Provisional translation

0713 version

# JST-Mirai R&D Program

## (Small start Type / Large scale Type)

FY2017

Application Guideline

Solicitation Period

Wed., June 7, 2017 – Wed., July 19, 2017 at 12:00 noon

Japan Science and Technology Agency（JST）

## <Solicitation and Selection Schedule>

| | |
|---|---|
| R&D proposal acceptance begins | Wed., June 7, 2017 |
| Briefings of Solicitation | Check the website below for updated information.<br>(NOTE: only in Japanese.)<br>http://www.jst.go.jp/mirai |
| Application deadline (Deadline for submitting applications through the e-Rad system) | Wed., July 19, 2017 at 12:00 noon (Japan time) *No delays accepted |

Application of proposal is implemented via e-Rad system (http://www.e-rad.go.jp/). Researchers who do not have an e-Rad login ID and password should immediately complete the researcher registration procedure. As the application deadline approaches, heavy demands on the e-Rad system could slow the application process and even cause the application deadline to be missed. Please give yourself enough time to complete submission of proposal.

**No proposal for which the application procedure has not been completed via e-Rad by the deadline is subject to examination for any reason.**

| | |
|---|---|
| Document screening period | Late July7 – Middle August |
| Notification of document screening results | Early August – Late August |
| Interview screening period | Middle August – Late September |
| Notification/announcement of selected Proposals | October |
| R&D project begins | After late October |

* The dates are expected dates. They are subject to change.
* As soon as it is determined, the document screening and the interview selection schedule will be announced on the website shown below:
  http://www.jst.go.jp/mirai/jp/application/research/

# ＜R&D Areas for which Proposals will be Solicited＞

Under the Application Guideline, JST-Mirai R&D program will invite R&D proposals as follows.

**Period for submitting proposals :**

**Wed., June 7, 2017 – Wed., July 19, 2017 at 12:00 noon (No delays accepted)**

**No proposal for which the application procedure has not been completed via e-Rad by the deadline is subject to examination for any reason.**

**Only one application may be submitted across all prioritized themes and technology themes of the small start type and the large-scale type in R&D Proposal Applications.**

| R&D Type | R&D Areas for which Proposals will be Solicited |
|---|---|
| **Small start Type (Feasibility Study)** | **“Realization of a Super Smart Society (Society 5.0)” area**<br>(R&D Supervisor (Program Officer; PO): Akira MAEDA)<br>1. Building a service platform for creation of new services by collaboration and cooperation of various components |
| | **“Realization of a Sustainable Society” area**<br>(R&D Supervisor (PO): Hideyo KUNIEDA)<br>1. Innovation in manufacturing for new process of sustainable resource recycle<br>2. Improving intellectual capability to enhance “a Socially Active Life” for overcoming the reducing labor force |
| | **“Realization of the most Safe and Secure Society in the world” area**<br>(R&D Supervisor (PO): Ken-ichi TANAKA)<br>1. Development of the crisis navigator for individuals<br>2. Creation of "humane service" industries |
| | **“Realization of a Low Carbon Society, a global issue” area**<br>(R&D Supervisor (PO): Kazuhito HASHIMOTO)<br>1. Realization of a low carbon society through game changing technologies |
| **Large scale Type** | (R&D Supervisor (PO): Yoshio HAYASHI)<br>1. Laser-plasma acceleration technologies leading to innovative downsizing and high energy of particle accelerators<br>2. High-temperature superconducting wire joint technologies leading to innovative reduction of energy loss<br>3. Quantum inertial sensor technologies leading to innovative high precision and downsizing of self-localization units |

# Contents

# Chapter 1

# Introduction:

# Invitation to Submit R&D Proposals

## 1.1 Overview of JST-Mirai R&D Program

Today, new knowledge and ideas can have a great influence on the international competitiveness of organizations and nations. It is important to boldly attempt new experimentation and promote high-risk and high-impact research and development (R&D) that will yield important innovations. The Fifth Science and Technology Basic Plan states that “Japan will popularize and disseminate suitable methods for promoting challenging” in the R&D projects conducted by government ministries. Japan demands the large-scale promotion of new, profitable creations that can assist in the building of future industries and in reforming society; specifically, it is seeking the “realizing a world-leading super-smart society (Society 5.0).”

In response to the goals mentioned above, JST will commence the JST-Mirai R&D Program during the 2017 fiscal year.

By considering social and industrial needs (including potential needs), this program will set technologically challenging goals with clear targets (exits) designed to produce beneficial economic and social impacts. In an attempt to reach a stage (proof of concept: POC) where application feasibility may be judged, the R&D for prospective projects will take advantage of promising results produced by prior programs such as “Strategic Basic Research Program” and “Grants-in-Aid for Scientific Research”. This R&D will adopt operation practices that allow innovative ideas to be readily incorporated and rapidly, flexibly, and swiftly brought to commercialization.

The JST-Mirai R&D Program facilitates projects of two different approaches: “Small start Type” and “Large-scale Type”.

In small-start projects, R&D, in principle, proceeds stepwise from a feasibility study to full-scale research. To evaluate the feasibility of the ideas proposed, feasibility studies will adopt the small-start method[1] and incorporate many innovative ideas through calls. R&D themes will be called for in the areas[2] stipulated by the Ministry of Education, Culture, Sports, Science and Technology and along with the “prioritized themes” JST has chosen.

The large-scale type involves collecting and analyzing information on science and technology innovations and changes in existing technology systems. Investment will be concentrated towards R&D projects that relate to “technology themes” that have been judged by Ministry of Education, Culture, Sports, Science and Technology as important for forming bases for future technologies.

The JST-Mirai R&D Program applies a stage-gate method[3]. When considering small-start projects, R&D projects that can transition from feasibility study to full-scale research will be prioritized and invested in. Similarly, through narrowing down the research projects currently underway, the most suitable R&D projects will be chosen for concentrated investment. It should also be noted that large-scale type projects require the sourcing of private funds and investment during the R&D phase to facilitate investment of private funds.

Note 1: The small-start method: A system for adopting a large number of R&D projects despite relatively little funding being available at the time of adoption.
Note 2: Area: “Area selected when setting prioritized themes(divisions).”
Note 3: Stage-gate method: A system in which R&D is divided into a number of stages, with an evaluation conducted at each stage to decide whether to continue with the project or cancel it.

## 1.2 Purpose and characteristics of JST-Mirai R&D Program

The rapid development of digital technologies combined with progress in open innovation has forced the global structure of the creation of innovation to undergo great changes. Society and industries are at a great turning point in Japan. In the era of the great reformation that is now in progress, the JST-Mirai R&D Program sets a goal for "what research Japan should conduct and what strategic research Japan should strengthen in a style of challenging innovation creation to keep yielding new values."

JST takes into account such social and industrial issues and the creation of new industries to connect the government, universities, and industries in a wide range of fields from basic research to application, challenge technologically extremely difficult research for a presently unclear market, and manage JST-Mirai R&D Program while being intensely conscious of permitting failures and teaming up with you to succeed in the realization of an "innovative eco-system" that keeps creating innovation.

## 1.3 Important matters of the JST-Mirai R&D Program and characteristics of its management

**(1) Focus on "new value" creation by R&D that meets the purpose of prioritized themes and technology themes**

- Concrete forms of values that the society seeks

The JST-Mirai R&D Program depicts a future society to practice back cast type R&D to realize science and technology for society.

This project takes two approaches to define an image to be sought as a new value for society.

One is an approach (the Small start type) for JST to define new values (prioritized themes) the society and industries seek through "calling for theme proposals"* by taking into account areas set by the Ministry of Education, Culture, Sports, Science, and Technology.

The other one is an approach (the Large-scale type) through which the Ministry can collect and analyze information about science and technology innovations, alter the existing technology system, and specify technologies (technology themes) to be future base technologies.

R&D in this program is performed to realize the prioritized/technology themes.

*Calling for theme proposals:
This project took the approach of calling for a wide range of proposals about the future image to be realized by science and technology (continuing throughout the year). Prioritized themes to calls for proposals were examined through calling for proposals between January 30, 2017 and March 6, 2017.

- Themes for attempting various mergers

Prioritized themes and technology themes are yielded through the examination of various values that society and industries seek. Therefore, the themes are set to

encourage collaboration and cooperation among various organizations and researchers to merge science and humanity fields. The themes are also set to keep in mind the social implementation of realized values and to solve complex issues.

R&D proposals for this project that take into account these points are called for.

- R&D promotion by R&D supervisor

"Chapter V, Prioritized themes and technology themes to call for proposals" explains an outline of prioritized themes and technology themes and the R&D supervisor's policies for calling for proposals and selecting and managing them. Take into account the outlines and messages to prepare a proposal for this project. Base technologies common to measurements and determinations may be proposed for any prioritized theme.

The R&D supervisor aims for early completion of an R&D portfolio for each area and prioritized theme and makes announcements as necessary for public calls.

**(2) Duties and expectations for the Principal Investigator and R&D institution**

- Expectation for setting the POC toward the realization of excellent ideas and values

The JST-Mirai R&D Program conducts R&D for reaching "a stage where application feasibility (proof of concept: POC) may be judged" that is necessary to realize prioritized themes and technology themes. The POC is set as a point for solutions based on core social and industrial problems for realizing prioritized themes and technology themes. The POC is set on the basis of the activities of society and private firms to whom the POC is passed after it is attained, and on ideas for overlooking its ramifications.

The small start type selects Principal Investigators (project leader: PL) across prioritized themes in each area under an R&D supervisor through public calling, and the PL promotes research. A PL promotes R&D based on original and challenging ideas under flexible management by the R&D supervisor. An active approach is expected that accurately grasps social and industrial needs to improve feasibility.

The large-scale type selects Principal Investigators (program manager: PM) through public calling who have excellent ideas and are boldly given authority. A PL, as an R&D producer, chooses researchers. She/he is expected to recruit top-level knowledge in Japan.

The Principal Investigator takes into account prior evaluation and coordination with an R&D supervisor to set the POC (and milestones) and conduct R&D to aim to achieve it. During R&D, the Principal Investigator may flexibly review an R&D plan and form a team (including public calling for proposals) upon approval of the R&D plan by the R&D supervisor.

- Improving support systems

The R&D organization is requested to provide proper support for the promotion of R&D, for example, dispatching aides to assist R&D management by an Principal Investigator; setting up an intellectual property management committee associated with the creation, protection, and utilization of intellectual properties (see "(4) promotion and maintenance of collaboration between industries and academia" here); and supporting collaboration among R&D organizations. JST also cooperates in building a support system.

● Changing Principal Investigators

Challenging and highly creative research is encouraged. Approaches are expected that possess diversity in the fields of science and humanities, generation, and gender. It is also considered necessary to allow dynamic changes in the priority of R&D contents in the integrated management of basic and applied research during a set period for realizing values that the society and industries seek, or achieving their social implementation.

To put those into effective practice, the small start type allows changes of Principal Investigators (Project Leader; PL). Sharing roles with aides is also presumed to be a form of practice. Continuous management by an Principal Investigator (Program Manager; PM) is a principle for the large scale type. However, changing PMs is also allowed at a proper time during an R&D period, if there is a reason that R&D is to continue, under the condition that inducing private fund investment and a plan to lead to development after the POC, and a viewpoint of human resource development are taken into account for securing the continuation and development of the initial ideas. An R&D management committee decides PM changes upon receiving advice from an R&D supervisor.

**(3) Flexible and "thorough" R&D**

● Spiral and flexible research promotion

The JST-Mirai R&D Program allows a "spiral model" of R&D in addition to that of a "linear model" that presumes reaching the POC from the seeds of basic research to applied research. For example, it allows timely responses, such as basic research conducted for solving issues appearing during R&D and a team for it to be formed (including public calling), new technologies and findings to be introduced, society and industries to respond to constantly changing needs, the results of some R&D to spin out, and collaboration with other organizations and ELSI to be responded to.

To improve the likelihood of reaching the POC and maximize results for any approach, R&D supervisors and JST staff examine progress in detail in addition to staging gate evaluations to perform intense management.

● Stage gate implementation

The JST-Mirai R&D Program performs a "stage gate evaluation" during the R&D period, which is a strict evaluation for judging whether to continue or revoke R&D from the viewpoint of the likelihood of reaching the POC. Papers and patents are utilized as evidence for judging the feasibility of reaching the POC.

The small start type has decided to adopt many small start R&D projects that have relatively small R&D budgets and aim to verify research plans, necessary technology, and research elements toward meeting the requirements for carrying out full-scale research (small starts), and prioritizing projects that have passed the stage gate evaluation as large scale research (stage up).

Concerning projects that do not reach the stage up but can contribute to other projects for reaching the POC and the element research and technologies, the small start type may take into account the encouragement of challenging and highly original research to attempt to merge with other projects or utilize them as element research.

The small start type may also continuously survey and examine the potential of element research and technologies that are likely to make important contributions to the realization of prioritized themes in the future.

The large-scale type performs a first stage gate evaluation of approximately three years of R&D initiation, when the introduction of private funds is requested for subsequent R&D activities from the viewpoint of inducing private fund investment. Be sure to see “3.1.2(9), Stage gate evaluation” for the stage gate evaluation of the large-scale type.

The likelihood of reaching the POC is improved by research and its results through these approaches and an attempt is made to accelerate R&D toward social implementation.

**(4) Promoting Industry-Academia Collaboration**

● Basic policies set out for managing intellectual properties

The JST-Mirai R&D Program has decided to connect R&D results to values for economic and social impacts in order to obtain secure and effective rights for the results in order to maintain reliability and superiority.

For this purpose, JST sets out basic policies common to this project, “Basic policies for the management of intellectual properties,” to attempt to integrate activities for R&D and intellectual properties and encourage the preparation of integrated policies for obtaining rights, announcement, non-disclosure, and utilization of results.

Principal Investigators need to establish the mutual agreement “Treaty of mutually owned intellectual properties,” which complies with the basic policies agreed with participating organizations and researchers. The treaty of mutually owned intellectual properties needs to be submitted to JST and the R&D supervisor within a certain period of time of research initiation and its review results will be used to judge whether R&D should be conducted.

Promotion of R&D based on basic policies is expected to strengthen collaboration and bridging with society and industries.

The basic policies are provided separately. See below for contents and details.

http://www.jst.go.jp/mirai/jp/uploads/chizaihoshin29.pdf

## 1.4 Management system for the JST-Mirai R&D Program

The PD (program director) supervises the whole JST-Mirai R&D Program for overall, and POs (program officer, R&D supervisor) are in charge of R&D area management (illustration below).

The “Program supervisors committee for the JST-Mirai R&D Program” has been set up as a supreme organization for managing the JST-Mrai program. The PD chairs the program supervisors committee, in which outside experts and JST executive director in charge participate as committee members.

The program supervisors committee reviews important management matters for the JST-Mirai R&D Program: it decides on the important policies of the program, sets prioritized themes, coordinates cross-disciplinary matters including budgets, selects project candidates for adoption as prioritized themes and technology themes, and decides whether to continue or to revoke projects on the basis of stage gate evaluations.

Each R&D supervisor(PO), who chairs the committee, her/his aides, outside gurus, and JST staff participate in an R&D management committee as committee members. This committee sets prioritized theme candidates (only the small start type), selects candidate projects for adoption, instructs and manages R&D projects, through site-visit, and performs stage gate evaluations. An R&D supervisor(PO) also increases or decreases the amount of R&D expenses, merges projects, and revokes projects through evaluation.

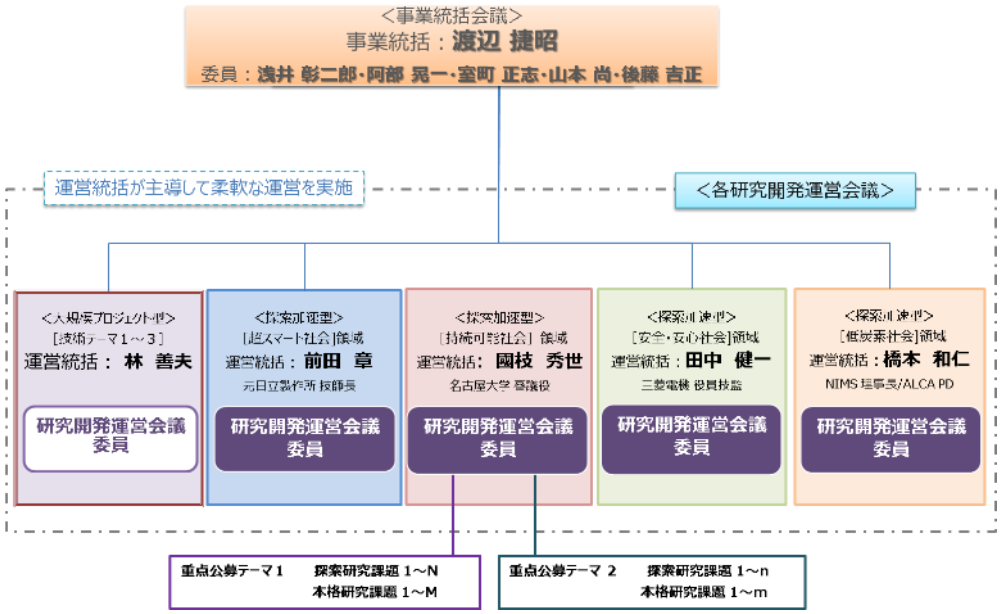



Fig. Organizaion of JST-Mirai R&D Program

## 1.5 For Researchers Considering Applying for /Participating in the Program (reference)

### 1.5.1 Contribution to achieving Sustainable Development Goals (SDGs)

**JST contributes to achieving sustainable development goals (SDGs)**

The "Sustainable Development Summit of the United Nations," held in September 2015, unanimously adopted a resulting document, the "**Transforming our world: the 2030 Agenda for Sustainable Development**" centered Sustainable Development Goals (SDGs) as a more comprehensive and new goal for globally common actions for humans, the earth, and prosperity. JST takes into account science and technology innovations that are indispensable for achieving SDGs to actively make contributions through the management of the projects.

