened to the public
FY 1999			**April 1999 - March 2000** • New Techno-Venture Oriented Research and Development (Pre-Venture Program) launched • RSP Research Result Training Model established • Japan Science and Technology Information Aggregator, Electronic system (J-STAGE), opened to the public
FY 2000		Masahiro Kawasaki (Jan. 2000 – July 2001)	**April 2000 - March 2001** • Solution-Oriented Research for Science and Technology (SORST) launched • Began offering J-STORE service • Technology transfer-related projects merged with Technology Transfer Facilitation Program • Project for polymorphism database development launched • Japanese Single Nucleotide Polymorphisms database (JSNP database) opened to the public • Human Organized Whole genome Database (HOWDY) opened to the public • Science Channel began broadcasting
FY 2001			**April 2001 - March 2002** • The Japan Atomic Energy Research Institute and the Japan Science and Technology Corporation established a coordinated cooperation structure to launch Research System for Science and Technology for Society and began Research and Development on Technology for Society

	JST Mid-term Plan	Science and Technology Basic Plan	Domestic and overseas developments	Prime minister
			April 1996 – March 1997 July : Dolly, the world's first cloned sheep, was born in Scotland July : Start of the Atlanta Olympics Dec. : The Hiroshima Peace Memorial (Genbaku Dome) and Itsukushima Shrine were registered as World Cultural Heritage sites March : PubMed opened to the public free of charge – : Competitive research funds introduced	Ryutaro Hashimoto (Jan. 1996 – July 1998)
			April 1997 – March 1998 April : Consumption tax raised to 5% July : Act on Organ Transplantation enacted, which states that "brain death constitutes the death of a person" July : Hong Kong returned to China Oct. : Nagano Shinkansen opened Dec. : Kyoto Convention on the Prevention of Global Warming held Feb. : Start of the Nagano Winter Olympics	
		First Science and Technology Basic Plan (FY1996 – 2000) ◉ **Plan to support 10,000 post-doctoral students** ◉ **Promote cooperation and exchange between industry, academia, and the government** ◉ **Promote the acceptance of foreign researchers** ◉ **Institute impartial evaluations** ◉ **Increase R&D investment by the government** **Target total investment Approximately 17 trillion yen [17.6 trillion yen in real terms]**	April 1998 – March 1999 May : Enactment of the Act on the Promotion of Technology Transfer from Universities to Private Business Operators (TLO Act) freed transfers of technologies patented by the government to the private sector July : Nozomi, Japan's first Mars probe, launched successfully Jan. : The European Union (EU)'s single currency, the euro, adopted by member countries Feb. : Financial Reconstruction Commission approved the injection of a total of 7.45 trillion yen in public money into 15 major banks	Keizo Obuchi (July 1998 – April 2000)
			April 1999 – March 2000 April : Start of the issuance of regional promotion coupons June : World Conference on Science held in Budapest Aug. : Act on Special Measures concerning Industrial Revitalization (Japanese version of the Bayh-Dole Act) promulgated Sept. : First critical accident occurred in Japan at the Tokaimura facility Jan. : Reached Jan. 1, 2000, for which there were concerns over the Y2K problem	
			April 2000 – March 2001 April : Civil Rehabilitation Act instituted June : 99% of the human genome decoded by America's Celera Corporation and a Japan-US-European international public project July : Okinawa Summit held Sept. : Start of the Sydney Olympics Oct. : Hideki Shirakawa awarded the Nobel Prize in Chemistry Jan. : Ministry of Education, Culture, Sports, Science and Technology (MEXT) launched as a result of a reorganization of central government ministries and agencies Jan. : Council for Science and Technology Policy launched Jan. : Basic Act on the Formation of an Advanced Information and Telecommunications Network Society (IT Basic Act) approved	Yoshiro Mori (April 2000 – April 2001)

