Section 3 Building platform for the co-creation of new knowledge and value

1 The Importance of a Platform for Co-creation

(1) Changes in the creation of knowledge and value

With the rapid development and deepening of science and technology in recent years, knowledge has become more sophisticated, specialized and segmentalized. At the same time, in addition to this trend of sophistication and deepening in already segmentalized areas, new sciences tend to be produced increasingly in domains where multiple fields are integrated. Sometimes, totally new knowledge is created in exchanges between fields of science that had been thought to have no relation.

Science and technology's relationship with society has also become deep and complex. What society and individuals want from science and technology has also become more diverse. These changes have been accelerating. The knowledge and abilities necessary for the creation of value in our ever-changing society have also become more diverse.

In light of such circumstances, to create revolutionary knowledge and value ahead of other countries of the world, it is indispensable to fuse and further develop cutting-edge technologies in a wide range of scientific fields and integrate the diverse viewpoints and experiences of researchers.

Innovation by a single organization, called "closed innovation," has reached a limit. Open innovation, in which the diverse knowledge and technologies of various organizations are used in the creation of innovative value, has become the main stream of innovation. As discussed in Chapter 1-3-1(3), Japanese R&D is still done mainly based on an "in-house policy." Japan lags behind the world in open innovation.

The importance of teamwork by researchers with varied knowledge and viewpoints has also been increasing in scientific research. The most recent movement in such teamwork is called "open science," in which people with diverse backgrounds and knowledge, including not only specialists but also lay people, get involved in scientific research through the Internet.

In such circumstances, to create new knowledge and value ahead of other countries of the world and to make Japan "the Most Innovation-friendly Country in the World," it is not sufficient to develop a highly mobile human resource system and a research environment in which diverse human resources are able to play active roles and maximize the potential of individual human resources. It is indispensable to build platforms for co-creation by maximizing the mobility and diversity of human resources. Members with varied knowledge, viewpoints and ideas get together at such platforms, stimulating each other, integrating their knowledge, viewpoints and ideas, and creating results whose quality surpasses that of work done by these persons individually.

(2) The concept of platforms for co-creation

The concept of platforms for co-creation includes the following.

First is that a platform for co-creation platform is a place where diverse human resources assemble and have interchanges to produce new discoveries and innovations. An organization that has leading-edge infrastructure and human resources with knowledge and experience serves as its core. Examples of such a platform include the Specific Advanced Large Research Facilities, such as SPring-8, SACLA, J-PARC and the

supercomputer "K computer", and the Tsukuba Innovation Arena (TIA-nano).

Second is that the platform for co-creation could be a place to conduct leading-edge and interdisciplinary R&D, which have not been achieved by existing organizations. The platform for co-creation is also expected to play a leading role in advancing system reformation and is expected to become a hub where diverse human resources work together for co-creation. Examples of programs to create such platforms include the World Premier International Research Center Initiative (WPI), the Creation of Innovation Centers for Advanced Interdisciplinary Research Areas Program, and the Center of Innovation (COI) Program.

Third is that the platforms for co-creation can be used for the creation of results through stimulation and integration among researchers who have diverse and flexible ideas and knowledge. The diverse human resources necessary for such platforms for co-creation will be recruited without being bound by physical restrictions or scientific fields and domains. Examples include the Impulsing PAradigm Change through disruptive Technologies (ImPACT) Program and the Future Earth Program.

(3) Human resources required for platforms for co-creation

To create new knowledge and value at platforms for co-creation, where human resources with diverse knowledge, viewpoints and ideas stimulate each other, it is desired to have leaders who are able to take a bird's-eye view of the project and integrate interdisciplinary knowledge. To foster human resources who display such leadership, education based on Design Thinking is effective. Education utilizing the Design Thinking method has been initiated at the i.school of the University of Tokyo and at the Graduate School of System Design and Management (SDM) of Keio University.

MEXT has been promoting the development of the human resources described above. The ministry will begin the Enhancing Development of Global Entrepreneur (EDGE) Program in FY2014 with the aim of building "innovation ecosystems"[1]. This program supports universities that develop and implement education programs which assimilate Design Thinking. The universities foster human resources who are able to identify issues by themselves, find solutions through approaches that integrate liberal arts and sciences, and commercialize the results of R&D through the collaboration of diverse human resources.