Michinari HAMAGUCHI
President, Japan Science and Technology Agency (JST)

*See the website below for Sustainable Development Goals and JST's approaches:
http://www.jst.go.jp/pr/intro/sdgs/index.html

## 1.5.2 Promotion of Diversity

### JST Promotes Diversity!

JST promotes diversity by not only encouraging mutual respect between a diversity of human resources as they each demonstrate their abilities to the maximum, but also emphasizing the diversity of each individual's career and working style. JST generates innovation through diversity, resolving problems for future society and contributing to the strengthening of Japan's industrial competitiveness and spiritual enrichment.
Furthermore, with regard to the "Childbirth, Child-raising, Nursing Care Support System" (renamed the "Childbirth, Child-raising, and Other Support System" from FY2015), based on the voices of researchers who are users of this system, JST is contributing to the generation of innovation in Japan through the creation of an environment that enables researchers who have taken leave to return to research while also revising and improving the support system.
When inviting applications for new research projects and during the screening process, applications are also considered from the perspective of diversity. We look forward to researchers actively applying to join these programs.

Michinari HAMAGUCHI
President, Japan Science & Technology Agency (JST)

### We Are Waiting for Your Application!

JST promotes diversity under the concept that diversity is a tool for understanding people who think differently from yourself and fusing your thinking with that of the other person to create new value.
While the role of women in diversity is very important, JST's diversity policies are also aimed at young researchers and researchers who have foreign citizenship. To ensure that each individual researcher is able to fully exercise their skills, JST provides continual support for researchers' childbirth, child-raising, and nursing care (for elderly relatives), and also endeavors to maintain a balanced membership composition in committees, etc. JST diversity is aiming to open the way to a new future by responding flexibly to various problems in cooperation with many people with a diverse range of experiences and ways of thinking. JST promotes diversity for not only JST employees but for all people utilizing the JST system. We look forward to receiving your proactive application to the programs.

Miyoko WATANABE
Deputy Executive Director and Director of Office for Diversity and Inclusion
Department of Personnel, Japan Science and Technology Agency (JST)

## 1.5.3 About responses to life events

JST is implementing supportive measures for assisting researchers to achieve balance between their research work and life events (gender equality expenses assistance that can be used to advance the R&D being carried out by the researcher in question or to reduce their financial burden) with the aim of enabling researchers to continue their R&D work

without interrupting their careers due to a life event (childbirth, child-raising, nursing of elderly relatives, etc.) or in the case that the researcher must put their career on hold temporarily, enabling them to resume their R&D activities as soon as it becomes possible for them to do so and continue their career from that point onwards. JST also presents role models for female scientists. For details, please refer to the websites below.

JST's Diversity Activities http://www.jst.go.jp/diversity/research/index.html

### 1.5.4 Promotion of dialogue and collaboration with the public

Concerning the bilateral communication activities with the public, based on the decision (titled "Concerning the Promotion of Dialogue on Science and Technology With the Public, a Basic Approach Policy") of the Minister in charge of science and technology policies and diet members with expert knowledge on June 19, 1010, it is considered essential for a research and development project, which has been provided with a minimum of JPY 30 million per year of public research fund (competitive or project research fund), to fulfill the following objectives: 1) achieve continued excellent results in the field of science and technology "scientific and technological dialogue with the public;" 2) obtain the public's understanding and support; 3) maintain a standpoint on promoting science and technology jointly with the public; and 4) return the achievements in the development of science and technology to the public for the further development of the field in Japan. In addition, the Fifth-term Basic Plan for Science and Technology, as decided by the cabinet on January 22, 1016, requests the deepening of relationship for dialogue and collaboration among various stakeholders, such as researchers, the public, media, industries, and policy makers. Such relationship is considered as a "joint creation," and is contrary to the conventional relationship in which science and technology and society stand opposite each other. From these viewpoints, an approach is requested to explain the contents and achievements of research activities to society and the public in the most widely understandable manner possible. To this end, researchers are requested to actively undertake the continual releases of research achievements, through lectures, symposia, and the internet, and full activities involving the participation of diverse stakeholders in a roundtable process.

(Reference) Concerning the "Promotion of Dialogue on Science and Technology With the Public, a Basic Approach Policy":
http://www8.cao.go.jp/cstp/output/20100619taiwa.pdf

(Reference) Concerning the "Fifth-term Basic Plan for Science and Technology":
http://www8.cao.go.jp/cstp/kihonkeikaku/5honbun.pdf

### 1.5.5 Open Access and Data Management Plan

JST announced the basic policies for handling research achievements toward the promotion of open science in April 2017. The policies stipulate the basic concepts for allowing one's access to papers on research achievements and archiving, as well as on managing and disclosing research data.

In principle, researchers participating in this program are mandated to produce documents on research achievements available to the public via the repository organizations or publications for open access. Researchers, whose proposals have been

adopted in the newly set research areas after the 2016 fiscal year, are also requested to prepare a data management plan. This plan will contain details on policies and plans for archiving, managing, and publishing, or the non-disclosure of research data, which are developing as achievements. Researchers must also submit the plan, along with the research plan document to JST. It is also mandatory for them to undertake archiving, managing, and publication of research data based on this plan.

Please see the following for details:

- JST's basic policies for handling research achievements toward an open science promotion
  http://www.jst.go.jp/pr/intro/openscience/policy_openscience.pdf
- Guideline of the JST's basic policies for handling research achievements toward an open science promotion
  http://www.jst.go.jp/pr/intro/openscience/guideline_openscience.pdf

### 1.5.6 Registration at researchmap

JST-Mirai R&D Program plans to utilize a database operated by JST for researcher information (researchmap*). This database is a master database on achievement information in various scenes, including achievement reports in the future. In addition, a community function of researchmap will be used in project operation to distribute various files and event guides. For that, it is essential for the Principal Investigator and Lead Joint Researcher of an adopted R&D project at researchmap. Those who have not yet registered are recommended to register as soon as possible.

The information registered in researchmap is utilized effectively for surveying national plans on academic, science and technology or statistical use purposes. Registration at researchmap and updating of achievement information are requested.

Please confirm the specific registration method, "6.15 Regarding Registration with researchmap."

*Researchmap (the obsolete designation was Read&Research http://researchmap.jp/) is the largest Japanese database of researcher information to partially look at Japanese researchers nationwide. As of January 2017, approximately 256,000 researchers are registered.

### 1.5.7 Towards the Promotion of Fair Research

**Towards the Promotion of Fair Research**

The recent incidents involving misconduct and dishonesty in research activities have resulted in an alarming condition that threatens the relationship of trust between science and society, and hinders the healthy development of scientific technologies. To prevent misconduct in research activities, autonomous self-purification of the scientific community must function. Each researcher must strictly discipline him/herself and work to create new knowledge and inventions that are useful for society, based on a high moral standard to meet the expectations of society.

As a funding agency for research, JST considers research misconduct a grave issue and makes every effort to prevent it in cooperation with relevant organizations, thereby

aiming to regain public trust.

1. JST believes that honesty in research activities is extremely important for Japan, which seeks to develop itself through science and technology.
2. JST supports honest and responsible research activities.
3. JST strictly condemns any misconduct in research activities.
4. JST will promote education in research ethics and reform its research funding programs in cooperation with relevant organizations, in order to prevent misconduct.

We must develop a healthy scientific culture based on social trust toward building a society filled with hopes and dreams for a bright future. We therefore request the continued understanding and cooperation of the research community and related institutions.

Michinari HAMAGUCHI
President, Japan Science & Technology Agency (JST)

JST takes the following measures in response to misconduct in research activities and inappropriate usage etc. of research funds. Researchers participating in the Strategic Basic Research Programs and their affiliated research institutions are asked to comply with these measures.

(Note) "Misconduct in research" means fabrication, falsification and plagiarism of data or results of survey published in research papers etc. caused by intent or a gross negligence of basic duty of care as a researcher in the course of research and development activities.
"Inappropriate usage" means usage of competitive research funds etc. according to a false invoice in research and development activities, for other purposes or in violation of laws and JST's proposal submission requirement, contract etc.
"Fraudulent receipt" means cases in which research is adopted as a subject for a research program through dishonesty or any other fraudulent means.
"Misconduct etc." means misconduct in research, inappropriate usage of fund and fraudulent receipt.

(1) Enrolling in Educational Programs on Research Integrity

JST requires as a condition of application for the program that the research project applicant has completed an educational program on research integrity (beginning with the Invitation for Research Proposals for FY2015).

In addition, in the case that the research proposal is accepted, the Research Director, Individual Researcher and participants in the research project are required to take a JST-designated e-learning program on research integrity.

For details regarding the above, please refer to "8.1 Enrolling in and Completing the Educational Programs on Research Integrity" and comply with the measures promptly.

(2) Measures Regarding the Inappropriate Usage of Research Funds

In the case of inappropriate usage of research funding provided under this program, the research project in question will be cancelled and all or part of the project's research funding, etc. must be returned.

Furthermore, depending on the details of the misconduct, limitations may be placed

on the eligibility of those involved to apply for or participate in these programs or other Ministry of Education, Culture, Sports, Science and Technology (MEXT) competitive funding systems, competitive funding systems allocated by independent administrative agencies under the auspices of MEXT (hereinafter referred to as "MEXT-related competitive funding systems"), or competitive funding allocated by independent administrative agencies under other ministries and agencies..

(3) Measures Regarding the Implementation of Research Funding Management/Auditing Systems and Responses to Misconduct at Research Institutions

Research institutions need to take responsibility, implementing a system for managing and auditing research funds, ensuring that research funding is spent appropriately, and taking measures against misconduct etc. including compliance education. Furthermore, in the case that an accusation of misconduct is leveled at a research institution, a prescribed investigation must be conducted and the findings reported to JST. In the case that the actions taken by the institution are found to be inadequate, funding for indirect costs may be reduced.

For details, please refer to "8.6 Regarding implementation of systems based on the "Guidelines of Management and Audit of Public Research Funds in Research Institutes (Implementation standards)"".

(4) Measures Regarding Misconduct in Research Activities

In the case that misconduct in research activities (fabrication, falsification, plagiarism, etc.) is discovered, the research project in question may be cancelled; all or part of the project's research fund etc. returned, and measures taken to publicize the facts of the matter. Furthermore, depending on the details of the misconduct, limitations may be placed on the eligibility of those involved to apply for or participate in these programs or other MEXT-related or national government ministry competitive funding systems.

For details, please refer to "8.7 Regarding implementation of systems based on the "Guidelines for Responding to Misconduct in Research Activities"".

(References)

The above measures shall be implemented in accordance with these application guidelines and the contract research agreement concluded between the research institution in question and JST based on related national government guidelines. The main related national government guidelines are as follows.

- "Guidelines for the Appropriate Implementation of Competitive Research Funding" (decided by the Liaison Conference among Relevant Ministries on Competitive Funds on September 9, 2005; revised October 17, 2012)
- "Guidelines on Management and Audit of the Public Research Expenses in Research Institutions (Implementation standards)" (decided by the Minister of Education, Culture, Sports, Science and Technology on February 15, 2007; revised February 18, 2014)
- "Guidelines for Responding to Misconduct in Research Activities" (decided by the Minister of Education, Culture, Sports, Science and Technology on August 26, 2014)

# Chapter 2
# Small start Type

## 2.1 Concerning the small-start type

### 2.1.1 Outline of the small start type

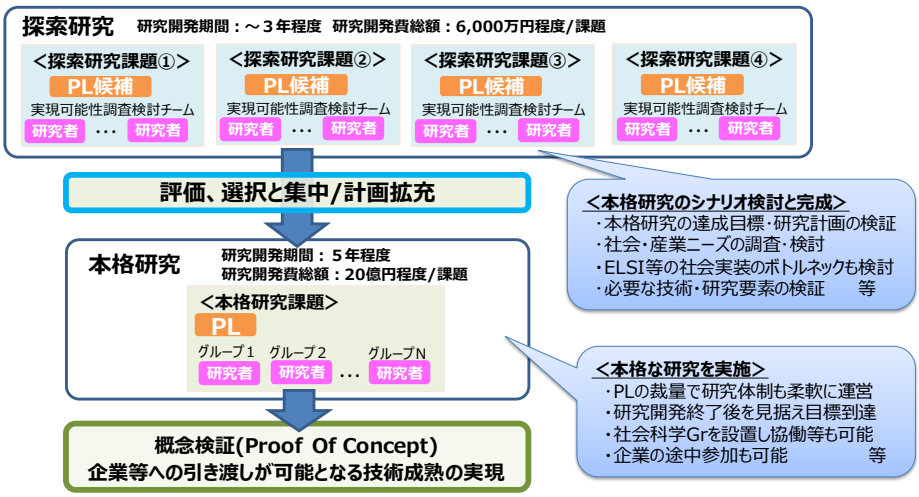
The JST-Mirai R&D Program has set images of the future society that can be achieved through developments in science and technology, or through creating new values sought by society and industries, as prioritized themes, and is requesting research ideas from researchers affiliated with universities, business firms, public research organizations, and select Principal Investigators (Project Leader: PL) (see Chapter V, “FY2017 Open Call Themes”).

**[Characteristics of small-start-type R&D]**

- The PL is affiliated with a university, business firm, or public research organization.
- R&D is pursued up to a stage (POC) where application feasibility can be judged, and then research results are actively submitted to business firms and society.
- The R&D proceeds stepwise, or from feasibility study to full-scale research (small-start method[1]). During the small-start stage, an R&D plan for full-scale research is examined in order to adequately judge the feasibility of the research idea before allowing the project to proceed towards full-scale research.
- A stage-gate method[2] is applied in order to narrow down R&D projects eligible for proceeding from the small-start stage to full-scale research and then becoming full-scale R&D projects. Then, optimum R&D projects are provided with concentrated investment.
- Small-start type R&D is conducted with a total R&D budget of approximately 60 million yen per project for a maximum period of three years, and full-scale research is conducted with a total R&D budget of two billion yen for a maximum period of five years.

(note 1) Small-start method: A mechanism for selecting a large number of projects despite a relatively small budget being available at the time of adoption
(the research scale is expanded when the research passes stage-gate evaluations).

(note 2) Stage-gate method: A system in which R&D is divided into a number of stages, with an evaluation conducted at each stage to decide whether to continue with the project or cancel it.



### 2.1.2 Mechanism of small start type

**(1) Research for small-start projects (small-start type and full-scale research)**

The small-start type adopts a small-start method. The PL conducts small-start-type research and then advances to full-scale research after passing a stage-gate evaluation.

We are requesting proposals for small-start-type R&D projects.

During the research stage of a small-start project, the PL should examine a full-scale research plan (including topics such as: verifying element technologies necessary for conducting full-scale research, verifying the social and economic impacts of POC, identifying the challenges for implementation into society, and creating a plan of necessary activities to be conducted after reaching POC) in order to judge the feasibility of conducting prospective full-scale research.

Upon completion of small-start-type research, JST performs stage-gate evaluations (specified by an R&D supervisor) to decide whether the research should be allowed to proceed to full-scale research or be cancelled. Depending on the judgement of the R&D supervisor, a number of R&D projects may be merged to form full-scale research projects.

At the full-scale research, the PL shall promote R&D activities toward achieving POC goals in consideration of the implementation of the results into society and its further development after completing R&D. Please see “4.1.3 Viewpoints for selection” for criteria for proposal selection (criteria for preliminary evaluation) and supplementary criteria for the selection of research proposals for the small-start type.

**(2) R&D costs and periods**

In principle, the total budget per project for small-start research is approximately 60 million yen (including indirect expenses) and its maximum research period is approximately three years. Occasionally, customized R&D budgets and time periods are set for each prioritized theme. Be sure to see Chapter V before deciding on an R&D plan. JST pays R&D costs (direct expenses) and indirect expenses (a maximum of 30% of the direct costs) to the research organization on the basis of the R&D agreement made.

**(3) R&D system**

We ask that the PL form an optimum R&D team composed of a number of researchers (a proposal may be submitted before the team is formed).

a. The PL may establish a group (“joint research group”) consisting of researchers affiliated with other laboratories or research organizations, if necessary for realizing R&D ideas, in addition to a “PL group” composed of members of her/his own laboratory.
b. Representatives of the members of a “Joint Research group” are referred to as “Lead Joint Researchers.”
c. Depending on research progress, the PL is allowed to employ as many researchers and assistant researchers the budgeted R&D costs will allow (this budget is stipulated within the R&D agreement with the research organization) for participation in R&D.

See “2.2.5, Requirements for application” for requirements concerning research teams.

### 2.1.3 Flow of R&D promotion in small-start projects

(1) Seeking and selecting proposals for small-start projects

JST is recruiting R&D proposals for each prioritized theme in the area stipulated by the government. An R&D proposal of the small-start type, including a clear statement of the POC to be reached and the contents of full-scale research, should be submitted. The entire program shares information and collaborates to select projects for each prioritized theme. Members of the R&D management committee cooperate with the PL during the selection process (see "4.1.2, Selection procedure" and "4.1.3, Selection viewpoints" for details).

(2) Preparation of an R&D plan for an accepted proposal

The PL should prepare a full research plan representing the entire period of the accepted small-start research. The PL should also prepare an annual research plan for each year. The plans should contain research costs and detail the composition of the research team.

(3) Agreement

After adopting a proposal, JST, in principle, concludes an R&D agreement with the research organization that the PL and the main joint researchers are affiliated with.

(4) Executing research

In principle, research must be performed over two and a half years, from October 2017 to March 2020.

*A research budget and period are set for each prioritized theme. See "Chapter V, Prioritized themes and technology themes for which proposals are sought" before preparing an R&D plan.

(5) Evaluation

The R&D supervisor should determine the progress and results of research, receive cooperation from members of the R&D management committee, and make evaluations at stage gates and upon the completion of the R&D project.

<Evaluation of R&D projects>

a. The R&D supervisor should be able to gain an understanding of the progress and results of the R&D and should receive cooperation from members of the R&D management committee in order to be able to make evaluations concerning the transferring of small-start research to full-scale research (stage-gate evaluation). These evaluations will be conducted at stage gates of full-scale research, and upon its completion. Stage-gate evaluations are conducted in the third year of full-scale research and evaluations at completion are made as soon as the R&D is completed, or at a proper time before the completion, depending on the nature and progress of the R&D.
b. In addition to the above, the R&D supervisor may evaluate R&D projects whenever she/he judges it to be necessary.
c. Changes in coordination or resource distribution (increases or decreases in R&D costs and reviews of R&D group compositions) are reflected in the results of project evaluations. Depending on the evaluation results, R&D projects may be finished sooner (i.e., cancelled) or merged or integrated with other projects.
d. A certain period after the completion of R&D, a follow-up survey is conducted concerning

the development and utilization of the R&D results and the activities of participating researchers. On the basis of these survey results, experts selected by JST perform a follow-up evaluation.