FY	Organization	President	Program developments
	Japan Science and Technology Corporation (Special public corporation)	Kazuki Okimura (July 2001 – Sept. 2007)	• National Museum of Emerging Science and Innovation (Miraikan) opened • Nationwide deployment of Innovation Plaza (later the JST Innovation Plaza) • Domestic Research Fellowship Program, STA Fellowship Program, Collaborative Research Fellowship, Overseas Research Fellowship, and more were transferred to the Japan Society for the Promotion of Science • ITBL (Information Technology Based Laboratory) Materials Application launched • Project to organize the Failure Knowledge Database launched • Project for engineering CPD (Counting Proffessional Development) launched • Institute for Bioinformatics Research and Development (BIRD) established (start of the Institute for Bioinformatics Research and Development Program) • An English-Japanese machine translation system went into operation • JREC-IN opened to the public
FY 2002			**April 2002 - March 2003** • Strategic Basic Research Programs were reorganized • Start of Technology Transfer Facilitation Program • Beijing Representative Office established • JST Link Center began operations • Web Learning Plaza opened to the public • Began offering J-STORE Undisclosed Patent Information • Revamped ReaD opened to the public • Human Resource Development Program for Technology Transfer Fostering Specialist Skills launched
FY 2003			**April 2003 - March 2004** • The Japan Atomic Energy Research Institute's portion of Research System for Science and Technology for Society transferred to JST • Technology Transfer Support Center program launched, New Technology Presentation Meetings program launched • Intermediation Member System reorganized into Implementation Promotion Member System • The Usable Patent Scheme was reorganized into the Scheme for Supporting Patent Applications • Support Program for Creation University Ventures transferred from MEXT to JST • Center for Research and Development Strategy (CRDS) established to draft strategies for R&D • Japan Science and Technology Corporation reorganized into an independent administrative institution to become the Japan Science and Technology Agency (October 1, 2003) • JDream service launched, New JOIS service launched, J-STAGE2 launched, and the SIST project transferred from MEXT to JST • Digital distribution of teaching materials via Rika Network began • Support for Super Science High Schools (SSH) project transferred from MEXT to JST
FY 2004	Japan Science and Technology Agency (Independent administrative institution)		**April 2004 - March 2005** • Program for Development of Advanced Measurement and Analysis Systems launched, New Technology Presentation Meetings in Partnership with Universities newly organized • Innovation Japan (University Technology Exhibitions) held • Began offering J-STORE Information on Foreign Patent Application Support • *Journal of Industry- Academia-Government Collaboration* first published • Portal site for Industry-Academia-Government Collaboration and Database for Industry-Academia-Government-Collaboration launched • Failure Knowledge Database opened to the general public • Online Japan Chemical Substance Dictionary (Nikkaji Web) opened to the general public • Supporting Student Contests in Science and Technology began
FY 2005			**April 2005 - March 2006** • Project to develop "innovative seeds" launched • Regional projects reorganized as Comprehensive Support Programs for Creation of Regional Innovation • Program for Collaboration of Regional Entities for Advancement of Technological Excellence and the Research for Promoting Technological Seeds established • Full-scale adoption of Program Directors (PD) and Program Officers (PO) scheme for Development of Creative Technological Seeds • JST Satellite opened • Electric Archive Initiative "Journal@rchive" opened to the public • Research System for Science and Technology for Society reorganized, Research Institute of Science and Technology for Society launched
FY 2006			**April 2006 - March 2007** • Collaborative Development of Innovative Seeds launched • R&D Resource Usage Model newly established for Comprehensive Support Programs for Creation of Regional Innovation • Feasibility studies (FS) for Contract Development projects adopted, institutional reforms to revise repayment terms carried out, etc. • Commercial Development by Innovation Venture Companies: General Program developments