Design Thinking is being integrated in some cases of the Program for Leading Graduate Schools, which started in FY2011. Toward developing human resources who will play active roles in platform for co-creation, it is required that such education as stated above be actively continued.

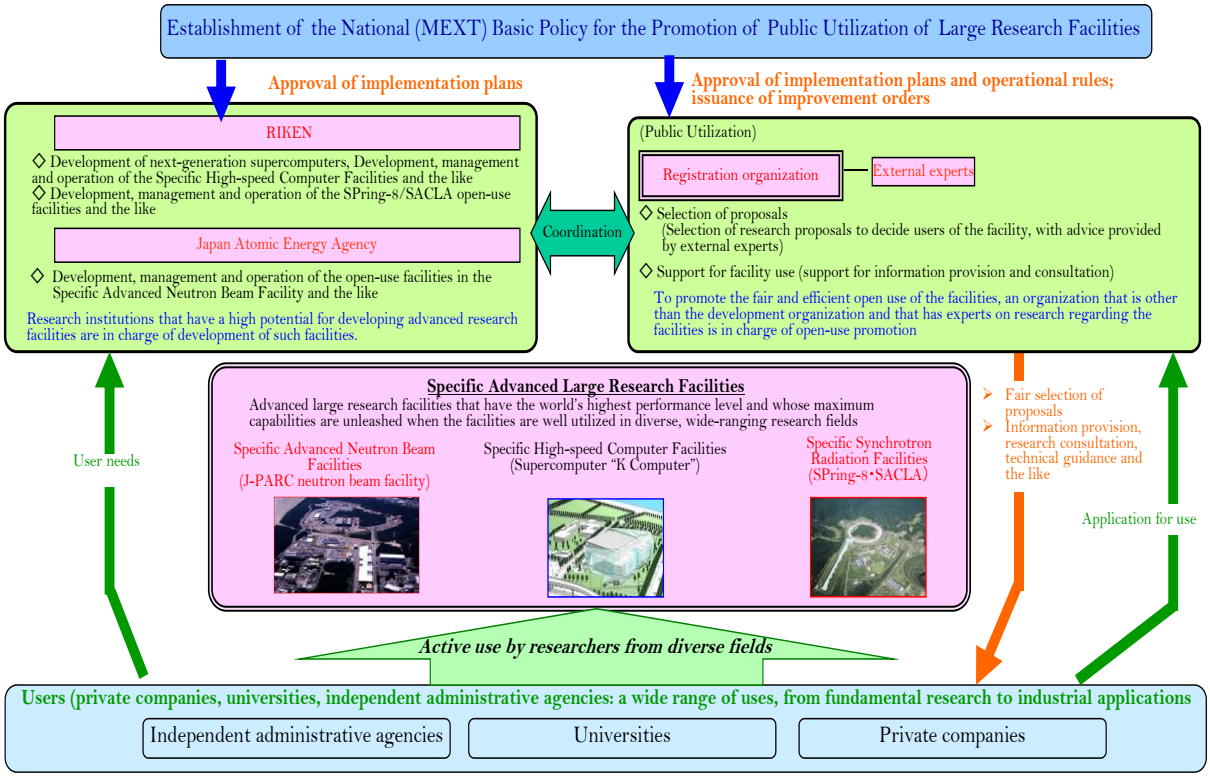
It is also required that people who have experience in R&D as researchers and managers at companies take active roles as program directors of various projects and coordinators of facilities.

2 Approaches to Building Platforms for Co-creation

Existing approaches for building platforms for co-creation in Section 1 are introduced below.

○ Public Utilization of Specific Advanced Large Research Facilities

1 The system accelerates innovation by securing the involvement of players that function together like organisms in an ecosystem.



Outline of the *Act on the Promotion of Public Utilization of the Specific Advanced Large Research Facilities*

Courtesy of MEXT

Promoting the open use of advanced large research facilities and equipment is useful for the effective utilization of those facilities. At the same time, such promotion effectively contributes to the creation of new knowledge and exchanges of human resources through progress in research collaboration and the development of domains of integrated disciplines. The government, based on the *Act on the Promotion of Public Utilization of the Specific Advanced Large Research Facilities* (Act No. 78 of June 29, 1994), has been promoting the stable operation of large-scale high-tech research facilities. These facilities enjoy unrivaled capabilities and are expected to be utilized by researchers from wide areas of industry, academia and government institutions. Specifically, the government has designated the Super Photon ring-8 GeV (SPring-8), the X-ray Free Electron Laser (SACLA), a neutron radiation facility and the supercomputer "K computer" of the Japan Proton Accelerator Research Complex (J-PARC) as Specific Advanced Large Research Facilities.