Besides evaluating of R&D projects, prioritized themes and R&D supervisors may also be evaluated. This evaluation is performed from the viewpoint of determining progress made towards achieving each theme and administrative performance. Selected Principal Investigators are requested to cooperate in the evaluation as appropriate.

## 2.2 Requesting and selecting small-start type research

### 2.2.1 R&D proposals sought

(1) Research proposals concerning the six prioritized themes described in "Chapter V, Prioritized themes and technology themes for which proposals are sought" are requested

(2) Carefully read the policies of the R&D supervisor in charge of requesting and selecting proposals for each prioritized theme described in "Chapter V, Prioritized themes and technology themes for which proposals are sought," as this will allow you to make a research proposal that is suitable for the prioritized theme.

(3) Be sure to see the description of important common provisions contained in "Chapter IV, Common provisions for small-start research and large-scale projects."

### 2.2.2 Period for submitting proposals

**Wed., June 7, 2017 – Wed., July 19, 2017 at 12:00 noon (No delays accepted)**

Please see "main schedule" on the opening page for details of the schedules for briefings and selection.

Proposals for which, for any reason, the registration procedure is not completed on e-Rad by the deadline will not be accepted for examination.

### 2.2.3 Number of project proposals for adoption

The number of proposals to be adopted for each prioritized theme is 4–10.
(This can vary depending on the objective of each prioritized theme, status of proposal applications, and budget.)

### 2.2.4 Special treatment upon adoption

(1) Concerning possible coordination of areas and prioritized themes

For each prioritized theme included in the selection process, a project supervisor or an R&D supervisor may conduct interdisciplinary coordination of the related research proposals. Consequently, a proposal made under a particular prioritized theme may be transferred to another prioritized theme. In such a case, a notice is sent to the proposer once this decision has been made.

(2) Concerning surveys on specific projects

A "specific project survey" may only be conducted on themes in order to attract

proposals during this and the next submission window. Concerning the R&D proposals, for which small budgets are required, research data can be supplemented over short periods, and accurate evaluations may be expected when applied on and after the next recruitment, the R&D supervisor may request the R&D proposer to perform a specific project survey separately from the adopted project.

A prerequisite for a specific project survey is, in principle, a re-application made under the pertinent prioritized theme and by the deadline specified by the R&D supervisor. In such a case, the application is handled in the same way as other R&D projects; no priority is given. Further, no direct application is allowed for the specific project survey.

### 2.2.5 Requirements for application

Requirements for application are the following (1) – (3):

Be aware of the following, which relates to application requirements.

- Research proposals that do not meet application requirements are, in principle, neither accepted nor adopted.
- Application requirements must be maintained throughout the entirety of the research project's duration, if adopted.

In principle, if the requirements cease to be maintained during the research period, the entire, or part of the, research project is cancelled (finished early).

In addition to (1) – (3) below, an application should only be made once you have gained an appropriate understanding of the contents of "4.1.1, Concerning restrictions on duplicate applications for the JST-Mirai R&D Program."

(1) Requirements for proposers

a. A research proposer, upon becoming a Principal Investigator, forms a research team from members of a domestic research organization (such as a private firm, an incorporated association, or an incorporated foundation) she/he is affiliated with in Japan (the proposer may be of any nationality).

*The following individuals may also apply to be research proposers:

- A researcher who is a foreigner and affiliated with a Japanese research organization.
- A researcher who is not affiliated with any specific research organization or with an overseas research organization but who can work with a Japanese research organization to form a R&D team if adopted as a Principal Investigator (any nationality is acceptable).

b. A researcher who can undertake duties for an entire R&D project, functioning as a representative of a R&D team throughout a R&D period.
(see "4.2.5 Responsibilities of Principal Investigato, Lead Joint Researchers after approval" for details).

c. A researcher who has completed a research ethics education program at the research organization she/he is affiliated with. (see "6.1 Enrolling in and Completing the Educational Program for Research Integrity" for details).

d. A researcher who can pledge to observe the following four points:

- That they understand and comply with "Guidelines for responding to inappropriate behavior during research activity" (a decision made by Minister of Education, Culture, Sports, Science and Technology, August 26, 2016)
- That they understand and comply with "Guidelines for managing and auditing public

research funds in research organizations (practice criteria) (revised on February 18, 2016)"

- That they, as Principal Investigator and R&D participants, will refrain from participating in inappropriate conduct (fabrication, fraudulent alteration, fraudulent use) in regard to research activities, or inappropriate use of research funding, if their research proposal is adopted.
- That they have no record of previous inappropriate research activity; this should be included in the proposal for full-scale research.
  (confirmation of this is required on the information input screen on e-Rad.)

(2) Requirements for research teams

The following requirements must be met.

a. A research team is an optimum system for realizing the idea of the R&D proposer, who will gain the position of Principal Investigator once the proposal is accepted.
b. A joint research group within a research team is necessary and essential for the realization of research ideas and can substantially contribute to achieving research goals.
c. If an overseas research organization participates as a joint research group (such as in a case where a researcher affiliated with an overseas research organization participates as a main joint researcher), it can be difficult to conduct research on realizing the research idea without input from the overseas organization (receiving such input requires approval from the R&D supervisor). In such a case, it should be possible to obtain results, such as intellectual property rights.

*When including an overseas research organization in a research team, describe in the R&D plan (form 3) for the research proposal the reason a researcher affiliated with an overseas research organization is required. Further, the overseas research organization must sign a contract agreeing to the proposed content stipulated by JST (maximum indirect expenses is 30% of direct costs). Before the interview for proposal selection, submit the specified form (to be outlined later) that shows prior approval from a person in charge of contracts for the overseas research organization.

(3) Requirements for research organizations

Research organizations must fully recognize that the original funding for R&D agreements is sourced from public funds, and they should make efforts to conduct their research efficiently, as well as to comply with associated laws. Any research organization that cannot perform the duties described in "4.2.6 Duties of R&D organizations" will not be approved to conduct research. Therefore, be sure to obtain prior approval from the R&D organization at which you plan to conduct your R&D before submitting an application.

## 2.3 R&D proposal (Form) Completion Requirements

A list of the forms to be submitted is shown below. To appropriately prepare an R&D proposal, follow the guidelines provided on the next page onward concerning completing such forms. Be sure to use the forms stipulated for this fiscal year.

Conditions for applications may vary by prioritized theme. Download and use the proposal forms for “small-start type” provided on e-Rad. Be sure to comply with “Chapter 5, FY2017 Open Call Themes” when preparing proposal forms.

| Form No. | Document |
|---|---|
| Form 1 | R&D proposal, cover |
| Form 2 | R&D Project Description |
| Form 3 | R&D plan of Feasibility Study |
| Form 4 | R&D Budget |
| Form 5 | R&D Project Applicant (Project Leader) |
| Form 6 | Other Support |
| Form 7 | Measures for Protecting Civil Rights and Complying with Laws and Regulations |
| Form 8 | References |

*Ensure the file does not exceed 3MB.

*Be sure to familiarize yourself with the definition of a stakeholder provided in “Chapter 4, 4.1.2, Selection method” (2) when preparing proposal forms.

*See “Chapter 7, Submission via the Cross-ministerial R&D Management System (e-Rad)” for application methods for R&D proposals.

*Be sure you have an appropriate understanding of “Chapter 6, Key Points in Submitting Proposals” and “Chapter4, 4.1.1, Concerning restrictions on duplicate applications for the JST-Mirai R&D Program” before making an application.

## (Form 1) R&D proposal "Small-start Type" called for in FY2017, Cover

| | |
|---|---|
| Prioritized theme | |
| Title of R&D project | |
| R&D period<br>*(1) = (2) + (3) | (1) total period: Month, 2017 – Month, Year ( years) |
| | (2) Feasibility study: Month, 2017- Month, Year ( years) |
| | (3) R&D project: Month, Year – Month, Year ( years) |
| R&D Budget<br>*(1) = (2) + (3)<br>Omit decimal point | (1) total R&D budget for whole period ( million yen) |
| | (2) total R&D budget for feasibilitystudy ( million yen) |
| | (3) total R&D budget for R&D project( million yen) |

| | | |
|---|---|---|
| Name of R&D Project Leader | Initial | |
| | Last | *same as above if same Principal Investigator |
| Affiliated Institution, Department, Title | | |
| Effort for this FY | This fiscal year: ____% | |
| Conflicts of interest with PO<br>*check | Conflict of interest with R&D supervisor (PO): ☐ Yes ☐ No<br>*If "Yes", describe contents in Form 3 "6. other" | |
| Researcher number | *Enter the 8-digit "e-Rad" login ID number which is provided by registering researcher information on the The Cross-ministerial Research and Development Management System (e-Rad) | |
| Information on Principal Investigator | URL:<br>author ID:<br>*URL if website (lab website, researchmap page) available for information on Project Leader, or ID if ORCHID ID, Researcher ID, or SCOPUS author ID is known | |

# (Form 2) R&D Project Description

*Delete guidelines in blue letters when completing this form.
*Be sure to check the policies of the R&D supervisors for each area, which are described in the application information. See “4.1.3, Viewpoints for selection” and “Chapter V, Prioritized themes and technology themes for which proposals are sought.”

## 1. POC to be achieved by this R&D project

*Provide simple and clear descriptions of the POC to be reached by these R&D projects during the small-start-type research phase and the full-scale research phase.

## 2. Reasons for setting the particular POC

*Take into account the following when describing why you set a particular POC as a goal:
- What are the social and industrial problems relating to the prioritized theme for which immediate actions should be made to determine a solution? Also provide how and why these problems were chosen.
- Values, i.e. social and economic impacts, that are believed to create both in Japan and overseas when these problems were solved (social implementation of technologies that allow the POC to be reached)

*Prepare a separate compact summary of the contents of “1. POC to be reached by these R&D projects” and this description, not exceeding 300 words, and include this summary in the “research objective” section of “common provisions” on e-Rad.

## 3. Measures necessary for reaching POC

*Clearly describe the background and any problems that may hinder you in reaching the stipulated POC. Describe necessary measures that will be taken toward realizing the POC during both the small-start-type research phase and the full-scale research phase. Also, describe the originality, inherent challenges, and effectiveness of your proposal.
*If possible, describe ideas for developing the research results beyond the POC (business model, distribution to private firms) and their social implementation (optional). (These can be subjects approached during research into the small-start-type, even if they are not yet concrete ideas. In such a case, describe the preparatory situation using form 3.1).
*In the case of a proposal relating to the “realization of a low carbon society, a global issue” area, quantitatively show the degree to which the technology projects to be approached will contribute to the realization of a low carbon society by approximately 2050.

*- Do not exceed two A4-size sheets (no exceptions) -*

# (Form 3) R&D plan of Feasibility Study

*Delete guidelines in blue letters when completing this form.

## 1. Preparatory situation at the beginning of full-scale research

*Provide a concrete description of the following, including the preparatory situation for full-scale research and R&D trends in Japan and overseas.

- Evidence-based verification of social and industrial impacts, as well as social and industrial needs
- Technology issues and understanding of their difficulties and feasibility
- Your understanding of the problems relating to the social implementation of the proposal
- Details of the full-scale research plan (team to conduct research, budget, milestones)
- Details of activities to be taken, keeping in mind the development of research results (business model, passing research results to private firms, etc.)

## 2. Matters to be achieved in small-start-type research

*On the basis of 1., clearly describe, within 300 words, matters to be achieved during the small-start-type research phase.

*copy this description and paste it into the “research outline” section of e-Rad’s “common provisions.”

## 3. Contents of the execution of small-start-type research

## 4. Team to conduct small-start-type research

### (1) Description of the R&D team

*Provide a description of your research team.

(Make corrections as appropriate in order to ensure that your team is capable of fulfilling the concept and plan of the proposed small-start-type research. The illustration below is for reference.)

**(2) Project Leader's Group** (example)

| Name of Principal Investigator | name of organization[1)] | title | effort[2)] |
|---|---|---|---|
| OO OO | OOuniversity<br>graduate school<br>OOdepartment OOmajor | professor | 40% |
| Name of R&D Participant[3,4)] | affiliation (omit if same as above[5] | title | |
| OO OO | | professor | |
| OO OO | | associate professor | |
| OO OO | | lecturer | |
| XX XX | XX Co., Ltd., XX Institute | chief researche | |

1) If the organization you are currently affiliated with differs from the organization at which you propose to conduct the adopted research, describe the latter in the column relating to special matters and inform us of the reason you have chosen this institution.
2) In the "effort" column, enter the distribution percentages (%) for the time required for the research relative to 100%, which represents the total work hours (including not only research activities but also education and therapeutic activities) of researchers in a year.
3) Fully describe the roles to be played by the members of the research group.
4) Add necessary information concerning the researchers participating in R&D. A description such as "X researcher" is acceptable in cases where the names of researchers are not known at the time the proposal is submitted.
5) When multiple organizations are required to research a particular item, the addition of members from different organizations as participants in the R&D process is acceptable.

**(2-1) Role of the group in relation to generating R&D ideas**

**(2-2) Special matters**

*Give details of situations (background, reasons, etc.) when work hours (effort) is necessary for completing special tasks (such as managers including the head of research departments or chairmen of academic associations in the process).

**(3) Joint R&D Group A**

- When joint research groups (joint research organizations) outside of the organization the Principal Investigator is affiliated with are required, describe each group separately.

- It is possible to include members of various research organizations affiliated with industries, universities, and the government in joint research groups.
- There is no limit to the number of joint research groups; however, forming an optimal team for pursuing the Principal Investigator's research idea should be the priority.
- Add or delete tables depending on the number of research groups involved.
- It is not mandatory to add members of joint research groups to research teams.

**Joint R&D group A** (for example)

| name of main joint researcher | name of joint research organization[1)] | title | effort[2)] |
|---|---|---|---|
| OO OO | OOInstitute OODepartment OOteam | team leader | 10% |
| Researcher number[6)]: 12345678<br>Research organization code[7)]: 1234567890 | | | |
| Name of R&D Participant[3,4)] | affiliation (omit if same as above) | title | |
| OO OO | | chief researcher | |
| OO OO | | researcher | |
| Plan to employ two | | special researcher | |
| XX XX | XX Co., Ltd. X Institute | chief researcher | |

1)-5) See previous pages.

6) Provide the eight-digit number of the main joint researcher, which was given upon registering researcher information on the R&D management system common to ministries (e-Rad).

7) Provide the codes for each affiliated research organization given by the R&D management system common to ministries (e-Rad).

**(3-1) Role of groups in generating R&D ideas**

**(3-2) Special matters**

*Enter situations when and reasons measuring of work hours (effort) is necessary during special tasks (such as when managers, such as heads of research departments or chairmen of academic associations, are involved).

*When adding an overseas research organization to a research team, see "(2) Requirements for a research team," of application information, "2.2.5, Requirements for applications," and then describe in this column the reason the inclusion of joint researchers affiliated with overseas research organizations is

necessary.

### (4) Other participating R&D organizations

| Name of R&D participant[3, 4)] | affiliation | title |
|---|---|---|
| OO OO | OOInstitute OODepartment OOteam | chief researcher |
| OO OO | | researcher |
| XX XX | XXCo.,Ltd. XXInstiture | chief researcher |

*Private firms and universities that have not signed an R&D agreement with JST in regard to participation but that are collaborating and cooperating with research groups that have signed an R&D agreement with JST relating to participation

#### (4-1) Role of organizations participating in R&D ideas

#### (4-2) Special matters

*When adding an overseas research organization to a research team, see "(2) Requirements for research teams" of application information "2.2.5, Requirements for application," beforehand and describe the reason joint researchers affiliated with overseas research organizations are required.

## 5. The Principal Investigator's management policies

### (1) Policies for research promotion

*Improvement, correction of proceedings, introduction of new findings and technologies, policies for developing results

### (2) Policies for managing intellectual property

*Policies for managing intellectual property should include the following:

- A basic idea of the Principal Investigator concerning how to build a management system and manage the intellectual property of the project.
- A basic description of how research results created by this research project will be grouped so that they are not considered to constitute intellectual property; in addition, a basic plan for deciding whether the results should be disclosed to the public.
- A basic plan concerning acquiring and maintaining or abandoning or transferring (including how to obtain funding) intellectual property rights during and after researching this project

## 6. Other

**(Common)**

*Describe the current status of preparations and examinations as to the support measures and systems at major research organizations.

*Describe the contents of conflicts of interests with R&D supervisors, if any. Check (2) of “4.1.2 Selection methods” for a definition of conflicts of interests.

**(by Prioritized Themes)**

*If there are any other special matters specified by a prioritized theme, describe them here.

# (Form 4) R&D Budget

*Delete guidelines in blue letters when completing this form.

*During the small-start-type phase, different prioritized themes may have different research periods. Be sure to check the R&D supervisor's policies relating to the area in question by consulting the application information contained within "Chapter V, Prioritized themes and technology themes for which proposals are sought" when completing this form.
*Enter an annual research-expense plan for each expense item and for each research group.
*More detailed research expense plans are requested for selection interviews.
*Research expenses may be reviewed upon adoption or during the research period, depending on the budgeting situation of the entire program, the management of the research area by the R&D supervisor, or the project-evaluation situation.
*Propose a necessary, adequate, and optimum team composition for realizing the Principal Investigator's research idea. A joint research group is essential for realizing a research idea and would greatly contribute to achieving a research objective.

○ **Research expense plan by expense account (for an entire team)**

| | Small start type | | | | large scale research |
|---|---|---|---|---|---|
| | 1st year (2017 Oct. -2018 Mar.) | 2nd year (2018 Apr. -2019 Mar.) | 3rd year (2019 Apr.- 2020 Mar.) | total (million yen) | FY 20XX -FY 20XX ( ) |
| equipment expense | | | | | |
| supplies expense | | | | | |
| travel expense | | | | | |
| personnel expense, gratitude (number of researchers) | ( ) | ( ) | ( ) | | |
| other | | | | | |
| direct expense | | | | | |
| indirect expense | | | | | |
| total(million yen) | | | | | |

*Research expense accounts and their uses are as follows:
- Facility and equipment: purchases of facilities and equipment
- Supply: purchases of supplies
- Travel: travel expenses for the Principal Investigator and researchers
- Personnel and gratitude: personnel costs of researchers, engineers, research aids, and RA(*), as well as for providing tokens of gratitude

*See application information "4.2.7(1), Concerning improving the treatment of students in doctoral courses (the latter stage)" for RA (research assistant).

### ○ Special matters

*Stipulate optimum budget and ratio for each account.

*If applicable, describe the reasons personnel expenses exceed 50% of the total research expenses or supply expenses and travel expenses exceed 30% of the total research expenses.