	JST Mid-term Plan	Science and Technology Basic Plan	Domestic and overseas developments	Prime minister
			April 2001 – March 2002 April : Freedom of Information Act enacted Sept. : First cow suspected to have contracted bovine spongiform encephalopathy (BSE) discovered in Japan Sept. : 9/11 terrorist attacks occurred in the U.S. Oct. : Ryoji Noyori awarded the Nobel Prize in Chemistry Nov. : Industry-Academia-Government Collaboration Summit held at the government's initiative Jan. : The euro, a European single currency, began to be circulated Jan. : Electronic notary system began operating	Junichiro Koizumi (April 2001 – Sept. 2006)
			**April 2002 – March 2003** May : Start of the Soccer World Cup hosted by South Korea and Japan June : Start of the Support Program for Creation University Ventures by MEXT Oct. : Masatoshi Koshiba awarded the Nobel Prize in Physics Oct. : Koichi Tanaka awarded the Nobel Prize in Chemistry Dec. : Intellectual Property Basic Act enacted March : Outbreak of the Iraq War	
	First JST Mid-term Plan (FY2003 - 2006) 1. Creation advanced technology 2. Promoting business using advanced technology 3. Promoting dissemination of S&T information 4. Research exchanges and research support 5. Promoting understanding of S&T by the public	**Second Science and Technology Basic Plan (FY2001 – 2005)** ◉Strategic Priority Setting in S&T ◉S&T system reforms to create and utilize excellent results ◉Internationalization of S&T activities Target total investment Approximately 24 trillion yen [21.1 trillion yen in real terms]	**April 2003 – March 2004** April : Japan Post launched May : Act on the Protection of Personal Information enacted Dec. : Outbreak of bovine spongiform encephalopathy (BSE) in the U.S., beef imports suspended	
			April 2004 – March 2005 April : Incorporation of national universities April : Teito Rapid Transit Authority privatized, Tokyo Metro launched April : New Tokyo International Airport Authority privatized, Narita International Airport launched May : Lay Judge Act established Aug. : Start of the Athens Olympics Dec. : Sumatra-Andaman Earthquake occurred Feb. : Kyoto Protocol issued March : World Exposition in Aichi, Japan (Aichi EXPO) held	
			April 2005 – March 2006 April : Across-the-board enactment of the Act on the Protection of Personal Information April : Full rescission of the deposit payoff system Oct. : Japan Highway Public Corporation broken up and privatized, six highway companies launched Oct. : A major earthquake occured in Pakistan Jan. : Japan Post Holdings launched	
			April 2006 – March 2007 April : Tensions in relations between Japan and South Korea over the Takeshima survey issue April : Terrestrial digital one-seg broadcasts launched Aug. : First Science and Technology Ministers' Meeting for the Asian Region	

FY	Organization	President	Program developments
	Japan Science and Technology Agency (Independent administrative institution)		• China Research Center established (renamed the China Research and Communication Center in 2013) • JDream II bibliographic search system service launched, information management website opened to the public • STN Service transferred to the Japan Association for International Chemical Information Acronym • Science Portal and Science Links Japan opened to the public • Full-scale launch of operations for "e-seeds.jp" • Start of Science Agora • Science Partnership Program (SPP) transferred from MEXT to JST
FY 2007			**April 2007 - March 2008** • 50-year anniversary since the launch of S&T information • Innovation Plaza renamed as JST Innovation Plaza • Commercial Development by Innovation Venture Companies: Drug Development Innovation Program launched • Linking mechanism of research results to practical application (Connecting Mechanism) launched • Center for Promotion of Science Education established • Science Window (a monthly publication) launched • Chinese Document Database (JST China File) service launched • Began offering Science Navi • Science Education Assistant program and Training to Improve the Instructional Abilities of Science and Math Teachers launched
FY 2008		Koichi Kitazawa (Oct. 2007 – Sept. 2011)	**April 2008 - March 2009** • 50th anniversary since the launch of technology transfer projects • Science and Technology Research Partnership for Sustainable Development (SATREPS) launched • Project for Open Innovation Seminar by Science and Technology Agency launched • Future Scientist Program, Support for Female Students in Choosing Science Courses, and Program to Promote Scientific Activities of Junior High and High School Students launched
FY 2009			**April 2009 - March 2010** • Strategic International Collaborative Research Program (SICORP) launched • Collaborative Development of Innovation Seeds Program and others reorganized and restarted in the form of the Adaptable and Seamless Technology Transfer Program through Target-driven R&D (A-STEP) • Strategic Promotion of Innovative Research and Development Program (S-Innovation) launched • Center for Low Carbon Society Strategy (LCS) established • Center for Intellectual Property Strategies established • Test (beta) version of J-GLOBAL (JST general link center of basis of all STI) opened to the public
FY 2010			**April 2010 - March 2011** • Advanced Low Carbon Technology Research and Development Program (ALCA) launched • Social Scenarios Study for Realizing a Low-carbon Society launched • Asia Science and Technology Portal (ASTP) established • Collaborative Research Based on Industrial Demand launched
FY 2011			**April 2011 - March 2012** • Japan High School Science Championships established • National Bioscience Database Center (NBDC) established • J-RAPID launched • J-GLOBAL Foresight opened to the public • Online version of Gakkai Meikan database opened to the public • ReaD merged with Researchmap (provided by the National Institute of Informatics) and was relaunched as ReaD & Researchmap