Joint research has been promoted by using these facilities and by utilizing the strengths of researchers from industry-university-government institutions. For example, Kyushu University and Ibaraki University worked in collaboration with the Comprehensive Research Organization for Science and Society, which supports users of the Public Beamline of J-PARC, and they succeeded in developing the world's first H_2-activation medium using economical iron instead of costly precious metals. A research group from Hokkaido University, Tokyo University of Pharmacy and Life Sciences, a private research institution, RIKEN (which is in charge of development and operation of SACLA) and the Japan Synchrotron Radiation Research Institute (JASRI) succeeded in observing live cells at nanometer resolution, a world's first.

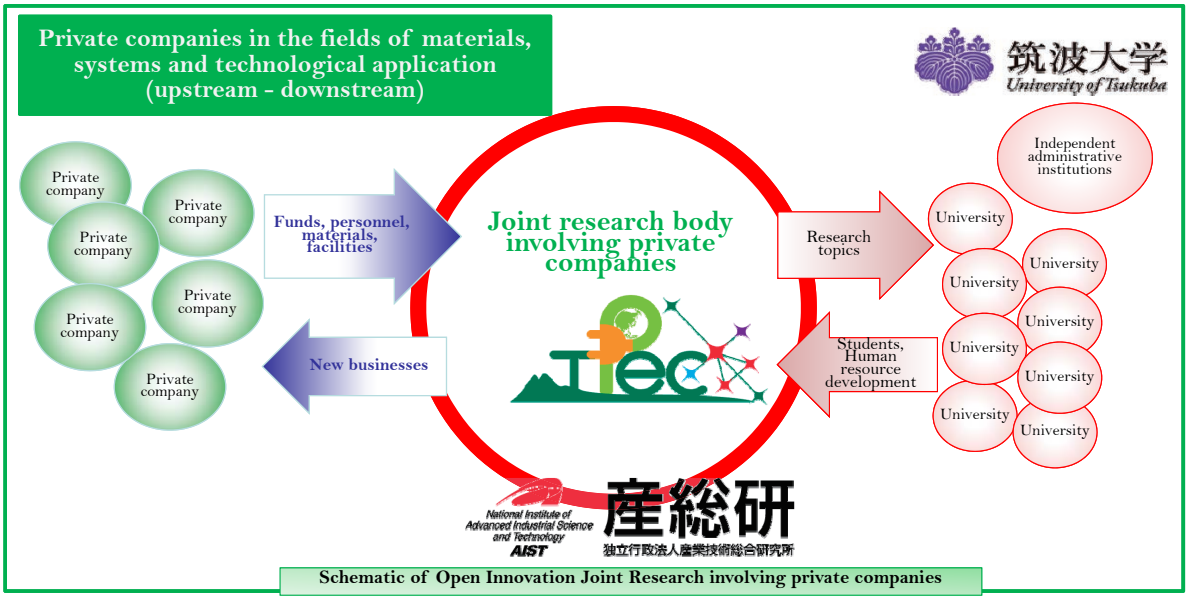
These facilities also contribute to the fostering and securing of young human resources, who will take

the main role in developing science and technology in the future. The SPring-8 program, for example, supports graduate course students by providing "seeds research subjects" that help the students to work as researchers. The programs at the supercomputer "K computer" are for fostering human resources who will support the basis of research in the future. The young researchers are able to use the facility as a part of the public-use quota reserved for "subjects for fostering young human resources."