### ○ R&D Budget plan by group

*Propose a necessary, adequate, and optimum team composition for realizing the Principal Investigator's research ideas. A joint research group is essential for realizing a research idea and can greatly contribute to achieving a research objective.

| | 1st year (2017 Oct -2018 Mar.) | 2nd year (2018 Apr. -2019 Mar.) | 3rd year (2019 Apr.- 2020 Mar.) | total (million yen) |
|---|---|---|---|---|
| Principal Investigator Group OO university | | | | |
| Joint research G-a XX university | | | | |
| Joint research G-b XX university | | | | |
| direct costs | | | | |
| indirect costs | | | | |
| total(million yen) | | | | |

### ○ Major facilities to be utilized (name of instrument, installation site)

○ **Major facilities planned for purchase ( more than JPY5,000,000 for every order, name of instrument, approximate cost)**

(example)

Group A:

XXXXXXXXX 15,000 K yen (1,000 yen)
XXXXXXXXX 5,000 K yen
XXXXXXXXX 10,000 K yen

Group B:

XXXXXXXXX 7,000 K yen
XXXXXXXXX 10,000 K yen

# (Form 5) R&D Project Applicant (Project Leader)

*Delete guidelines in blue letters when completing this form.

## ○ Basic information on the Principal Investigator (PL)

| | | | |
|---|---|---|---|
| (phonetic) Name | | | |
| Nationality/ gender | | birth date (A.D.) | |
| Affiliation, title | | | |
| Academic history (after graduation from college) | academic history:<br>(Filling-in example)<br>OOyear OOuniversity OOdepartment graduation<br>OOyear HOOyear OOgraduate school OOdepartment master's course OOmajor<br>OOyear OOgraduate school OOdepartment doctoral course OOmajor<br>OOyear Ph.D. (OOmajor) (OOuniversity) | | |
| Research history (main history and research contents) | job history:<br>(Filling-in example)<br>OOyear-OOyear OOCo.,Ltd OOR&Ddepartment (development of OOOO)<br>OOyear-OOyear OOuniversity special associate professor (research on OOOO)<br>OOyear-OOyeat OOCo., Ltd OOdepartment (in charge of OO) | | |
| Other special matters | (voluntary description on social contributions, international activities) | | |

## ○ List of achievements by the Principal Investigator (PL)

*Describe up to 20 previous achievements, such as published papers and books, related to this R&D project in chronological order, starting with the most recent.

*Follow the instructions below concerning items on papers to be described (the same applies to authored books):

*You may choose the order of the items freely.

*Put a "●" mark before the title of a paper if the paper is cited in form 3.

**<Project Leader>**

(example)

- Author(s)(all authors), Title, Journal/Book, Volume, Page numbers and Published year

**<Lead Joint Researcher A>**

(example)

- Author(s)(all authors), Title, Journal/Book, Volume, Page numbers and Published year

**< Lead Joint Researcher B>**

(example)

- Author(s)(all authors), Title, Journal/Book, Volume, Page numbers and Published year

# (Form 6) Information on Other Supports

*Delete guidelines in blue letters when completing this form.

*If the Principal Investigator and Lead Joint Researchers are receiving, applying for, or planning to apply for alternative funding systems or other research subsidies (including from private foundations or overseas organizations), describe the research title, research period, role, amount of research expenses received, and efforts made thus far for each of system or subsidy. Also, see application information "6.3, Measures to address unreasonable duplication and excessive concentration."
*If a description is found to be false, an adopted proposal may be cancelled later.
*If, during the selection process for this research proposal, a description in this form requires alteration because the research subsidies applied or planned to be applied for, as mentioned above, have been altered, correct this form and send a notification e-mail to the contact details provided at the end of these application requirements.
*Copies of the application documents and plans submitted to other systems may be requested during the selection interview.

(example)
**Project leader: XX XX (name)**

| Name of System | receiving situation | name of research projects (name of representative) | research period | role (representative/ shared role) | (1) received research expense (whole period)<br>(2) (2018 fiscal planned)<br>(3) (H29 fiscal planned)<br>(4) (H28 fiscal actual) | effort (%) |
|---|---|---|---|---|---|---|
| JST-Mirai Program (this Proposal) | applied | | | representative | | |
| Science research subsidy, base research (S) | received | ◊◊ creation by xx (OOOO) | 2015. Apr. -2019 Mar. | representative | (1) 100 M yen<br>(2) 50 M yen<br>(3) 25 M yen<br>(4) 5 M yen | 20 |
| JST strategic Research promotion CREST | applied | ◊◊ upgraded function by xx (OOOO) | 2017 Oct.-2023 Mar. | shared role | (1) 140 M yen<br>(2) 35 M yen<br>(3) 8 M yen<br>(4) - | |
| | | | | | | |

*List, in descending order of the amounts received (over the entire period), subsidies received or expected to be received. Then, describe subsidies applied for and those that you plan to apply for, if applicable.
*If a subsidy is being received or you expect to receive it, enter “received.” Enter “applied” if you have applied for but not yet received a subsidy or if you plan to apply for a subsidy.
*Describe representative or shared duties under “role.”
*Describe the amount (direct expenses) to be received by the research representative her/himself under “research expenses received by the research representative.”
*Describe the distribution ratio of the time required to perform the research relative to 100%, which represents total annual work hours (including not only time for research activities but also educational and therapeutic activities) under “effort” [as defined at the Comprehensive Science, Technology, and Innovation Convention]. Only account for efforts expended or planned to be expended on the presumption that a proposal is adopted by JST-Mirai R&D Program, not efforts made in regard to proposals submitted to other research organizations, such as those applied to or those planned to be applied to. The total efforts made during the small-start-type phase and efforts made toward subsidies being received should not exceed 100%.
*Add or delete lines as necessary.

(example)

**Lead Joint Reseacher a: XX XX (name)**

| Name of System | receiving situation | R&D project name (name of representative) | research period | role (representative/sharing) | (1) received expenses (whole period)<br>(2) (H30 fiscal planned)<br>(3) (H29 fiscal planned)<br>(4) (H28 fiscal actual) | effort (%) |
|---|---|---|---|---|---|---|
| JST-Mirai (this Proposal) | applied | | | shared | | |
| | | | | | (1) 000 yen<br>(2) 000 yen<br>(3) —<br>(4) — | |
| | | | | | | |

(example)

**Lead Joint Reseacher b: XX XX (name)**

| Name of System | receiving situation | R&D project name (name of representative) | research period | role (representative/ sharing) | (1) received expenses (whole period) (2) (H30 fiscal planned) (3) (H29 fiscal planned) (4) (H28 fiscal actual) | effort (%) |
|---|---|---|---|---|---|---|
| JST-Mirai (this Proposal) | applied | | | shared | | |
| | | | | | (1) 000 yen (2) 000 yen (3) — (4) — | |
| | | | | | | |

# (Form 7)

## Protection of Human Rights and Compliance with Laws and Regulations

*Delete guidelines in blue letters when completing this form

*Describe the measures and actions that you will take if your research involves compliance with the related laws and regulations (e.g. research requiring the consent and the cooperation of the other party when implementing the research plan, research requiring consideration for the handling of personal information and research requiring efforts regarding bioethics and safety measures).

*This applies to surveys, research, experiments which require an approval procedure in an ethics committee inside and outside the research institution, such as for example questionnaire surveys in which personal information is involved, interview surveys, the use of provided samples, analysis study of the human genome, recombinant DNA experiments, experiments on animals, etc.

*Please indicate where this is not applicable.

# (Form 8) References

*Delete guidelines in blue letters when completing this form.

*Provide the names of two (2) individuals who have good knowledge of your Research Project (non-Japanese person(s) are acceptable). Provide names of the reference person, institution and contact information (phone numbers and e-mail address). The evaluators (JST and R&D Supervisor) may contact them regarding the R&D proposal during the screening process.

*Providing this reference information is not mandatory.

# Chapter 3
# Large-scale Type

## 3.1 Concerning the large-scale type

### 3.1.1 Outline of the large-scale type

An outline of JST-Mirai R&D Program (large-scaletype) is included below.
For additional information, see “Chapter IV, Common matters arising in relation to small-scale and large-scale typesand initiatives.”

(1) JST-Mirai R&D Program collects and analyzes information concerning science and technology innovations, introduces changes to current technology systems, and makes concentrated investments in technology R&D, in order to develop future base technologies specified by the Ministry of Education, Culture, Sports, Science, and Technology. These are used to carry out research for technological demonstrations.

(2) An R&D supervisor oversees several areas of technology and manages entire large-scale research initiatives. To accomplish this, s/he collaborates with experts in particular technological fields, using the following means to fully explore each technological theme, and to monitor the progress of the PM (Project Manager) and R&D projects:

- Select R&D projects;
- Advice, coordination, and approval of research plans (including R&D expense plans and teams);
- Evaluations of the work of PMs or research representatives, including how well they challenge, motivate, and give guidance to staff;
- Surveys carried out during site visits;
- Evaluations of the PM’s activities, achieved goals, and advice;
- Recommendations to the R&D supervisors conference that a PM be terminated or an R&D project revoked;
- various other means.

(3) The Project Manager(PM) developes the Proof of Concept (POC) based on excellent, original R&D ideas that s/he has established. S/he then prepares milestones and an R&D plan (including R&D costs and team plans). The PM is responsible for entire R&D projects and for the whole R&D team which s/he directs, manages, and guides in its progress, ensuring that the R&D reaches its goal.
The PM can flexibly form an optimum R&D teams composed of a number of researchers and organizations (for example, by issuing a public call for researchers) once the R&D plan has been approved by an R&D supervisor. The PM will promote the R&D project while receiving stage gate evaluation (to determine whether the R&D project should be continued or revoked) based on milestones set at the launch of the R&D project.

(4) To ensure swift social implementation of a newly createdfundamental technology, while encouraging investment from the private sector, large-scale typeencourage early participation by private firms and require a commitment to contribute funds from an “organization asked

to provide funds" (a "sponsoring organization"). See "3.1.2, Mechanism large-scale type". If sufficient funding is not provided by a sponsoring organization, action may be taken to terminate the R&D project early (revocation). For additional information about stage gate evaluation, see "3.1.2, Mechanism large-scale type (9)

### 3.1.2 Mechanism large-scale type

**(1) The execution of R&D projects managed by the PM**

○ A PM employed by JST is selected by the R&D management convention on PM and R&D projects and by the R&D supervisors' convention.

*There may be cases in which a quasi-mandate contract is offered in lieu of an employment contract, as described below.

○ JST signs a contract with an R&D organization on the basis of the PM's R&D plan, which has been approved by an R&D supervisor. The R&D organization carries out R&D in accordance with the R&D agreement. The PM is responsible for the execution and management of the R&D.

**(2) PM progress reports**

○ The PM shall give an R&D progress report to the R&D supervisor approximately once every six months. To assist the PM in effectively assessing progress, The R&D supervisor and R&D management committee members will ask PM to make progress reports and site visits as necessary.

○ The R&D supervisor and R&D management committee members will take into account the content of the progress reports when asking the PM for necessary improvements. When requested to make improvements, the PM is encouraged to adopt high-risk high-impact approaches, as the system is set up to provide him/her with the necessary freedom and authority.

○ The R&D management convention shall be allowed to ask JST to terminate a PM on the following grounds: on the basis of an evaluation or examination by the R&D supervisor; if improvements requested by the R&D supervisor and R&D management committee members are not made; and when it seems unlikely that the project will achieve its stated goal.

○ The PM is allowed to ask for advice from the R&D supervisor and from R&D management committee members. When asked for advice by the PM, the R&D supervisor must provide proper advice, as required.

**(3) Employment conditions for PMs**

In principle, employment conditions for PMs are as shown below. JST and PM will agree on a contract of employment accordingly.

Site: Tokyo

Term: until the completion of the R&D project/s (March 31, 2027 at the latest) note

Remuneration: as JST determines taking account of PM's experiences, within a range of

12,750,000 yen/year maximum. Commuting expenses are paid separately, as stipulated in the Rules of Employment. Various security/insurance benefits are included.
Form of contract: a single year contract. The contract is renewed each year based on JST's evaluatation on PM's performance.

Note: If the stage gate review and progress evaluations result in R&D termination, the period for contract renewal will extend to the end of the R&D period at the latest. Furthermore, if the R&D project runs into difficulties, or the PM needs to be replaced for a special reason, his/her term of employment runs up to the time of replacement.

**(4) R&D expenses**

The maximum budget for a project has been tentatively set at 1.4–2 billion yen (including indirect expenses, approximately 350-500 million yen/year for each year from the first to the fourth year).
The budget is set in accordance with the technological area involved. For more information, see "Chapter V, Calling for proposals in high priority or specified technological areas."
Based on the R&D agreement, the JST makes a payment to cover R&D expenses and indirect expenses (up to a maximum of 30% of direct expenses) to an R&D organization; these are contract R&D expenses.

**(5) R&D expenses: assessment and variability**

The proposed budget and R&D expenses are subject to assessment during the selection period; they can be changed to reflect constraints on the total budget. Actual R&D expenses are determined through the strict examination and approval of an R&D plan, stage gate reviews, and a clear understanding of progress.
The R&D budget is set each year, taking into account R&D progress and the total budget for all projects underway that year.

**(6) The R&D term**

An R&D period is about nine-and-a-half years maximum, from October 2017 to March 2027 (or until the end of the fiscal year following the 10th fiscal year), as long as the R&D initiative in question continues after the stage gate reviews. If the stage gate reviews and progress indicators result in an R&D termination, the PM is expected to consult with the R&D supervisor to summarize R&D achievements for the year.
The actual R&D period is determined through strict examination and approval of an R&D plan, stage gate reviews, and an assessment of progress.

**(7) The R&D team**

The PM is asked to form an optimum R&D team, composed of a number of organizations and researchers and drawn together by her/his own excellent, original R&D ideas. The team must be assembled using appropriate methods, including nominating and calling for experts.

Japanese research organizations and researchers must be selected for their ability to contribute high-level knowledge and R&D capabilities.

a. The PM may set up a research group ("joint research group") composed of researchers affiliated with laboratories or research organizations in order to follow through on R&D ideas.

b. Of the members of an R&D team, the representative of a "joint research group" is referred to as the "main joint researcher."

c. Researchers and research assistants for an R&D project may be employed using R&D expenses (within the research organization's R&D agreement) if needed to advance the research.

*See "3.2.4, Requirements for application" for a list of research team requirements.

d. If necessary, the PM can set up a research-focused "R&D representatives group" composed of researchers that s/he directs.

**(8) R&D support system**

As part of the R&D system, the PM is asked to establish a support system and measures to ensure that R&D will be carried out effectively and efficiently by researchers so that they can concentrate on R&D tasks.

To achieve this goal, the PM is asked to identify a system and relevant measures to support and promote R&D, in cooperation with the main joint researchers and R&D organizations. The R&D organizations, in particular, are expected to fully exploit their various functions and mechanisms to support the R&D project, as well as providing any assistance needed by the PM. The PM is asked to summarize the supporting measures that research organizations have committed themselves to providing, and to include this summary in an R&D proposal.

**(9) Stage gate evaluation**

Stage gate evaluation may lead to (i) changes in team composition, (ii) increases or decreases in R&D expenses, and (iii) termination of an R&D project.

For projects accepted during the 2017 fiscal year, a first stage gate evaluation will be made by the end of the 2020 fiscal year, at the latest. The R&D supervisor will determine the timing of the stage gate evaluation, on the basis of an R&D plan.

To ensure that newly created fundamental technologies are brought swiftly to the stage of social implementation, and also to attract private investment, a certain amount of funding for planned R&D from a "sponsoring organization" (as defined below) is required at the first stage gate evaluation after the launch of an R&D project. If no sponsorship funding is secured, a comprehensive evaluation may lead to the early termination or adjustment of the R&D project.

- The types of organization that can be asked to provide funding (sponsoring organizations) include the following: private firms, such as corporations, holding companies, limited corporations, general incorporated associations, general incorporated foundations, public interest incorporated associations, or public interest incorporated foundations.

- Corporate sponsorship can be used to cover the following expenses:

(a) A corporate sponsor can support an R&D organization that has signed an R&D agreement with JST by funding or offsetting joint R&D expenses (including indirect expenses) within a selected project. Appropriate forms of support include donations, gifts-in-kind (including the use of facilities, equipment, and supplies), personnel costs, gratuities, and travel expenses.

(b) R&D expenses can be directly funded by a sponsoring organization to promote R&D in selected projects. These expenses include the cost of supplies and equipment, personnel costs, gratuities, and travel expenses. They also include the salaries of researchers seconded by the corporate sponsor to an R&D organization that has signed an R&D agreement with JST.

(c) Expenses paid directly by the sponsoring organization to secure the right to make use of R&D results produced by the selected projects

- Definition of a "certain amount of funding"

20% or more of total R&D expenses (as set out in JST R&D agreement) per year must be funded by a sponsoring organization.

(Funding received from a sponsoring organization)/( Expenses associated with the R&D agreement are covered by JST and by funding provided by the sponsoring organization) = 20% or more

### 3.1.3 The promotion of large-scale type

**(1) Calling for and selecting R&D proposals**

JST calls for R&D proposals in every area of technology specified by the Ministry of Education, Culture, Sports, Science and Technology. The R&D supervisor collaborates with members of the R&D management committee to select proposals in each technolocgical theme.

**(2) The preparation of an R&D plan**

When a proposal has been selected, the PM prepares a comprehensive R&D plan to cover the whole R&D period. In addition, the PM prepares an annual R&D plan for each fiscal year. An R&D plan includes project goals, such as POC and milestones, R&D expenses, intellectual property creation plans, and the composition of an R&D team.

**(3) Contract**

When an R&D plan has been chosen, JST signs an R&D agreement in principle with a research organization that the PM and main joint researcher are affiliated with.

The PM selects R&D organizations by using appropriate methods, including nomination and publically calling for participants. In principle, chosen organizations may take part in R&D projects once they have signed an R&D agreement with the JST.

**(4) Conducting R&D**

An R&D period can last a maximum of about nine and a half years—
from October 2017 to March 2027 (it is possible to extend this period to the end of the 10th fiscal year). This timeframe includes stage gate reviews and R&D continuation (stage up). If stage gate review and progress management results lead to the R&D project being terminated, the PM is expected to consult with the R&D supervisor and to summarize the R&D results for that year.