JST Mid-term Plan	Science and Technology Basic Plan	Domestic and overseas developments	Prime minister
		Oct. : The Akasaki Institute established to introduce the research achievements of Distinguished Professor Isamu Akasaki, who developed blue-light emitting diodes (LED) while at Nagoya University Jan. : Apple (US) launches the iPhone	
		April 2007 – March 2008 June : The subprime loan problem came to a head in the U.S. July : Niigata Chuetsu Offshore Earthquake occurred Oct. : Postal privatization began, and Japan Post Holdings was launched Nov. : Shinya Yamanaka et. al. from Kyoto University succeeded in creating human iPS cells Jan. : Cross-ministerial Research and Development Management System (e-Rad) began operating	Shinzo Abe (Sept. 2006 – Sept. 2007)
	Third Science and Technology Basic Plan (FY2006 – 2010) ◉ Developing, securing and activating human resources ◉ Creating scientific development and persistent innovation ◉ Reinforcing the foundation for promoting S&T ◉ Strategically promoting international activities **Target total investment Approximately 25 trillion yen [21.5 trillion yen in real terms]**	April 2008 – March 2009 July : Second Science and Technology Ministers' Meeting for the Asian Region Aug. : Start of the Beijing Olympics Sept. : 2008 "Lehman Brothers Shock" financial crisis Oct. : Yoichiro Nambu, Makoto Kobayashi, and Toshihide Masukawa awarded the Nobel Prize in Physics Oct. : Osamu Shimomura awarded the Nobel Prize in Chemistry Jan. : Barack Obama inaugurated as President of the USA	Yasuo Fukuda (Sept. 2007 – Sept. 2008)
Second Mid-term Plan (FY2007 – 2011) 1. Creation advanced technology 2. Promoting business using advanced technology 3. Promoting dissemination of S&T information 4. Research exchanges and research support 5. Promoting understanding of S&T by the public		April 2009 – March 2010 May : Start of the lay judge system July : Revised Act on Organ Transplantation enacted, which acknowledges that brain death constitutes the death of a person Sept. : Consumer Affairs Agency launched Sept. : Change of administration to the Democratic Party Nov. : Review and prioritization of government programs by the Government Revitalization Unit Jan. : Japan Pension Service launched	Taro Aso (Sept. 2008 – Sept. 2009)
		April 2010 – March 2011 May : iPad went on sale in Japan June : Payments of child allowances began June : The Hayabusa asteroid probe returned Oct. : Akira Suzuki and Ei-ichi Negishi awarded the Nobel Prize in Chemistry Jan. : China released its GDP statistics for 2010, surpassing Japan to take the No. 2 spot globally March : The Great East Japan Earthquake occurred March : The accident at the Fukushima Daiichi Nuclear Power Plant occurred	Yukio Hatoyama (Sept. 2009 – June 2010)
		April 2011 – March 2012 July : The Japanese women's team took its first victory in the 2011 FIFA Women's World Cup in Germany July : Terrestrial analog broadcasts terminated, transition to terrestrial digital broadcasts completed July : Unprecedented flood damage occurred in Thailand, with the damage expanding to include Japanese companies Oct. : World population surpassed 7 billion people Feb. : Reconstruction Agency launched	Naoto Kan (June 2010 – Sept. 2011)