○ Establishment of the Tsukuba Innovation Arena (TIA)

In June 2009, TIA, a world-class research base for industry-university-government collaboration was established at Tsukuba Science City, where research facilities and human resources related to advanced nanotechnology are accumulated. The Cabinet Office, MEXT, METI and the Japan Business Federation (Nippon Keidanren) support this research base. The core organizations of the base are the National Institute of Advanced Industrial Science and Technology (AIST), the National Institute for Materials Science (NIMS), Tsukuba University and the High Energy Accelerator Research Organization. Six core research domains[1], for which accumulated research infrastructures[2] are able to be utilized, were designated. R&D utilizing the base has been conducted by more than 80 universities and 220 companies as of March 31, 2014. Researchers and research organizations from industry, universities and government have assembled and been integrated in R&D activities across the borders of organizations.

Tsukuba Power-Electronics Constellations, an open innovation R&D base with a private-sector initiative, was established in April 2012 by the public and industry with the aim of it becoming an independent center of



Outline of the collaborative research body for open innovation joined by the private sector

Courtesy of METI

1 Nano electronics (nano CMOS, silicon photonics, etc.), N-MEMS (high-value - added production of many types of products and mass production of integrated N-MEMS), carbon nanotubes (demonstration of mass production of CNT and the development of materials for diverse uses and CNT integrated materials), power electronics (integrated R&D and demonstration of power semiconductors: from SiC substrate to device to system), Nano Green (research on environmental technologies using nanotechnology), safety evaluation of nano materials (correction and evaluation of the data related to the safety of nano materials from around the world).

2 Nanodevice Research Foundry (trial manufacturing, demonstration, and evaluation of prototype devices, SiC power devices are done at this base); Networking School of Nanotechnology (Tsukuba University, together with related universities, serves as a graduate school of nanotechnology); Nanotech Open User Facilities (Research facility owned by AIST and NIMS for open use by researchers from industry-university-government institutions (used for nano-measurement, nano-processing, etc.))

sustainable power electronics R&D. At the base, the development of young human resources, the mutual use of intellectual property and the development of facilities for open use have been promoted. In FY2013, the number of companies participating in this research base exceeded 30. Japanese-style open innovation has been promoted at this base through the formation of vertically integrated collaborative research teams that work consistently from the development of raw materials to applications.

In March 2014, a new core domain for R&D collaboration was established to promote collaborative research in the existing core research domains and to create new core research domains. By utilizing the open research environment of the High-Energy Accelerator Research Organization, the co-creation of new knowledge will be promoted in this new core domain through exchanges in R&D among four core organizations.

Since FY2010, the Tsukuba Nanotechnology Human Resource Development Program, a collaborative program for industry, academia and independent administrative corporations, has been implemented, with Tsukuba University acting as the central organization. Human resources with basic abilities, broad views, and the ability to identify themes are being developed through the utilization of TIA infrastructure and participation in research conducted at the TIA.

○ Implementation of the World Premier International Research Center Initiative (WPI)

MEXT has been promoting WPI (See Part I, Chapter 2, Section 2, 3 (5).)

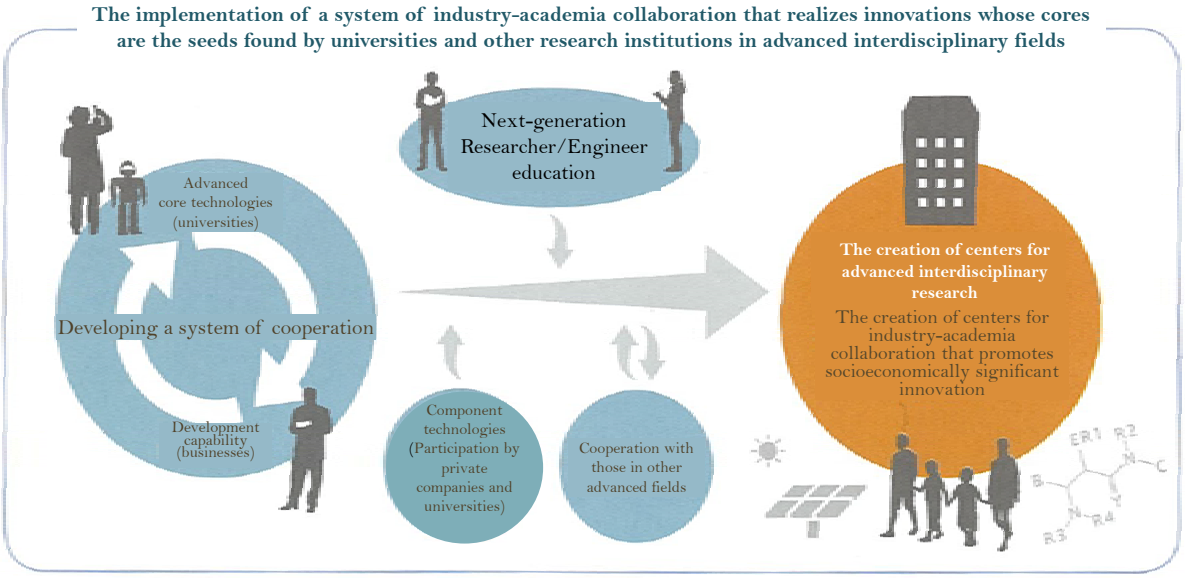
At each research base, under the strong leadership of the director of the base, chief researchers who are front-runners in R&D in their fields have been working. The number of chief researchers at each research base varies from 10 to over 20. The language used in the research environment is basically English, because about 30% to 55% of the researchers are non-Japanese. A research environment for co-creation by diverse human resources has been created at each base, where many types of support, including capable research aid personnel, are provided.