**(5) Evaluation**

The R&D supervisor monitors the progress and results of the R&D and collaborates with members of the R&D management committee to evaluate the project at each stage gate review, and to ensure the completion of the project.

<Evaluating R&D projects and PMs>

a. An R&D supervisor monitors the progress and results of the R&D and collaborates with members of the R&D management committee to submit evaluations at stage gate reviews and to ensure the completion of R&D projects. A stage gate review is carried out approximately three years after the launch of the research project, to determine whether or not it should continue. An interim evaluation is carried out approximately every three years after the stage gate review. A final assessment is made during the last year of an R&D period.

b. In addition to the above, an R&D project evaluation may be carried out whenever the R&D supervisor judges that it is necessary.

c. The results of project evaluations, including the interim review, are taken into consideration during subsequent adjustments to an R&D plan. They also contribute to resource distribution (an increase or decrease in R&D expenses, or a change in the composition of the research group). Some evaluation results may lead to early completion (termination) of an R&D project or to the adjustment of an R&D period.

d. Both the activities of the PM her/himself and the R&D project are evaluated. JST also evaluates project personnel each year.

e. At a set time after an R&D project has been completed, a follow-up survey is carried out to analyze the development and use of R&D results and the activities of research participants. Outside experts appointed by JST will provide a follow-up evaluation, based on the results of the follow-up survey.

In addition to the R&D project evaluation, the R&D supervisor’s effectiveness in achieving a goal may be assessed, from a management viewpoint. The appointed PMs are asked to cooperate with these evaluations, as necessary.

**(6) Situations where it is difficult to continue an R&D project**

When one of the situations described below arises, JST determines whether an R&D project should be continued on the basis of analyses carried out by the R&D supervisor and management committee.

a. If a PM should pass away, or PM should receive an order of commencement of guardianship

b. If the PM misused R&D funds or other forms of inappropriate conduct related to the R&D activity

c. When other reasons to make it difficult to continue the R&D

## 3.2 Requesting and selecting large-scale research

### 3.2.1 R&D proposals sought

(1) R&D proposals are called for in three technological themes, as described in "Chapter V, Calling for proposals in high priority or specified technological areas."

(2) Further information about the three key technological areas are described in "Chapter V, Calling for proposals in high priority or specified technological areas." This chapter also explains the policies by means of which the R&D supervisor calls for, selects, and manages proposals, ensuring that they fit within the three specified technological areas.

(3) Be sure to check important common matters described in "Chapter IV, Common matters arising in relation to small-scale and large-scale research projects and initiatives."

### 3.2.2 Period for submitting proposals

**Wed., June 7, 2017 – Wed., July 19, 2017 at 12:00 noon (No delays accepted)**

See the "main schedule" for briefing and selection on the opening page.

Only if an application procedure has been completed through e-Rad by the deadline will a proposal be subject to examination.

### 3.2.3 Number of project proposals for adoption

We plan to accept one project in each technological theme.

### 3.2.4 Requirements for application

Application guidelines are described below in points (1)-(3).

Please be aware of the following requirements:

*An R&D proposal that does not meet all requirements by the selection deadline will, on principle, be neither selected nor accepted.

*Application guidelines and requirements must be adhered to throughout the entire R&D research period, once a proposal has been accepted. If any requirements are neglected during this period, the whole or part of the R&D project will be terminated. Before applying, ensure

that you have read and understood “Chapter 6, Application Precautions” in addition to the following points, (1)-(3).

**(1) Requirements for submitting a proposal**

The applicants shall meet all of the following requirements.

- An application shall be made by one person; it may not be a joint proposal.

- The applicant is employed by JST and must work exclusively on PM tasks. S/he may swiftly terminate this JST contract within six months of employment (whether directly employed by or seconded to JST). A contract of employment may be terminated within one year of acceptance, if approved by the R&D management committee. Depending on how the contract is handled, an R&D agreement with an R&D organization directed by the PM may be suspended.

- The applicant must work exclusively on project management tasks, to fulfil the aims of the system. However, the applicant may also do the following:

  i. take advantage of a cross-appointment systemnote) to engage in tasks (excluding research tasks, see ii below) as a university instructor, as long as this takes up no more than 10% of his/her time and effort.

  ii. carry out R&D projects related to the R&D agreement with JST that take up no more than 10% of his/her time and effort; this scenario only applies when it is highly effective for the PM her/himself to carry out such research, and when the application is affiliated with a university or public organization, such as an independent legal corporation. An applicant affiliated with a university may spend no more than 20% of his/her time overall on R&D and university teaching.

  Note) A temporary measure allows an applicant affiliated with a university that has no cross-appointment system in place to participate as PM based on a quasi-mandatory contract with JST.

  (a) The university plans to set up a cross-appointment system.

  (b) The applicant concludes his/her employment contract with JST within a year

- An applicant who becomes the PM is affiliated with a research organization in Japan to form a research team there (there are no restrictions on the applicant’s nationality).

*The persons mentioned below may also propose research projects:

Researchers of foreign nationality who are affiliated with research organizations in Japan;

Researchers who are not affiliated with any Japanese organization or affiliated with overseas research organization, but who can be affiliated with a research organization in Japan to form a research team if accepted as an R&D representative (there are no restrictions on the applicant’s nationality).

*People affiliated with private firms, including research organizations other than universities, are also acceptable.

- The applicant can manage all aspects of the R&D project in question, as the person in charge of an R&D team.

*See “4.2.5, The duties of accepted R&D representatives and main joint researchers” for additional details.

-The applicant has completed a research ethics education program at the R&D organization that s/he is affiliated with. Alternatively, the applicant may have completed an education program provided by JST.

*See “6.1, Regarding attendance at and completion of a program of research ethics education” for details.

- The applicant pledges to observe the following four points and understands and agrees to comply with the “Guidelines for responding to fraudulent behavior at research organizations (Ruling by the Minister of Education, Culture, Sports, Science and Technology, August 26, 206).”
The applicant understands and agrees to comply with the ”Guidelines for the management and audit of public research expenses at research organizations (practical criteria), revised on February 18, 2014.”
The PM and R&D participants are forbidden to engage in fraudulent behavior (fabrication, fraudulent modification and use) or to declare fraudulent research expenses.

- The applicant has not been involved in fraudulent research activities involving research achievements described in the research proposal.

*The applicant is requested to confirm his/her acceptance of these terms by using the e-Rad screen for inputting application information.

**(2) Requirements for research teams**

A research team needs to meet the following requirements. Also see “4.1.3 Perspectives on selection.”

a. A research team is an optimum system for realizing the R&D ideas of the author of an R&D proposal, acting as the research representative.

b. A joint research group, placed in an R&D team, is indispensable for realizing R&D ideas and can greatly contribute to achieving research objectives.
Research that an overseas research organization is collaborating as part of a joint research group ( a researchers affiliated with the overseas research organization are participating in the research as lead researcher), must be the one that it is difficult to achieve goal of R&D ideas without participation of the said foreigh organization (the approval of the R&D supervisor is necessary). When working with an overseas body, it should be possible to fully grasp intellectual property rights arising from the research. *Those who wish to form an R&D team that includes an overseas research organization must describe the composition of the overseas team in the joint research group column of a large-scale R&D proposal (R&D system-form 5). They must also explain, under “special matters” why the joint researchers

affiliated with the overseas research organization are needed.
The overseas research organization must, on principle, accept JST's R&D funding guidelines (maximum indirect expenses of 30%) when signing an agreement with JST. Please submit a form (to be finalized later) to show prior approval by a responsible person in the contract department of the overseas research organization before the selection interview. An overseas research organization is not allowed to participate in an R&D team unless an R&D agreement can be signed.

**(3) Requirements for R&D organizations**

An R&D organization must fully recognize that R&D funding is public money; it must therefore comply with the laws that require R&D to be carried out efficiently.
A project at an R&D organization that cannot fulfil the requirements and duties described in "4.2.6, Duties of an R&D organization" will not be approved. Be sure to obtain prior approval from the organization at which the R&D will be carried out before making an application.

## 3.3 R&D proposal (Form) Completion Requirements

For R&D proposal forms in English please contact JST via email at kaikaku_mirai@jst.go.jp

# Chapter 4
# Common subject matters of
# Small start type and Large scale type

## 4.1 Common matters concerning calling for and selection of project proposals

### 4.1.1 About restriction on duplicate applications to the JST-Mirai R&D Program

The following restrictions are imposed on duplicate applications concerning R&D proposals called for the JST-Mirai R&D Program in fiscal year 2017.

Certain measures may also be taken for unreasonable duplication or concentration for other projects inside and outside JST that are not described here. See “6.3, Measures for unreasonable duplications and concentration” for details.

<Common to small start type and large scale type themes>

(1) A Principal Investigator (PL/PM) is only allowed to apply one proposal for every prioritized/technology theme of the small start type and the large-scale type.

(2) The following restrictions are imposed on R&D proposals if the main joint researcher participates in research:

a .Multiple applications are not allowed in which the Principal Investigator and the main joint researcher exchange positions.

b. If a person participates in two or more R&D proposals as a Principal Investigator or a Lead Joint Researcher and multiple R&D projects are adopted, the R&D supervisor takes into account the contents and scales of the research to make adjustments, such as decreasing research expenses or disapproving some of the R&D projects in which the researcher participates.

<only applies to “Realization of a Low Carbon Society, a global issue” area (small start type)>

A “present Principal Investigator” of advanced low carbon technology development, a strategic creative research promotion project, is not allowed to apply for the JST-Mirai R&D Program (small start type) in the “Realization of a low carbon society” area (except for the case that the research period for the R&D project ends within fiscal year 2017).

### 4.1.2 Selection method

See “Solicitation and Selection Schedule” on the cover for the schedule related to selection.

**(1) Selection process**

The R&D supervisor cooperates with the R&D management committee to review documents, and conducts interviews in order to make a selection. She/he may also seek cooperation from outside evaluators.

Document-based selection for small start type proposals may perform a first-stage selection mainly based on the proposal document “whole ideas of R&D projects – form 2” of the small start type R&D by prioritized theme, depending on the number of applications.

This first stage selection is mainly based on whether a proposal meets the purpose of the prioritized theme (whether it is promising for achieving the objective of the prioritized theme) and on the viewpoint of whether it meets the objective of the small start type. Only proposals

that meet the criteria proceed to full document-based selection by the "R&D plan for the small start type – Form 3."

The first stage selection is only for the small start type. When the first stage selection is conducted, it is not announced to the public.

In addition, surveys besides the above may be conducted if necessary for selection. Furthermore, if the Principal Investigator or a main joint researcher is affiliated with a commercial organization, submission of a financial statement may be requested.

JST selects Principal Investigators and R&D projects on the basis of the above selection.

Names of R&D management committee members are announced on the website of this project as soon as it is decided. However, this is not to guarantee that all of the names will be announced by the end of the selection.

Prioritized themes and technology themes: http://www.jst.go.jp/mirai/jp/theme/
R&D management committee members: http://www.jst.go.jp/mirai/jo/pdpo/

**(2) Persons engaged in selection**

Based on JST's rules and from the viewpoint of fair and transparent evaluation, the stakeholders described below do not participate in the selection of R&D proposers and the like.

a. Those who are in kinship with an R&D proposer
b. Those who are affiliated with the same department or laboratory of an R&D organization of a university or a national R&D agency or the same department of the same private firm
c. Those who conduct joint R&D closely related to an R&D proposer.
   (For example, conducting a joint project, writing a joint research paper, research members for the same objective, or those considered affiliated with a research group that is substantially similar to that of a Principle Investigator.)
d. Those who are in a close teacher-student relationship or in a direct employment relationship with an R&D proposer
e. Those who are in a directly competitive relationship with the R&D projects of an R&D proposer.
f. Others who are judged to be stakeholders by JST

**(3) Interviews for selection and notice of selection results**

a. A proposer who is selected for interview as a result of document-based selection receives such a notice and is informed on guidelines for interview, schedule, and additionally requested information materials. Submission of applications and plans for other research funds may also be requested at the time of the interview. JST and the R&D supervisor may contact proposers subject to interviews concerning matters for which explanations are requested at the interview, depending on results of document-based selection and surveys. An R&D supervisor may also set out matters and comments for which an R&D proposer is requested to respond at an interview based on document-based selection. If an Principal Investigator or a Lead Joint Researcher is affiliated with a commercial

organization, submission of a financial statement may be requested.

The interview schedule will be announced on the website that publicizes the calls for R&D proposals as soon as it is decided.

http://www.jst.go.jp/mirai/jp/application/research/

b. The R&D proposer her/himself is requested to explain the contents of the proposal at the time of the interview. Interviews are in principle conducted in the Japanese language. However, if a proposer finds it difficult to explain a proposal in Japanese, she/he may explain it in English.

c. An R&D proposer whose proposal is not adopted at the stages of document-based and interview selection receives a notice of the selection result. The reasons why the proposal was not adopted are mailed separately.

d. An R&D proposer whose proposal is adopted as a result of selection receives a notice of such an effect as well as a procedure for R&D initiation.

### 4.1.3 Selection Perspective

**(1) Selection Standards (Preliminary Evaluation Standards)**

Common selection standards for the small start type and large-scale type are described below. All standards described in 1.-5. must be met for selection of the small start type (full-scale research) and the large scale type.

| **Common to the small start type (full-scale research) and the large-scale type** |
|---|
| 1. Does the objective aim for the proof of concept (POC)?<br>・ Is the objective (and milestone) set to allow the POC to be clearly defined in a form that makes objective judgment possible? Also, does the objective meet the purposes of a prioritized theme and a technology theme? |
| 2. Whether highly impactful<br>・ Are the needs to achieve the proof of concept (POC), or so far non-existing social and economic impacts, and social and industrial needs for it verified on the basis of evidence? |
| 3. Are challenges and risks understood?<br>・ Is a bottleneck (technological issues and difficulty, issues and difficulties for social implementation) in achieving the proof of concept (POC) clearly recognized? And are risks in achieving it understood accurately? |
| 4. Are the R&D plan and R&D ideas appropriate?<br>・ Is a method for the bottleneck described in 3., or an R&D plan* appropriate? In addition, is a vision (business model and the like) for activities after research completion included in the plan?<br>*A specific plan of participation of industries for “large scale type”<br>*The quality of the Principal Investigator (PL/PM) is judged as part of R&D ideas and to supplement selection criteria for the small start type and the large-scale type. |
| 5. Are the quality and achievements of the Principal Investigator appropriate?<br>Check “(2) Supplement for selection standard” on the next page for this item. |

**(2) Supplement for selection standards**

In addition to the above “(1)Selection standards”, selection standards (standards for prior evaluation) for each of the small start type (Feasibility study) and the large scale type are given below.

**<Supplement to selection standards for the small start type (feasibility study)>**

Feasibility studies of the small start type are selected using the following items based on selection standards.

Full-scale research projects are selected on the basis of evaluation after a feasibility study.

| |
|---|
| 1. Is the goal clear and aiming for a proof of concept (POC)?<br>• The proof of concept (POC) is defined as clearly as possible and is focused on the core of a prioritized theme.<br>• Socially, industrially, and technologically challenging goals are explained as specifically as possible in a form that allows the proof of concept (POC)to be judged for validity and focused on the core of a prioritized theme. |
| 2. Whether or not impactful?<br>• Achievement of the proposed proof of concept (POC) exerts great social and economic impacts (if realized, it reforms the future of society and industries in Japan) and social and industrial needs for it are verified with concrete evidence, or the verification process is examined. |
| 3. Are challenges and risks understood?<br>• Is a bottleneck (technological difficulties, issues in social implementation) in achieving a proposed proof of concept (POC) explained clearly or is the verification process examined?<br>• A set goal is adequate for clearing the bottleneck (technological issues and difficulties) and highly challenging considering research trends in Japan and overseas (“results of R&D are expected to be considered “marvelous” by society, business firms, and investors).<br>• Risks in achieving the proposed proof of concept (POC) are accurately recognized, the likelihood of the achievement is indicated reasonably well, or the verification process is examined. |
| 4. Are the R&D plan and ideas appropriate?<br>• An R&D plan (execution system, budget, setting stage gates) for achieving a proposed proof of concept (POC) has been considered.<br>*The goal for the feasibility study and a plan for achieving it are at least concrete and appropriate in the above plan.<br>• Plans, techniques, and milestones have original contents.<br>• An action plan that takes into account development (a business model including costs accruing after the POC and time, passing results over to business firms) of research results is examined. |

The Principal Investigator for the small start type research plays a role in promoting R&D under the R&D supervisor. The Principal Investigator is expected to integrate collaboration with her/his aides and pass the position and support from an affiliated organization to another person in order to manage whole R&D project.

Considering the role and responsibilities of the Principal Investigator in small start type

research, it has been decided that the quality and achievements of the Principal Investigator are evaluated using “5. Are the quality and achievements of a PM appropriate?” in “4.1.3, Selection viewpoints” <Supplement to selection standards for the large scale type> defined for the large scale type as a reference.

Measures and system preparation are required for supporting R&D at R&D institutions for the examination of transfer to full-scale research. The preparation and examination are used as references for selecting feasibility studies.

**<supplement to selection criteria for the large scale type>**

Large scale type studies are selected using the following items based on the selection criteria.

1. Is the goal clear and aiming for a proof of concept (POC)?
   - The goal (and milestones) aiming for the proof of concept are clearly set.
   - The R&D plan concretely proves and shows a proof of concept (POC) to others, including private firms, so that feasibility may be judged when the goal is reached.

2. Whether or not impactful?
   - A reasonable vision for development after a proof of concept (POC) and a reasonable outcome that reforms the future of society and industries in Japan are depicted.
   - A goal and a depicted outcome, if realized, bring great innovations (of high impact) to the society and industries in Japan in the future.
     *It is desirable to indicate evidence-based and concrete impacts if possible.

3. Are challenges and risks understood?
   - The set goal is highly challenging enough to clear a bottleneck (technological issues and difficulty) (are R&D results expected to be considered “marvelous” by business firms and investors?).
   - Risks in reaching the goal are accurately recognized.
   - The likelihood of reaching the goal is indicated in a reasonable manner, taking risks into account.

4. Are the R&D plan and ideas appropriate?
   - The R&D plan aims to reach a goal and is appropriate (including an R&D team and setting stage gates).
   - It can recruit top-level R&D capabilities and knowledge. In addition, it can be expected to yield excellent achievements to be publicized (papers and the like).
   - On the basis of a reasonable vision for development after the proof of concept (POC), approaches are planned that lead to exits such as collaboration with private firms, venture businesses, passing R&D to other projects, and yielding human resources that can pass R&D over.
   - Participation by industries is planned in a concrete manner.