FY	Organization	President	Program developments
FY2012	Japan Science and Technology Agency (Independent administrative institution)	Michiharu Nakamura (Oct. 2011 – Sept. 2015)	**April 2012 - March 2013** • JST Center for Revitalization Promotion established • e-ASIA Joint Research Program launched • J-GLOBAL opened to the public (test version opened to the public in 2009) • Japan Link Center (JaLC) established • Plaza / Satellite operations concluded • J-STAGE 3 launched • Document information service transferred to the private sector • Life Science Database Integration Project, Human Data Sharing Guidelines enacted • Next-generation Scientist Cultivation Program launched
FY2013			**April 2013 - March 2014** • Research Center Network for Realization of Regenerative Medicine launched • ACCEL Program launched • Next Generation Technology Transfer Program (NexTEP) launched • Center of Innovation (COI) Program launched • Began providing data to JDream III, a service that offers bibliographical information under a private business operator • Japan Junior High School Science Championships established
FY2014			**April 2014 - March 2015** • Japan-Asia Youth Exchange Program in Science (SAKURA Science Plan) launched • SUpport program of Capital Contribution to Early-Stage companieS (SUCCESS) launched • JREC-IN and Web Learning Plaza merged, JREC-IN Portal opened to the public • ReaD & Researchmap renamed as researchmap • Barack Obama, the 44th President of the United States of America, visited the National Museum of Emerging Science and Innovation (Miraikan) • Global Science Campus launched
FY2015	Japan Science and Technology Agency (National research and development agency)		**April 2015 - March 2016** • Name changed to the National Research and Development Agency from the Japan Science and Technology Agency (April 1, 2015) • Program for Creating STart-ups from Advanced Research and Technology (START) transferred from MEXT to JST • Adaptable and Seamless Technology Transfer Program through Target-driven R&D (A-STEP) reorganized • Promotion of Pre-University Research Activities in Science launched • Advanced Program for Program Manager's Candidate Hub launched • JST Project Database and J-GLOBAL knowledge (test version) opened to the public • JST Document Delivery Service ended / JST Library in Tokyo closed • Japan Information Platform for S&T Innovation, a homepage on new information projects, opened to the public
FY2016		Michinari Hamaguchi (Sept. 2015 –)	**April 2016 -** • Center for Materials Research by Information Integration established a consortium • J-STAGE evaluation version opened to the public