Kavli Institute for the Physics and Mathematics of the Universe (Kavli IPMU) of the University of Tokyo, one of the bases for this program, has been working to identify the matter that makes up the universe. Kavli IPMU has been producing many research results, including a computer simulation that clarifies that the first stars, which had been thought to be several hundreds of times as heavy as the sun, were really only about 40 times as heavy as the sun. The buildings of the base facilities are designed so that researchers from diverse disciplines and cultures can naturally meet and communicate. Discussions are often held at a café space where all the researchers at the base get together at 3 p.m. for tea time.

Researchers enjoying tea time and discussions at the cafe in the research building of Kavli IPMU (WPI base)

Courtesy of Kavli Institute for the Physics and Mathematics of the Universe (The University of Tokyo)

○ Implementation of the Program for the Creation of Innovation Centers for Advanced Interdisciplinary Research Areas



Outline of the Creation of Innovation Centers for Advanced Interdisciplinary Research Areas
Courtesy of MEXT

Since 2006, MEXT has been promoting the formation of R&D bases under programs of the Creation of Innovation Centers for Advanced Interdisciplinary Research Areas. From a long-term perspective, these bases are particularly important for innovation in advanced and integrated science fields. At each base, teams pursuing industry-university-government collaboration are conducting R&D from the basic level, toward putting the results into practical application. At the same time, the education of researchers and engineers who will play major roles in the next generation is being promoted.