5. Are the quality and achievements of the Principal Investigator appropriate?
   - Outstanding ideas, knowledge, planning ability, and management ability
   - Expert knowledge and understanding of technology themes, ability to grasp news and R&D trends in Japan and overseas
   - Ability to overlook a wide range of technologies and market trends, ability to commercialize and develop ideas from various viewpoints
   - Ability to communicate not only with researchers but with all associated people, leadership for reaching a goal
   - Network with experts in industries, academia, and the government and ability to collect technological information
   - Willingness to achieve highly impactful innovations
   - Ability to present comprehensible explanations about her/his own R&D ideas to outsiders

**<supplement>**

1. See “Chapter V, Prioritized themes and technology themes to call for proposals” for item 1. “Purposes of prioritized themes and technology themes” of “4.1.3(1), Selection criteria (prior evaluation criteria”. Unique selection viewpoints and policies as well as management policies are also described by prioritized theme and by technology theme.
2. “Unreasonable duplications” or “excessive concentration” of R&D expenses is also a selection criterion. See “6.3, Measures for unreasonable duplications and excessive concentration” for details.
3. JST may ask for the submission of information materials besides proposal documents to manage conflicts of interests among researchers. (An example is a case in which a PM allows an organization in conflict of interest with the PM to participate in a joint research group.)

## 4.2 Common matters related to research promotion after adoption

### 4.2.1 Preparing a R&D Plan

a. Once selected, project leader and program manager (PL/PM) will be requested to an overall R&D plan covering the entire R&D project period. PL/PM will be also requested to prepare overall and annual R&D plans. R&D plans include information on the R&D budget and team structure. Actual R&D budgets are determined after confirmation and approval by R&D Supervisor (PO) when an annual R&D plan is prepared.

b. R&D plans (overall and annual plans) become official once they are checked and approved by the PO. The PO will offer advice and coordination assistance on the R&D plan, and provide instructions when necessary, based on information the PO gains through, for example, the project selection process, discussions with PL/PMs, regular progress updates, and the results of R&D evaluations.

c. The PO, in approving R&D project plans to achieve objectives including the accomplishment of the overall objectives of prioritized themes and technical themes, may merge or link R&D projects, or take other coordinative actions.

*R&D organizations and budgets set forth in R&D plans may be revised during the R&D project period in response to overall JST-Mirai R&D Program budget conditions, Area management actions taken by the PO, or factors like results of R&D evaluations.

### 4.2.2 R&D agreement

a. Once a R&D project is selected, JST, in principle, will enter into a contract R&D agreement with the R&D institutions with which the PL/PM, Lead Joint Researcher are affiliated.

b. If it is not possible to conclude contract research agreements with these research institutions, or not possible to put in place the management and audit systems required in connection with the use of public funds, or it the subject R&D institutions are conspicuously financially unstable, it may be impossible to pursue R&D at the subject R&D institutions. For more details, please refer to "4.2.6 Responsibilities of R&D Institutions".

c. In principal, patents and other intellectual property rights resulting from R&D shall, in accordance with contract R&D agreement terms, reside with R&D institutions under the condition that the R&D institutions abide by the items provided in Article 19 (Japanese version of the Bayh-Dole Act) of the Industrial Technology Enhancement Act. However this rule does not apply to foreign R&D institutes.

[Important]
When a PL/PM is employed by JST (including cross appointments), depending on the R&D institution where the PL/PM will perform R&D work, there will be cases where joint R&D contracts need to be concluded in a different way from the usual contract R&D agreements and intellectual property rights dealt with separately.

### 4.2.3 About forms of participation

The Principal Investigator whose R&D prpposal has been selected will become affiliated with JST during an R&D period for full-scale research of the small start type and during one for the

large-scale type.

(1) An adopted Project Leader (PL) for the small start type, is in principle requested to be affiliated with JST during full-scale research period.

(2) Program Manager (PM) for the large-scale type, is in principle requested to be exclusively affiliated with JST from the R&D beginning.

*If necessary, researchers who are planning to submit a R&D project proposal should notify the research institutions with which they are affiliated, collaborate, etc. of their intent in advance.

*If necessary, a researcher may change his/her research institution affiliation or otherwise revise the terms of his/her participation during the R&D project period.

### 4.2.4 R&D costs

JST will pay research institutions a contract research cost, which is defined as the sum of the research costs (direct costs) and overhead (indirect) costs, which is up to 30% of the direct costs.

(1) R&D Costs (Direct Costs)

R&D costs (direct costs) means costs that are directly related to and required for the pursuit of the subject research. R&D costs can include:

a. Commodities: Costs for the purchase of new facilities[1)], equipment, consumable supplies, etc.

b. Travel Expenses: Expenses for travel by the Principal Investigator, Lead Joint Researcher, research participants listed on the research plan and Individual Researcher.

c. Personnel costs: Salaries for research participants and honorariums.
However, duplications are avoided in personnel cost for a researcher (Principal Investigator, Lead Joint Researchers), a national university, an independent administrative corporation, or an incorporated educational institution that the government provides with a management subsidy or a private school subsidy.

d. Other Expenses: Costs related to the presentation of research results (research paper submission fees, etc.), costs for leasing and transferring of equipment, etc.

Note 1) The purchase of new research equipment and apparatuses will proceed according to the “Research Equipment and Apparatus Sharing Systems for Research Organization Units” (hereinafter referred to as “apparatus sharing systems”), which shall operate on the premises of “Introduction of New Research Equipment and Apparatuses Operating Integrally with Research Organization Management” (Advance Research Fundamentals Working Group, Scholarship Commission, November 2015). Please refer to “5.2.10 Other Considerations” for details.

*The following costs are examples of those not treated as research costs (direct cost).

・Costs for items not consistent with the research objectives.

・Costs that are considered to be more appropriately handled as overhead cost（indirect cost).

*For certain items, JST has created specific rules and guidelines from sources like the

contract research agreement, administration manuals, and a common governmental expense categorization table. Universities, etc. (Universities, public research institutions and public-service corporations recognized by JST) and companies (mainly research institutions operated by private companies) may differ in their handling of administrative matters. For more details, please refer to the following URLs (only in Japanese).

<JST-Mirai R&D Program: > (TBA)

http://www.jst.go.jp/contract/index.html

<MEXT: Table of expense classification common to prefectures>

http://www.mext.go.jp/a_menu/shinkou/hojyo/1311601.htm

*In hiring research staffs, please give consideration to supporting the career paths of people who have recently completed their doctoral programs and improvement of working condition of doctoral course students. For more details, please refer to “4.2.5 Responsibilities of Research Directors, Lead Joint Researchers” and “4.2.7 Other Considerations”.

(2) Overhead (Indirect) Costs

Overhead (indirect) costs are costs required for the management, etc. of research institutes pursuing research; they are in principle capped at 30% of direct costs. According to “Common Guidance for the Execution of Indirect Expenses of the Competitive Fund” (agreed upon by the coordination committees of relevant ministries and agencies on April, 2001 and revised on May 29, 2014), regarding indirect expenses, a policy on use, etc. shall be created and shall be systematically and properly executed to ensure that use is transparent.

(3) Multiple-year contract and Carryover

From the perspective of the effective and efficient use of research expenses to maximize research results and prevent unauthorized use, in order to be capable of carrying over research expenses and procurement contacts over financial years, JST has made research contracts into multiple-year contracts. With regard to carrying over, universities are treated differently from business firms. In addition, multiple-year contract or carrying over may not be acceptable to the office management system of some research organizations.

### 4.2.5 Responsibilities of Principal Investigato, Lead Joint Researchers after approval

(1) Research Directors, Lead Joint Researcher, and Individual Researchers are responsible for fully recognizing that JST research budgets are funded by precious tax revenues collected from citizens, and for fairly and efficiently executing budgeted expenditures.

(2) Once a proposed research project is selected, the Research Director and Lead Joint Researcher shall affirm that they will fulfill the following requirements, presented to them via JST briefings and other means, and submit to JST a written document evidencing this affirmation.

a. Comply with application guidelines and other requirements.

b. Pledge not to become involved in research misconduct (fabrication, falsification, plagiarism) or in the improper use of these funds.

c. To prevent any research misconduct (fabrication, falsification, plagiarism), enroll in and

complete the JST-specified research integrity educational program (CITI Japan e-learning program) and promise to educate the research participants of the obligation to enroll in and complete the program and make them understand. For details refer to “8.1 Enrolling in and Completing the Educational Program for Research Integrity.”

Note that failure to complete the research integrity educational program in c. above can result in the suspension of the research budget until confirmation has been made that the program has been completed.

(3) The Research Director and research participants are required to complete the research integrity educational program (CITI Japan e-learning program) specified by JST to prevent research misconduct (fabrication, falsification and plagiarism). For details, refer to “8.1 Enrolling in and Completing the Educational Program for Research Integrity.”

(4) Promotion and management of R&D

a. The Principal Investigator is held responsible for the whole R&D team, with responsibilities including preparation and implementation of a R&D plan. The Principal Investigator needs to comply with “Basic policies for the management of Intellectual Properties,” conclude “joint intellectual property treaties,” and cooperate with R&D institutions in order to promote proper activities for intellectual properties.

The Principal Investigator is responsible for cooperation with R&D organizations to provide an R&D site and research environment necessary for R&D promotion. When serious obstruction of R&D implementation location and environments to promote research is found, R&D project may be cancelled.

“Basic policies for the management of Intellectual Properties”
http://www.jst.go.jp/mirai/jp/uploads/chizaihoshin29.pdf

b. R&D teams shall also be responsible for submitting R&D reports and other required documentation to JST and Research Supervisors and taking steps required for &D evaluations. R&D teams shall also be responsible for providing the progress and other reports the Research Supervisor may request from time to time.

(5) Principle Investigators together with R&D institutions shall appropriately manage (expenditure planning, monitoring, etc.) overall R&D budgets for R&D teams. Lead Joint Researcher together with R&D institutions shall appropriately manage (expenditure planning, monitoring, etc.) R&D budgets for his/her own R&D team.

When students join to R&D team, their academic supervisors are also held responsible as “research monitors” for the terms and conditions of the contract research agreement with JST. If, for example, a student researcher has committed misconduct or other improprieties as defined by Article 13 of the contract research agreement, both the student and the academic supervisor will be held accountable.

(6) Principle Investigators and Lead Joint Researcher are asked to be mindful of research and working environments and conditions for their own group's research participants, and especially research staff and others whose employment is being funded by JST-Mirai R&D program funds.

(7) It is recommended that Research Director Principle Investigators and Lead Joint

Researcher actively support the development of varied domestic and international career paths for research staff who have recently completed doctoral programs and are being employed with research budget funds. In the research project selection interview, research project applicants will be asked about plans for supporting the development of varied domestic and international career paths for research staff who have recently completed doctoral programs and will be employed with research budget funds. In addition, in interim and post-completion evaluations, questions will be asked regarding the status of career path assistance efforts and the post-completion career paths of the research staff who were the subject of career path assistance efforts.

* Please refer to the details in "4.2.7, Other Considerations"

(8) Handling of Research Results

a. Given that R&D results were obtained with national government funding, it is asked that R&D results be actively reported on both domestically and internationally, with due consideration for the acquisition of intellectual property rights. It is also asked that active efforts be made to secure intellectual property rights under the "Basic policies for the management of Intellectual Properties". In principle, intellectual property rights are to be applied, in accordance with contract research agreement terms, by the research institutions with which researchers are affiliated.

b. When reporting on R&D results through research papers or other media, please indicate that the results were obtained via the JST-Mirai R&D program (Small start type, Large-scale type).

c. The Principle Investigator is asked to submit to JST a data management plan that sets forth policy on storage, management, publicity and non-publicity in regard to research data obtained from research team activities and research data to be made public for each of the items below, together with a research plan document. Further, data storage, management, and publishing based on the above policy are requested.
For details regarding the following entries, please refer to the "Guideline of the JST's basic policies for handling research achievements toward an open science promotion" below.

http://www.jst.go.jp/pr/intro/openscience/guideline_openscience.pdf

[Entries in the data-managing plan]

- Policy on the storage and management of research data to be managed
- Policy related to publicity and non-publicity in regard to research data
- Providing methods and systems for data to be made public
- Assumed use applications for public research data
- Initiative for the promotion of the use of public research data
- Other items of note

d. The adopted researcher is requested to participate in the workshops and symposia that JST holds in Japan and overseas, interdisciplinary activities and outreach activities aiming for the promotion of R&D collaboration and synergy in prioritized themes, technology themes and areas of this project with researchers of the R&D group. In addition, she/he is expected to actively promote global activities and issue information while promoting R&D activities.

e. It is asked that active efforts be made to secure intellectual property rights. In principle,

intellectual property rights are to be applied, in accordance with contract research agreement terms, by the research institutions with which researchers are affiliated.

(9) Researchers are asked to actively engage citizens in discussions of science and technology to promote citizen's understanding and support of science and technology. Efforts to engage citizens in discussions of science and technology will be evaluated both interim and post-completion evaluations.
*Please refer to the guideline details in "1.5.4, Promotion of dialogue and collaboration with the public"

(10) Researchers shall abide by research agreements entered into by JST and research institutions, and shall abide by JST's various rules.

(11) It should be noted that JST will provide research project names, names of researchers, research budget information, and other required information to the Cross-ministerial R&D Management System (e-Rad) and the Government Research and Development Database ("6.2, Handling of Information Provided in Research Proposals, Etc."). Principle Investigators and others, therefore, may be asked to provide various types of information in that connection.

(12) Researchers will cooperate with accounting examinations by JST, accounting audits by the national government, and similar activities.

(13) Researchers will cooperate with JST-Mirai R&D Program evaluations. Researchers will cooperate by providing various types of information, responding to interviews, etc. in connection with follow-up evaluations performed sometime after project completion.

### 4.2.6. Responsibilities of Research Institutions

Research Institutions must fully recognize that the research funds are public funding, ensure compliance with related law, and make efforts to implement the research effectively upon implementation. Research institutes that cannot accomplish the tasks described below will not be enjoined to implement research; thus, when applying, the prior consent of the research institute at which the implementation of research is planned shall definitively be obtained.

(1) For Domestic Institutions

a. Research organizations shall conclude the research contract with the content proposed by JST. Further, research institutes are responsible for properly implementing research in accordance with the research contract document, administrative process document, and research plan. When the contract cannot be concluded, or when it is judged that research at the research institute is not being implemented properly, the implementation of research at the research institute shall not be admitted

*For the latest sample of the research contract document, please refer to the URL below.
http://www.jst.go.jp/contract/index.html

b. Research institutions, with an autonomously instituted management and audit system for public research budgets, are obligated to properly execute the contract research funds in accordance with the "Guidelines for Management and Audit of Public Research Funds at Research Institutions (implementation standards)" (decided by the Minister of Education, Culture, Sports, Science and Technology on February 15, 2007; revised on Feb. 18, 2014). Research institutions, in addition to reporting the status of their management and audit system for public research budgets to the Ministry of Education, Culture, Sports, Science and Technology, are also obligated to support various investigations into their system implementation and other related matters

*"Regarding implementation of systems based on the Guidelines of Management and Audit of Public Research Funds in Research Institutes (Implementation standards)"
http://www.mext.go.jp/a_menu/kansa/houkoku/1343904.htm

c. In accordance with the "Guidelines for Responding to Misconduct in Research Activities" (August 26, 2014, adopted by the Minister of Education, Culture, Sports, Sciences and Technology), research institutes are asked to construct necessary regulations and systems that they are responsible for in order to prevent misconduct. Research institutes are responsible for responding to various investigations relating to systems construction based on the guideline

*"Regarding implementation of systems based on the "Guidelines for Responding to Misconduct in Research Activities"
http://www.mext.go.jp/b_menu/houdou/26/08/1351568.htm

d. Research institutes are responsible for ensuring that associated researchers fully recognize the contents of the above guideline described in a and b and have been trained with teaching materials related to research ethics provided by JST.

e. Research institutes shall expend and manage research expenses properly in accordance with the regulations of the research organization while considering flexibility; when items are regulated by administrative process documents, etc., provided by JST, which state rules specific to the project, the rules shall be obeyed. (For research institutes receiving Grants-in-Aid for scientific research expenses, it is possible that items not described in administrative process documents for use in research expenses may be handled in conformity with the Grants-in-Aid for scientific research expenses.)

f. Research institutes shall either enter into contracts with associated researchers that ensure that intellectual property rights resulting from the implementation of research will be accorded to the research institutes or construct work regulations in this vein. In case a student who is not employed by a research organization participates in research, a necessary measure, such as concluding a contract with the student in advance, needs to be taken in order for pertinent intellectual property right associated with the invention (including ideas) that the student made during the research to belong to the research organization unless it is clear that the student cannot be an inventor. Take into consideration eliminating conditions unfavorable to the student, the inventor, concerning the price of transferring the intellectual property right.

In addition, when intellectual property rights are transferred, exclusive licenses are granted, etc., in principle, the prior approval of JST is needed, and when application, registration, implementation, and renunciation are conducted, a prior report to JST is needed.

g. Research institutes are responsible for responding to accounting investigations by JST and account audits by the Government.

h. Research institutes shall obey measures pertaining to changing terms of payment and will accept decreased payments decided upon by JST based on JST investigations related to administrative managing systems, financial conditions, etc.

i. When research institutes are national or municipal organizations, such institutes concluding research contracts shall definitively implement necessary budgetary measures before starting research contracts for which they are responsible. (In case it becomes apparent that the non-fulfillment of necessary procedures after contracting will occur, measures to release the research contract and rescind research funds will be taken.)

j. As part of the effort to prevent misconduct in research and development activities, JST has required researchers, who are part of newly selected research projects and who also are affiliated with a research institution, to enroll in and complete the educational program on research integrity (The procedures required for enrollment will be handled by JST). Research institutions are to supervise, without fail, the enrollment in and completion of the program by the relevant persons.

In the event that the relevant researchers fail to complete the educational program as stipulated despite repeated reminders by JST, the research institution will be instructed to halt, partially or entirely, the execution of contract research fund payments. In line with this instruction, the research institution is to halt all use of the research funds and not restart their use until further notice from JST.

k. Take necessary measures, such as concluding a joint research contract with participating organizations within a range of contract research agreements with JST concerning handling of intellectual property rights or confidentiality in order to avoid problems in properly undertaking research or utilizing research achievement.