JST Mid-term Plan	Science and Technology Basic Plan	Domestic and overseas developments	Prime minister
			Yoshihiko Noda (Sept. 2011 – Dec. 2012)
	Fourth Science and Technology Basic Plan (FY2011 – 2015) ◉ Realization of Sustainable Growth and Societal Development into the Future ◉ Key challenges to the Priority Issues Facing Japan ◉ Enhancing Basic Research and Human Resource Development ◉ Development of Policy Created together with Society Target total investment Approximately 25 trillion yen	April 2012 – March 2013 May : Tokyo Skytree opened July : Start of the London Olympics Sept. : Nuclear Regulation Authority launched Oct. : Shinya Yamanaka awarded the Nobel Prize in Physiology or Medicine Jan. : Special reconstruction income tax imposed (lasting through 2037) March : Reciprocal use of ten types of traffic IC cards launched	
The Third Mid-term Plan (FY2012 – 2016) 1. Planning of research and development strategy for the creation of innovation 2. Creation of innovation (1) Promoting the creation of innovation (2) Building infrastructure for the creation of innovation		April 2013 – March 2014 June : Mount Fuji registered as a World Cultural Heritage site July : Stock markets from the Tokyo Stock Exchange and Osaka Securities Exchange merged Sept. : Tokyo selected as the host city for the 2020 Olympic and Paralympic Games Dec. : "Washoku, traditional dietary cultures of the Japanese" registered to the UNESCO Representative List of the Intangible Cultural Heritage of Humanity Dec. : The number of foreigners visiting Japan surpassed 10 million in a year for the first time ever March : Abeno Harukas, Japan's first high-rise complex building, completely opened	
		April 2014 – March 2015 April : Consumption tax raised to 8% June : Comprehensive Strategy on Science, Technology and Innovation 2014 enacted July : Cabinet decision reached approving the use of Japan's right to collective defense Oct. : Isamu Akasaki, Hiroshi Amano, and Shuji Nakamura awarded the Nobel Prize in Physics	
		April 2015 – March 2016 June : Comprehensive Strategy on Science, Technology and Innovation 2015 enacted Sept. : Security-related laws enacted at the plenary session of the House of Councillors Oct. : Takaaki Kajita awarded the Nobel Prize in Physics Oct. : Satoshi Omura awarded the Nobel Prize in Physiology or Medicine Jan. : National identification number system launched	Shinzo Abe (Dec. 2012 –)
	Fifth Science and Technology Basic Plan (FY2012 – 2021) ◉ Acting to create new value for the development of future industry and social transformation ◉ Addressing economic and social challenges ◉ Reinforcing the "Fundamentals" for STI (science, technology, and innovation) ◉ Establishing a systemic virtuous cycle of human resources, knowledge, and capital for innovation ◉ Deepening the relationship between STI and society ◉ Enhancing capacity to promote STI Target total investment: Approximately 26 trillion yen	April 2016 – April : Full-scale liberalization of power retailing May : Comprehensive Strategy on Science, Technology and Innovation 2016 enacted May : During his trip to Japan for the Ise-Shima Summit, US President Obama paid a visit to Hiroshima, a first for any sitting US president	

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Editor's Postscript

In April 2014, two years before the Japan Science and Technology Agency (JST) would mark its 20th anniversary, then President Michiharu Nakamura entrusted me with planning the commemorative events. We devised various ideas and activities for the occasion, and one of those decisions was to issue this commemorative publication.

The Japan Information Center of Science and Technology (JICST) and the Research Development Corporation of Japan (JRDC), both of which are JST's predecessors, have issued several anniversary publications in the past. However, this is the first anniversary publication since both organizations were merged to form JST. To mark the 20th anniversary of JST we organized our editorial policy to not only record our progress over the last 20 years but also indicate our direction forward in the coming 20 years, focusing on the development of society, economy, science, and technology in Japan.

While compiling this publication, we ensured that the articles avoided the use of specialized terminology as much as possible, thus making this anniversary publication both easy and appealing to read. In addition, the content was designed to focus on the advancement of Japan's policies on science and technology.

The 20th Anniversary Commemorative Publication Committee was established to promote the editorial work. This committee was responsible for listing the business operations of JST that have significantly expanded over the past 20 years, deliberating and deciding what content should be included, and finally commissioning and organizing the writing of the manuscripts.

As the successive presidents have mentioned in Part I, JST has undergone substantial transformations over the past 20 years. Frequent organizational changes caused repeated relocation of offices that, as a result, affected our compilation of this information. For example, certain administrative records were lost due to office relocation, and we encountered difficulties in gathering certain documents, including photographs.

As progress continues towards an advanced, information-based society, I mention this as a challenge that needs to be considered with regard to organizing corporate archives. All JST officers and staff members consider it a great honor to receive messages from the Nobel laureates who have long-term associations with JST; we have included them in this publication. I would also like to express my gratitude to the Nobel laureates for accepting this request despite the time constraints in writing.

Many people from within and outside JST offered their cooperation and provided us with invaluable information for the compilation of this publication, and I would like to express my sincere gratitude to them once again.

October 2016

Mikiko Fukushima
Chair,
20th Anniversary Commemorative Publication Committee

Commemorative Publication for JST's 20th Anniversary

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