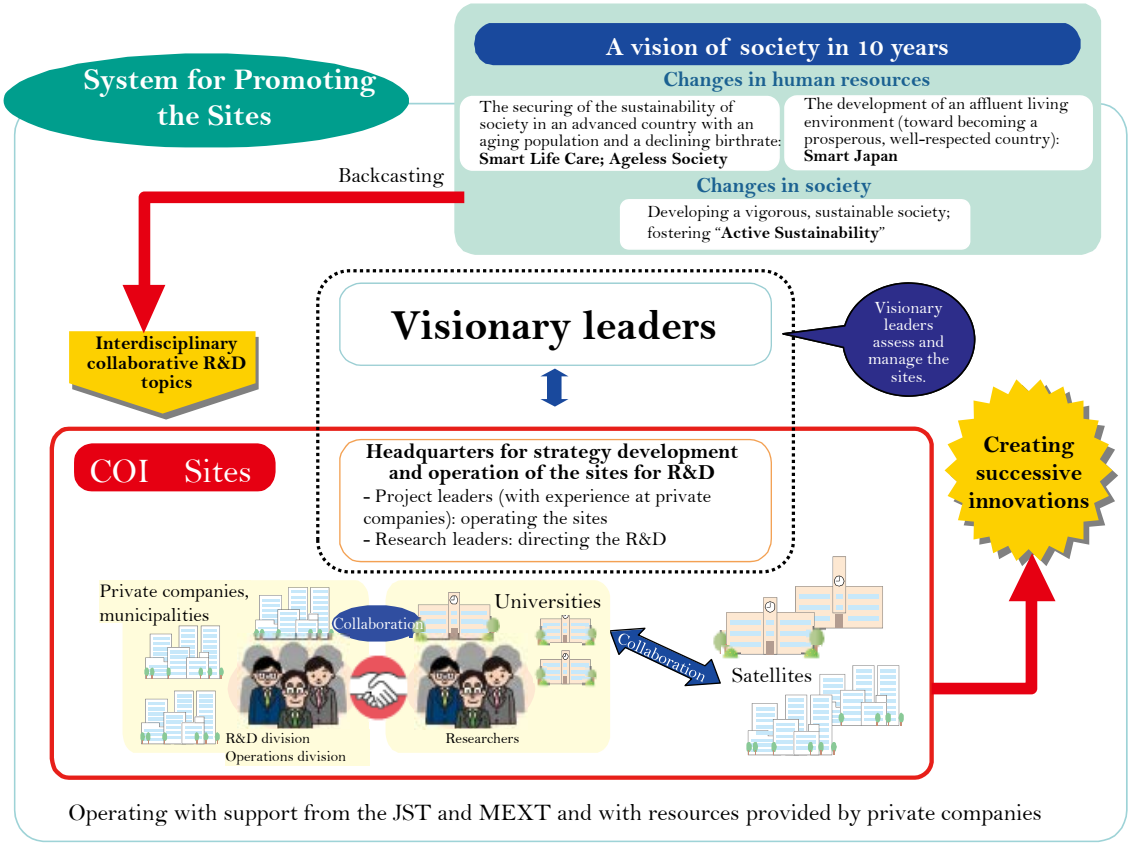
Tokyo Women's Medical University, one of the bases for this program, has been conducting projects under the Advanced Interdisciplinary Center for the Establishment of Regenerative Medicine (CSTEC) Program since 2006, while striving to establish collaboration systems with diverse research bodies in Japan and abroad. The university aims at developing world's-first technology in regenerative medicine, which is done multidisciplinarily[1]. The technology integrates cell sheet engineering and medicine. The university also aims at the dissemination and commercialization of the developed techniques.

At this base, the world's first clinical research on the use of cell sheets on the cornea and myocardium were conducted with private companies. World's-first clinical application of the results was also achieved with success in transplanting cell sheets that were transported by air. The base holds seminars related to regenerative medicine and provides systematic medical educational programs. Human resource development has been promoted, not only of doctors and researchers in the engineering and pharmaceutical sciences but also of people who will contribute to collaboration among researchers of diverse fields.

○ Building the Center of Innovation (COI) for industry-academia collaboration

MEXT has been implementing the Center of Innovation Science and Technology based Radical Innovation and Entrepreneurship Program (COI STREAM) since 2013.

1 This means that multiple doctors and medical specialists who specialize in diverse fields make treatment plans and are involved in treatments.



Promotion system of the Center of Innovation for industry-academia collaboration
Courtesy of MEXT

This program is aimed at making radical innovation happen. For that purpose, future social visions are identified first, taking social needs into account. Based on these visions, revolutionary R&D themes are determined with a 10-year perspective. Subsequently, R&D on the determined themes is promoted towards radical innovations under academia-industry collaboration by interdisciplinary and regional collaborative teams.

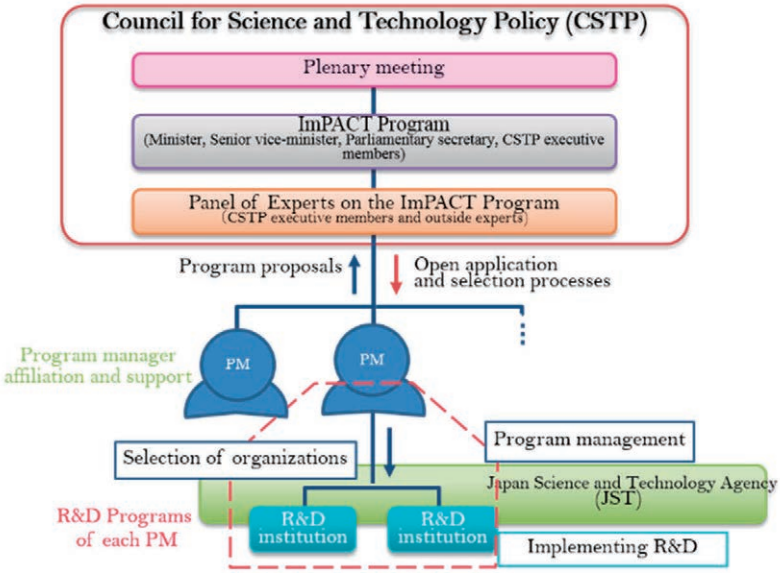
Centers had been selected as COI sites, as of the end of FY2013. At each COI site, a Project Leader appointed from industries serves as a head of the site, leading R&D to realize radical innovations with free and flexible thinking. In addition, a Research Leader is appointed from universities and plays an important role in integrating all knowledge and resources, promoting R&D projects. Therefore, balanced collaboration under the balanced leadership of the Project Leader and the Research Leader is a key to co-creation under the program.