(2) For Overseas Institutions

a. In principal, R&D institutes shall conclude research contracts with content proposed by JST. (Indirect costs are capped at 30% of direct costs.) Further, research institutes are responsible for proper implementation of the research in accordance with the research contract document and research plan. When contracts cannot be concluded, or when it is judged that research at the research organization will not be properly implemented, the implementation of research at the research organization shall not be admitted.

*For a sample of a research contract document for overseas institutes, please refer to the URL below.

http://www.jst.go.jp/contract/index.html

b. R&D institutes are responsible for properly disbursing and managing R&D expenses for which they are responsible based on the research contract, guiding principles, etc. When JST designates guiding principles, etc. separately; they are responsible for creating and reporting expense details (for domestic organizations, this corresponds to accounting books) in English. Research institutes shall respond to various investigations related to implementation status per JST request in the period of the contract.

c. Research institutes shall transfer intellectual property rights resulting from research without compensation (Article 19 of the Industrial Technology Enhancement Act, the

Japanese version of the Bayh-Dole Act, will not apply to overseas organizations).

*From the view of the point of Security Export Control, JST may not conclude joint research agreements with such institutions as Japanese Ministry of Economy, Trade and Industry (METI) announces in the “Foreign User List” (or “End User List”).

(3) R&D institutions that receive funds to cover overhead cost (indirect cost)

R&D institutions that receive funds to cover overhead cost (indirect cost) must appropriately manage their overhead cost (indirect cost) and properly retain, for a period of five years following the conclusion of the contract research agreement, receipts and other documentation* evidencing the proper use of funds for covering overhead cost (indirect cost). Furthermore, the head of a research institution that has received funds to cover overhead cost (indirect cost) must report, on the designated form, each fiscal year's overhead cost (indirect cost) expenditures by June 30 of the following fiscal year through Research and Technology Management System common to ministries (e-Rad).

*As documentary evidence, documentation that incorporates overhead cost (indirect cost) covered by other competitive funds may also be used (It is not necessary to employ segment accounting to reflect multiple research agreements.)

### 4.2.7 Other Considerations

(1) RA (Research Assistants)

The 3rd, 4th and 5th Science and Technology Basic Plan set a numerical target that “enabling 20 percent of doctorate course students to receive an amount equivalent to their living expenses” in order to attract quality students and business persons from Japan and overseas by increasing economic supports.

In “Reformation of Education in Graduated School Leading Future (Deliberation Summary)” (Work Group on Universities, Central Council for Education, September 15, 2015), it was requested that research assistant (RA) employment for (latter-stage) doctoral students be enhanced by various financial resources and that payment for employed (latter-stage) doctoral student RAs and TAs be standardized at a level approximating living expenses.

Given these intentions, it is requested that (latter-stage) doctoral students be employed as RAs and that payment at at an appropriate level for living expenses and at an appropriate level for hours worked be established.

Excerpt from “Fifth term Basic Plan of Science and Technology, Chapter IV Strengthening basic force for science and technology, (1) human resource development”,①Development, securement, and activity promotion of human resources as intellectual professionals, (iii) Promotion of reforming graduate school education.

To attract excellent students and working people in Japan and from overseas, financial supports to graduate students, those in a Ph.D. course (the latter half) in particular, are improved. Universities and public research organizations are requested to increase employment and improve treatment of students in the Ph.D. course (the latter half) as teaching assistants (TA), research assistants (RA) or the like. The central government

attempts to enlarge the fellowship program as well as promote approaches by relevant agencies. This aims to quickly achieve the goal for "about 20% of students in the PH.D. course (the latter half) to receive a fellowship roughly corresponding to living expenses" set out in the basic plans of the 3rd and 4th terms. <omitted hereafter>

"Fifth term basic plan of science and technology"
(outline)
http://www8.cao.go.jp/cstp/kihonkeikaku/5gaiyo.pdf
(text)
http://www8.cao.go.jp/cstp/kihonkeikaku/5honbun.pdf

"Reforming graduate school education, which leads the future (summary by council)" (September 15, 2015, University subcommittee, Central council for education,)
(outline)
http://www.mext.go.jp/component/b_menu/shingi/toushin/__icsFiles/afieldfile/2016/02/09/1366899_02.pdf
(text)
http://www.mext.go.jp/component/b_menu/shingi/toushin/__icsFiles/afieldfile/2016/02/09/1366899_01.pdf

Note: Considerations in hiring doctoral course students as Research Assistants (RAs)

- It is recommended that annual compensation approximate 2 million yen per year, or 170,000 yen per month, so please estimate research budgets based on these figures.
- Judgments regarding the specifics of payment amounts, payment timing, etc. will be left to research institutions. There are no requirements concerning the payment of amounts either above or below the levels mentioned above.
- The prerequisite for one receiving scholarship or other program payments as an RA are that multiple funding sources are not a hindrance to the respective scholarship, program, and affiliated research institution and that expenses can be prorated to the time engaged on the other programs.

(2) Career Paths for Young Research Staff with Doctoral Qualifications

The Ministry of Education, Culture, Sports, Science and Technology's basic policy for supporting diverse career paths for young research staff who have doctoral qualifications and are being employed with public research funds (December 20, 2011 Council for Science and Technology, Committee on Human Resources) states that it is necessary to actively support public research institutions and research directors who are using public research funds to employ young research staff with doctoral qualifications in their efforts to secure diverse domestic and overseas career paths for these young research staff members. Given these intentions, when public research funds (i.e., competitive funds, other project research funds, and project-type education research funds) are used to employ junior doctoral researchers, when projects are adopted, active assistance to ensure that students can pursue various research career paths will be appreciated.

Further, considering the utilization of indirect costs for relevant initiatives will be appreciated. For more details, please refer to "4.2.5 Responsibilities of Principal Investigator, Lead Joint Researchers after approval" and the following URL.

http://www.mext.go.jp/b_menu/shingi/gijyutu/gijyutu10/toushin/1317945.htm

(3) Promotion of the sharing of research equipment and apparatuses

"About reforming competitive research fund toward sustainable creation of research achievement (mid-term summary)" (June 24, 2015, Committee for reforming competitive research fund) is said to consider it proper to share relatively large facilities and instruments for universal use while aiming to fully achieve research objectives.

In addition, "About introduction of a joint use system for new research facilities and instruments integrated with research organization management" (November 2015, Advanced Research Base Subcommittee, Science, Technology and Academy Council) requests that universities and national research and development corporations operate "Joint use system for research facilities and instruments for each research organization unit" (instrument joint use system, hereafter).

Based on the above described background, follow a joint-use system for instruments of affiliated organizations within a range of management conditions for other research expenses to actively undertake joint-use of large and universal-use research facilities and instruments to be purchased for this project in particular to the extent giving rise to no problem in promoting relevant research issue, utilization of research facilities and instruments purchased with other research funds, purchase with combined research expenses, and their utilization. Note that balance needs to be maintained between management of instruments and facilities for joint use and use of instruments for achieving research objectives of relevant research issues.

Furthermore, attempt to actively collaborate with "Research facility network project for collaboration of universities" implemented for nationwide mutual facility utilization in Institute of Molecular Science, National Institutes of Natural Sciences, University Joint Utilization Corporation, and the all-university joint use system established by "facility support and preparation project" at universities to promote joint use of research facilities and instruments not bound to research organizations in addition to the above described joint-use system for instruments.

○"About introduction of a new joint-use system for research facilities and instruments integrated with research organization management" (November 25, 2015, Advanced Research Base Subcommittee, Science and Technology and Academy Council)
http://www.mext.go.jp/component/b_menu/shingi/toushin/__icsFiles/afieldfile/2016/01/21/1366216_01_1.pdf

○"About reforming competitive research expenses toward sustainable creation of research achievements" (mid-term summary)
(June 24, 2015, Committee for reforming competitive research expenses)
http://www.mext.go.jp/b_menu/shingi/chousa/shinkou/039/gaiyou/1359306.htm

○"About unifying rules for the use of competitive fund"
(March 31, 2015, Agreement at liaison conference of relevant governmental ministries related to competitive fund)
http://www8.cao.go.jp/cstp/compefund/siyouruuru.pdf

○"Research facility network project for collaboration of universities"
https://chem-eqnet.ims.ac.jp/

(4) About securing a research period up to the end of the fiscal year (undertaking R&D)

We have taken the following measures to enable you to conduct your research until the end of the fiscal year.

- Research organizations and researchers shall submit a project completion notice as an achievement immediately after project completion. JST inspects the completion and research achievement of the project.
- The deadline for submitting the “Actual Performance Report,” the report on research results for this fiscal year, will be May 31 of the next fiscal year.
- The deadline for submitting the “Actual Performance Report (and Settlement of Balance) for Contract Research” will be May 31 of the next fiscal year.

*R&D institutions should keep in mind that the measures above have been made to enable research to be conducted until the very last day of the fiscal year; thus, they should make efforts to prepare whatever necessary by that time.

# Chapter 5
# FY2017 Open Call Themes

## 5.1 Small start Type : Prioritized Themes FY2017

### R&D area of the Small start Type

Japan Science and Technology Agency (JST) sets an emphasized theme for invitation of research proposal based on research areas (sections) for an accelerated search that the Ministry of Education, Culture, Sports, Science and Technology sets out. For FY 2017, research and development proposals of an accelerated search for an emphasized theme of research areas in this description are invited. Such common base technologies as metrical or measurement technologies are also subjects of an emphasized theme for any invited proposal.

**Concerning R&D areas for setting prioritized themes in JST-Mirai R&D Program**

JST is to set themes of research and development (hereinafter referred to as "an emphasized theme for invitation of research proposal") to be carried out for an "accelerated search" of the future society creation project. For FY 2017, JST shall set the following four areas (sections) temporarily as the first project year, based on the Fifth Science and Technology Basic Plan.

Considering an emphasized theme for invitation of research proposal, the purposes of this project is to see clearly the targets that impact the economy and society to boldly challenge technological goals, collect innovative and diverse ideas widely, coordinate with various government policies, avoid duplications with research and development, challenge emphatically other national research and development agencies, and follow a strategy.

(1) "The realization of super smart society"

This area is set as a transdisciplinary area (on a skewer as it was) while closely keeping an eye on the creation of a future society and new values toward societal reforms. Specifically, research and development, in which networks and the Internet of Things (IoT) are utilized, are not restricted to manufacturing industries but spread to various fields. Base technologies for Japan to maintain and strengthen its competitiveness in a super smart society (base technologies necessary for building a common platform by taking advantage of IoT, including advanced metrical technologies that serve as a core for new value creation and in which Japan has been competitive) are improved in this area. Technologies related to satellite measurement, satellite remote sensing, satellite communications, and satellite broadcasting are also included.

"Reference": Definition of a Super smart Society (Society 5.0) (excerpt from the Fifth Science and Technology Basic Plan)

A society that can provide necessary goods and services in needed quantities and time to a person who needs them, meet the needs of various people in society, provide high quality service to anyone, and allow anyone to live actively and comfortably regardless of her/his age, gender, region, or language.

(2) “The realization of a sustainable society”

Subjects of this area are securing resources and food (stably securing resources, cycling utilization, and food), realizing a sustainable society responding to super aging and population decrease (creation of a healthy longevity society through realization of the most advanced medical technologies in the world), improving competitiveness in manufacturing goods and things, and dealing with biological diversity. Other subjects include, among others, are marine technologies contributing to sustainable development and utilization of the ocean.

(3) “The realization of the safest and securest society in the world”

This area responds to natural disasters; secures food safety, living environment, industrial health, and cyber security; and responds to national security issues.

(4) “The realization of a global issue of a low carbon society”

Toward substantial reduction of greenhouse effect gases by 2050, subjects in this area include securing stable energy and efficient utilization of energy (energy saving technologies, efficient use of renewable energy, technologies to stabilize such energy utilization as hydrogen, stored energy, and similar activities).

In addition, research and development related to strategic development and utilization of common base technologies and research instruments, and research and development related to frontiers, such as the ocean and space, that are important for national strategies are subjects for the areas discussed above in (1)-(4).

## 5.1.1 “Realization of a super smart society (Society 5.0)” area

R& D Supervisor (Program Officer: PO):
Akira MAEDA
(Former Corporate Chief Engineer, Information & Communication Technology Business Division, Hitachi Ltd.)

### I Goal of the “Realization of a super smart society (Society 5.0)” area

This area assumes that a “super smart society” (synonymous to Society 5.0) is considered a “society in which things of the real society are incorporated with intelligent software for sophisticated functions (making it smart), and things cooperate to automate societal systems for high efficiency as well as facilitate new functions and services.” The question “how is it different from ”a smart society” or “an information society” referred to as in Society 4.0” may be answered as following: “assuming information technologies is for sophisticated information and data processing in cyber space, a super smart society incorporates intelligence of information technologies into a physical entity, such as electrical power systems, transportation systems, service robots, and similar entities, for them to interact for the expansion of the range of automation and autonomy as the whole system, and possesses a mechanism for sustainable creation of new services and businesses.

In other words, it is believed that in a “super smart society” or “Society 5.0”, cyber space cannot be separated from the real world; software is incorporated into things in the real world and the existing societal systems collaborate by IoT, integrated with real world (hardware) and software to constitute a system or “system of systems,”.

Based on this assumption, “system coordination,” “system of systems,” and “distributed coordination” that emphasize collaboration of the whole system were extracted from an analysis of about 400 offered proposals and interviews with 39 experts. Based on the above, a basis for flexible and dynamic collaboration and cooperation of functions implemented in various systems were defined as “service platform” to be set up as a the prioritized theme for recruitment of research proposal. A workshop was held for experts to dig into specific contents of the service platform and contents of research. At the workshop, the service platform was reconfirmed to be important, and “building a service platform that allows collaboration and cooperation of various components for creation of new services” was set up as a prioritized theme for recruitment of research proposal.

# II Prioritized theme

## Building a service platform that allows collaboration and cooperation of various components for creation of new services

**(1) About the theme**

To accelerate the realization of a ”super smart society” , this prioritized theme aims to build a “service platform”; a mechanism that allows the creation of new services by extract “functions” possessed by various instruments connected to networks by IoT, and the “functions” of existing and new systems are turned as components and combined for collaboration and cooperation. Specifically, functions* at various layers, including controls of things in the real world, are turned as components to provide an open API to build a mechanism for the collaboration and cooperation of various components. This allows for API to be accessed, utilize, and combine functions of components to realize new functions and services. Moreover, techniques, including artificial intelligence, automate collaboration of functions to develop technologies that allow flexible and dynamic collaboration and cooperation, including negotiation and mediation functions, among systems and instruments.

In addition, this prioritized theme for recruitment of research proposal keeps in mind new values and services to be realized through building the platform in carrying out research while depicting a scenario toward the goal.

At present, the 5th Science and Technology Basic Plan of the Cabinet Office sets out 11 systems to realize a “super smart society” (Society 5.0); these systems are, among others, smart manufacturing system, energy value chain system, and high degree transportation system. The Plan also implements policies to promote individual systems. In addition, to support the 11 systems, approaches have already begun for base technologies, including AI, big data processing technologies, and database construction. However, adequate approaches have not yet been taken for a service platform mechanism by functional cooperation; these approaches include continued supplies of optimal services in flexible combinations of existing/new systems or instruments. The mechanism has not yet been realized.

To promote the prioritized theme for recruitment of research proposal and to realize a service platform for collaboration and cooperation of various functions allow the planning of automation, autonomy, and efficiency among a wide range of existing/new systems, and create a new system, a new service, a new business, a new innovation other than the 11 systems. A super smart society will be realized through research and development of API and component preparation techniques, collaboration and cooperation techniques for component combination, techniques to secure real time actions by modelling simulation, security techniques, and architectural design techniques.

*functions at various layers:

For example, technologies from transportation system to automated driving layer down to individual IoT sensors. Functions include not only information exchange in cyber space but also systems and controlling things in the real world.

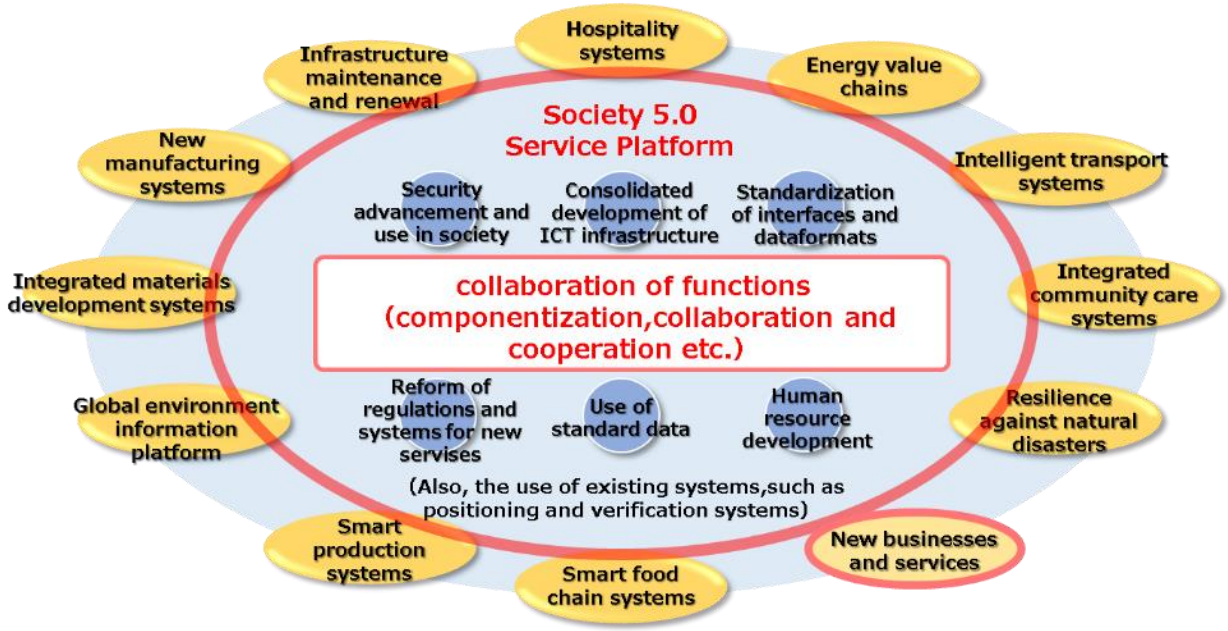



Fig. Primary target of this prioritized theme (red frame,red word)

## (2) Policies of the R&D Supervisor for proposal selection and R&D management

### ① Background

Recent rapid progress in information and communication technologies has connected humans to things, or things to things, in many fields, including manufacturing, transportation, finance, and medicine, to improve efficiency of existing services and create new businesses and services. The conventional society for “sophisticated information processing in cyber space” has been made super smart to be a society in which “information technologies incorporate intelligence into things, and the intelligence interacts to create new values,” This movement has been accepted by society and people to stimulate an emergence of new services, such as Uber and Airbnb, which are changing values and lifestyle, including sharing of economy that promotes changes from possession to utilization.