"The Last 5X Innovations for the Lively Life", selected as a COI site, consists of more than 30 private companies, universities, Kyoto Prefecture and Kyoto City. Kyoto University and private companies lead R&D on the following themes: life-monitoring technologies using cordless and ICT technologies; energy-saving technologies; preventive and advanced medical[1] technologies based on data accumulated from genome cohort studies; and advanced medical technologies that realize early treatment and recovery. This site is aimed at creating a safer society in which elderly people can be monitored wherever and whenever they are, through the commercialization of the developed technologies.

1 "Advanced medicine" means medical technologies for preventing or delaying the onset of diseases by onset prediction and presymptomatic diagnosis and conducting therapeutic intervention before disease onset.

○ Implementation of the Impulsing PAradigm Change through disruptive Technologies (ImPACT)

The Council for Science and Technology Policy (CSTP) started the program for the ImPACT in FY2013. The program aims to establish a system for the creation of "discontinuous innovations" [1] which, if realized, bring about changes in society. The program also aims at showcasing the activities of such programs as models of behavior for future innovation projects. Under this program, to promote attempts in high-risk/high-impact research, carefully selected program managers (hereinafter: PMs) who have excellent ideas and are given broad authority are expected to create innovations together with excellent researchers.



System for implementing the Program for the ImPACT
Courtesy of CSTP

The CSTP has started recruiting PMs, toward dramatically improving industrial competitiveness and overcoming serious social problems by setting five themes[2] that make it possible to integrate varied knowledge and to employ diverse technological approaches. The PM is expected to make a project plan based on ideas and concepts and to organize a team toward realization of the plan. It is expected that the PM will manage the project flexibly toward the achievement of the goal. In organizing a team, the PM is expected to use insight in recruiting diverse human resources. Researchers from various fields and disciplines collaborate in innovation by assembling diverse knowledge beyond the constraints of existing fields and disciplines.

PMs are planned to be selected in June 2014, and the R&D projects will be started in October.

○The promotion of activities under Future Earth

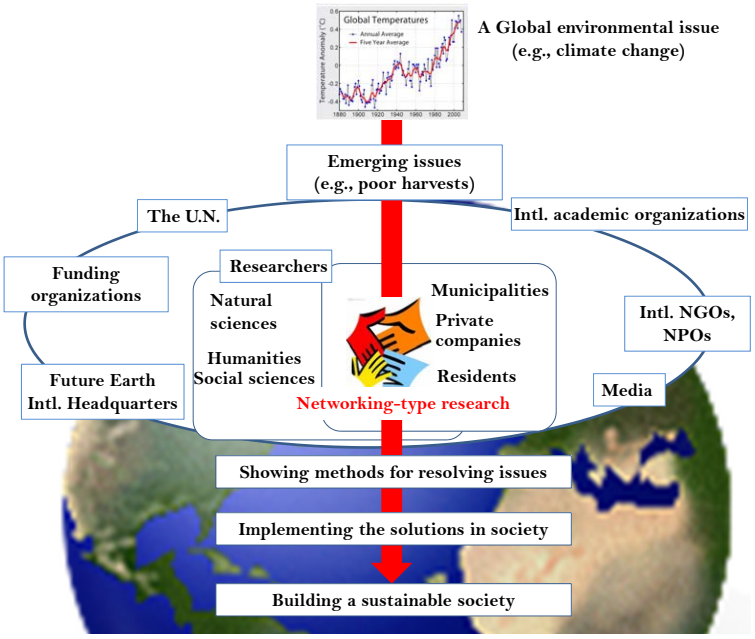
In June 2012, international academic organizations, UN agencies and groups of funding agencies[3] announced the launch of Future Earth, a new initiative which provides an international framework for global environmental change research and integrates a number of existing international research programs in a more solution-oriented way. Future Earth is characterized by co-design and co-production by science and

1 Example of discontinuous innovation (The innovation was done not by building up technologies on the basis of existing technologies and products.): (The development of a fuel-cell vehicle in an industry in which gasoline-powered vehicles have been the norm)

2 1) Freedom from restriction of resources, and revolution in craftsmanship (New Millennium Japanese Way of Value Creation). 2) Realization of a revolutionary energy-saving eco-society with a different lifestyle (symbiosis with the earth). 3) Realization of a society with high functionality that surpasses the information and network society (a smart community that connects humans and society). 4) Provision of the world's most comfortable living environment in a society with declining birth rates and demographic aging (the realization of a healthy and comfortable life for everybody). 5) Minimization of damage from natural disasters and hazards beyond human understanding by controlling their influence (the realization of resilience that makes every citizen feel safe).

3 The International Council for Science (ICSU), the International Social Science Council (ISSC), UNESCO, the United Nations Environment Programme (UNEP), United Nations University, the World Meteorological Organization (WMO), Belmont Forum (a group of research funding agencies), and the International Group of Funding Agencies for Global Change Research (IGFA)

society. Researchers from a broad range of disciplines and countries work in partnership with various stakeholders from private, public and voluntary sectors at every step, from planning research projects to submitting proposals to funding organizations and, after the submitted proposals are adopted, to promoting implementation of the research and dissemination of the results. It aims to ensure that the results are used by the stakeholders, the results are applied to problems and, finally, the transition to global sustainability is accelerated.



Flow from the emergence of a problem to its solution
Courtesy of MEXT

Future Earth recommends that each country promote international collaborative research and domestic research in line with three themes: "Dynamic Planet", "Global Development" and "Transformation towards Sustainability". To start full-fledged 10-year research initiatives in 2015, an interim secretariat of Future Earth was established in 2013 and the way forward is being discussed.

As the initiative is being officially launched, it is expected that world-scale co-creation across national borders and disciplines will be promoted by industry-university-government-private sector collaboration and by the involvement of stakeholders from the planning stage of research.

3 Utilization of Research and Development (R&D) Institutions as Platforms for Co-creation

As stated above, several approaches are being taken for forming platforms for co-creation. To create new knowledge and value continuously in our country, it is necessary to accelerate and expand the movements of creation that have been initiated under the programs stated above. To that end, it is effective to maximize the utilization of independent administrative corporations for R&D as platforms for co-creation and as hubs of networks in various fields and sectors.

The independent administrative institutions that specialize in R&D were newly classified under the Basic Policy Concerning Reform, etc. of Independent Administrative Institutions as independent administrative corporations for R&D. The independent administrative corporations are organizations that address challenges that are difficult for universities and private companies to meet. Under the business operation principle of doing research "efficiently and effectively," the primary objective of an independent administrative corporation is "maximization of research results." R&D is characterized by requiring long-term work and by being uncertain, unpredictable and specialized. In light of such characteristics and the need to maximize R&D results, the independent administrative corporations are required to secure far more flexible work operation than that of former organizations. Salaries and allowances and the procurement of materials and services are included in items to be treated flexibly.

R&D corporations are expected to develop as platforms for co-creation by effectively utilizing their characteristics and flexibly recruiting diverse human resources with varied knowledge, viewpoints and ideas from Japan and abroad whenever necessary in the progress of projects.

It is also expected that the corporations will form industry-university-government consortia and will serve as the hubs of networks by employing approaches used by world-leading public R&D organizations abroad. By assembling researchers from universities and industries, the creation of seeds for innovative technologies will be enhanced. At the same time, the private corporations will promote prompt commercialization of the research results. Private companies are able to grow out of a self-sufficiency policy of R&D and utilize human networks through the formation of consortia. The promotion of open innovation by industry-university-government collaboration is expected as a result of the above-mentioned initiatives.

Further examinations on the precise system, organization and operation of the independent administrative R&D corporations will be conducted. It is necessary to strive to make these corporations into organizations that lead the science, technology and innovation of Japan.