The Cabinet Office is promoting research and development for sophisticated individual systems by national policies and base technologies, including AI and big data and database, toward the realization of a super smart society. However, platform technologies, which connect between cyber space and things in the real world and go beyond data collaboration to allow collaboration and cooperation among systems and instruments, have not been developed adequately. Moreover, private companies have promoted research and development in IoT and AI, and begun approaches to cross-sectional data collaboration. However, technologies have not been developed adequately for API and component preparation for inter-systems and collaboration and cooperation among instruments.

This prioritized theme forrecruitment of research proposal aims to build a service platform that serves as a basis for new service creation to contribute to the realization of a super smart society and accelerated creation of new values.

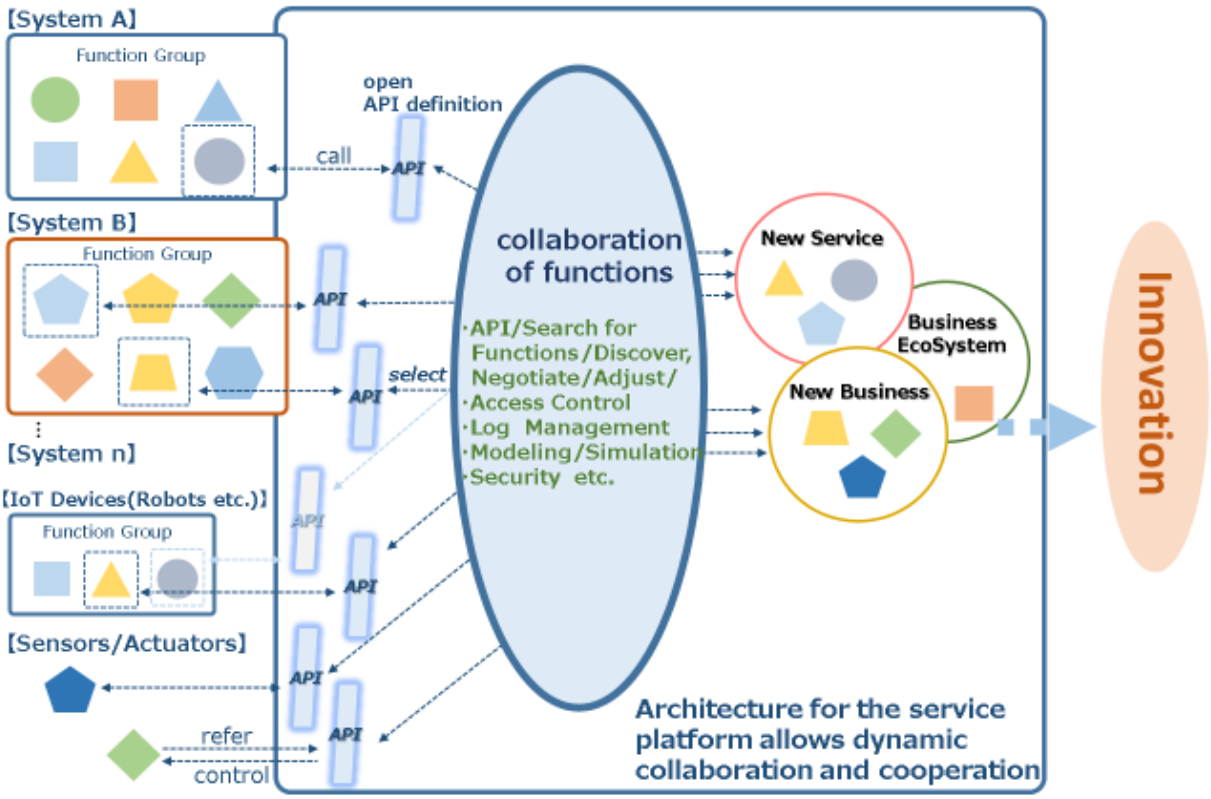



Fig. collaboration of function by a service platform

**② Policiesof proposals selection**

(Regarding the proposal scenario)

As a service platform, proposals are recruited for a system technology that allows flexible and dynamic collaboration of functions among systems and instruments.

Every proposal must include a specific scenario for how functional collaboration among systems and instruments creates values (societal and economic). Please depict a scenario for implementation in a society as much as possible, in addition to a research and development plan. In the case of a proposal for the development of a common base technology for various services, for example, please depict a specific partner of collaboration, such as an electrical power and a transportation system, and show how societal and economic impacts may be created. If the impacts are not clear, research contents may include a FS to clarify the impacts.

Moreover, a proposal of an element technology is acceptable if its value is clearly shown in the whole system. In such case, please show clearly implemented contents of the FS for ideas of the scenario.

(Regarding technologies)

We welcome proposals for the development of the following new technologies necessary for building a service platform based on specific use cases or scenarios:

- Technologies for turning sub-functions to API or components while utilizing existing systems as they are
- Technologies that secure stability and reliability, in addition to realizing functions as a system through the collaboration and cooperation of many various components that are

different in size and operational policies

- Technologies that secure traceability, including information on records of API call outs
- Technologies that secure real-time actions and reliability by modelling and simulation, to realize functions for controlling things and systems turned to API in real space
- Security technologies common to the above technologies, and service platform technologies for security
- Architectural design for the whole platform on the assumption of collaboration and cooperation

(Regarding team composition)

It is not necessary to form a team that covers all ideas at the beginning. It is acceptable to propose building a team during FS.

### ③ Policies to promote research and development

FS is performed during preparation of a full-scale research. In principle, FS period is one and a half years (until the end of FY 2018).

Specifically, an approach is supposed to be conducted to the following studies in FS:

- Clarify research achievements and a scenario for implementation in a society, and verify the impacts on societal and economic impacts
- Verify technological feasibility, and specify technological development targets and a development scenario
- Proceed to form an effective team, including private companies, while keeping an eye on implementation in a society

Moreover, in transition from FS to a full-scale research, it is assumed that not only selection and concentration but also bold system changes, including sub-team reorganization within a project team, may take place. An earlier transition to a full-scale research (research and development proposal) is also possible depending on research progress.

Upon selection of the individual proposal in the prioritized theme for recruitment of research proposal, a whole platform architecture, incorporating tracking, value redistribution, and a societal system, will be considered. The architecture of a whole platform may be applied as a project. If not adopted, however, the research and development supervisor will manage the study of a platform architecture. Promotion of participation, coordination, and collaboration activities in an international collaboration frame will also be reviewed in this theme.

### ④ R&D Period and Budgets

The R&D budgets amounts to JPY 10 to 30 million (including indirect expenses) throughout the FS period (one and a half years in principle). Budget will be allocated flexibly depending upon research contents. When it moves up to a full-scale research, the budget is increased to a maximum of JPY 400 million (including indirect expenses) for carrying out research toward proof of concept (POC).

## 5.1.2 “Realization of a Sustainable Society” area

R&D Supervisor (Program Officer: PO):
Hideyo KUNIEDA
(Council member, Nagoya University)

### I Goals of “Realization of a Sustainable Society” area

The “Quest of a sustainable society” is an ultimate goal for not only Japan but also the whole humankind.

The direction of development has shifted globally from mere economic development to sustainable societies. This direction is expressed in the Sustainable Development Goals (SDGs) of the United Nations. We now face the necessity to increase the quality of life and at the same time realize sustainable development of society.

Attention to the present situation of Japan shows that the stagnant economy has persisted for more than 20 years in the changing global environment characterized by climate change; further, globalization has weakened competitiveness in many industries, including manufacturing, in which Japan exceled. Moreover, population decrease has begun in the aging society with smaller numbers of children proceeding faster than other countries of the world to decrease its productive labor population and increase the number of elderlies who need support by society. It is fact that the sustainability of the life in Japan becomes in crtical situation.

This research area aims to adapt flexibly to these changes in “environment,” “society,” and “economy” to realize a high quality and mature society by maximum utilization of science and technology.

Based on proposed themes from the society (about 700 proposals related to this area) and discussions with experts in various fields, various research fields and approaches are reviewd which may creat values and contribute to the goals in our area. Then, the prioritized themes are explored for the maximum benefits to future generations specifically in regard to the goal “improving the natural environment (ecological services) and the well-being of people toward the realization of a sustainable society.”

A “symbiosis with natural environment” and “responding to super aging and decreasing population” are two view points of the review. “Innovation in manufacturing for new process of sustainable resource recycle” and “Improving intellectual capability to enhance a “Societally Active life”[1] for overcoming the reducing laborer force,” were chosen finally as the prioritized themes for FY 2017.

[1] Societically active life means lifetime during which an individual can stand on herself or himself to participate actively in societical activities, including a job. It is different from “biological longevity” or “healthy longevity,” which means the ability to live a daily life without restriction, owing to health problems.

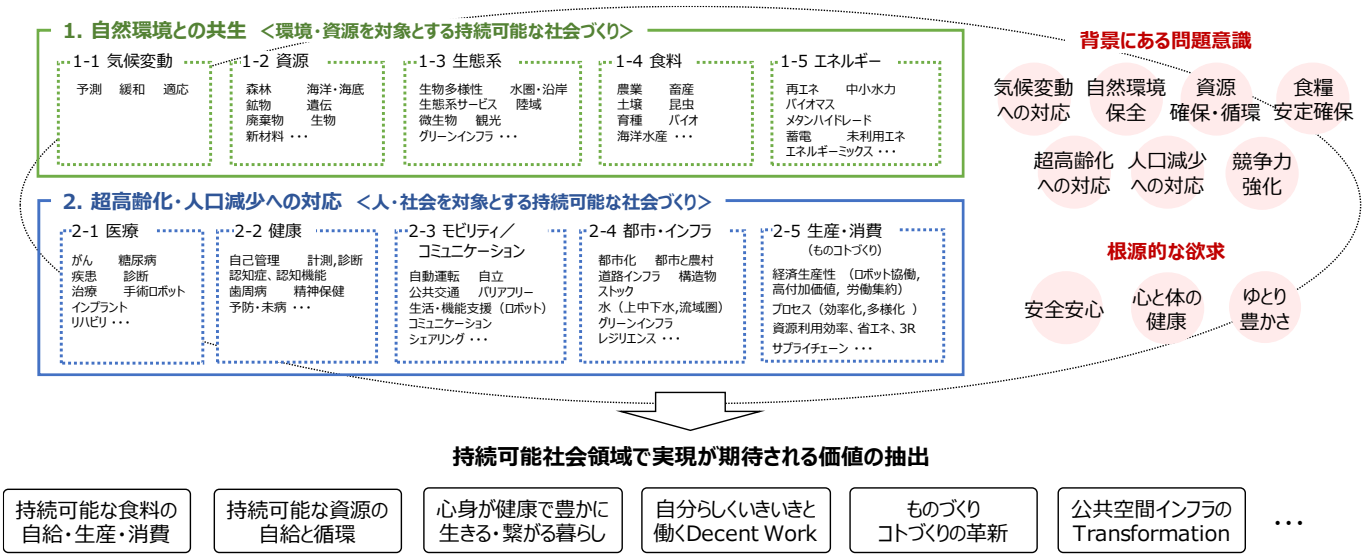



Fig.1 The values expected to be created in this area

# II Prioritized Themes

## 1. Innovation in manufacturing for new process of sustainable resource recycle

### (1) About the theme

This prioritized theme aims to recover industrial competitiveness in changing societies, and to promote sustainable utilization of natural resources, especially mineral (metal and nonmetal) resources and fossil resources that are becoming short globally soon. New manufacturing processes are expected by carrying out research and developments(R&D) on the selection of materials and on the design, production, and separation of products for optimizing the whole material cycle from the design, production, use, separation, and to retrieval of material for a great leap in resource utilization efficiency.

Many products have been designed for the best initial performance and price in the society of mass production and consumption, assuming disposal at the end of the product life. However, it becomes strongly demanded to shift to "recycle-oriented manufacturing" for highly efficient utilization of resources in response to tight supply of global resources, which will surely come in near future.

When looking at the world, one finds that SDGs (Sustainable Development Goals) of the United Nations include "Goal 12. Ensure sustainable consumption and production patterns." Responses from the society and industries are requested urgently. In fact, Europe has a concept "CE: Circular Economy," which is spreading in EU countries to ask the cost of recovery and retrieval of material to be charged on manufacturers. Because the cost is added to the price of the product, highly efficient recycling utilization of resources becomes major area of the manufacturing competitiveness of industries.

When looking at approaches to effective utilization of resources in Japan, one finds mostly individual and independent R&D's for reducing the use volume of resources (rare metals in particular) and recovery of resources from used products. Moreover, retrieval is still major process than reuse with/without refurbish (specifically upgradability[2] utilization), which provides us with higher efficiency of resource recycle. In addition, frequently observed examples of retrieval are "down cycle," which is material treatment for lower quality products. Therefore, it is urgent to carry out fundamental level R&D, of the processes in production, use, separation, reuse and retrieval to convert down cycle to upcycle (retrieval of material with higher quality), in order to make a leap in resource recycle efficiency.

In some area, an effective utilization of resources results from technology progress and societal demands, and it spreads from iron to rare metal and plastics. The cycle is changing slowly from conventional utilization(retrieval) to more efficient reuse and longer life of use. For more highly efficient resource utilization, this program promotes R&D on advanced individual technologies and their integration to create a totally new resource recycle loop from "design, production, separation and reuse".

[2] Upgradability: Capability of being improved in functionality and performance not by the reintroduction of the entire product but by the replacement of some components or system.

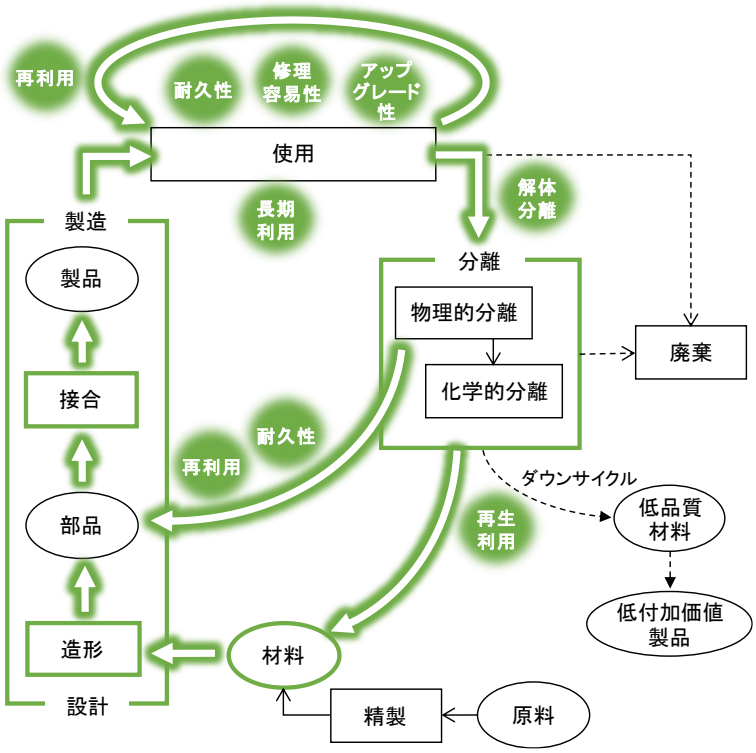



Fig.2 New process of sustainable resource recycle model

### (2) Policies of the R&D Supervisor for proposal selection and R&D management

#### ① Policies for proposal selection

For this prioritized theme, a series of R&D will be promoted for an efficient cycle of resources in a whole cycle of design, production, and separation of materials.

Described below are major requirements of a full-scale research that are not necessarily planned in all FS proposals. However, it is necessary in FS proposals to include “new cycle for resources and products” and “original and challenging solutions for bottlenecks.” (Please confirm in the following description.) Please note that requirements left unclarified in your proposal need to be clarified during the FS stage before moving to the full-scale research.

(Contents of R&D)

A design is necessary; it should include the plan to integrate and optimize whole recycle system, with processes of design, production, and separation for improving resource efficiency, by a new cycle of resources and products through conversion from downcycle to recycle and upcycle, and from retrieval to reuse and long life use. A scientific and technological bottleneck needs to be set out; such bottleneck provides a high impact when solved, and its highly original and challenging solutions are considered as major elements of R&D. Following i-iii are examples of possible approaches.

Although some R&D studies may depend on existing technologies, R&D carried out only on the extension of such existing technologies will not be supported by this program. For the creation of high impact effects on society and economy, proposals are expected to include R&D based on basic scientific studies and aiming to develop innovative technologies with a big leap.

i. Advanced material design and development that facilitate easy retrieval

What is conceived here are the design and R&D of a material to easily process used material to equivalent or better matrial in quality than the original one and then ultimate efficency of recycle will be achieved.

ii. R&D on molding and coating techniques that improve tolerance substantially

R&D for innovative molding and coating techniques that allow substantial extension of product lifetime

iii. R&D of bonding techniques that allow ready for physical separation

R&D on innovative technologies for easy separation while meeting such performance as bonding strength, tight sealing, and environmental tolerance

Specifically, the following images of proposal are conceivable:

- Concerning a conventional down-cycle manufacturing process for the retrieval after crushing, a proposal may aim to research and develop advanced technologies related to material development and production for easy retrieval by innovative bonding techniques for easy physical separation, so that different material can be retrieved from different pieces. Such an advanced bonding technique allows to obtain materials of equivalent to or better than the original material in quality, as well as to decrease the quantity of waste material.
- A proposal may aim to develop advanced technologies of molding and coating to extend product lifetime and part lifetime substantially, which have been rather short, and to develop bonding techniques for easy physical parts separation to achieve improvement in repairing and upgrading through the reuse with replacement of parts, shifting from conventional retrieval to reuse concerning major cycles.

Inclusion of R&D on important measuring techniques themselves is conceivable for the promotion of R&D on the observation of critical microscopic structure of bonding surface and nano structure of material surface.

Standardization plans in collaboration with a wide range of industries for the maximization of recycling efficiency, including standardization of parts for sharing, will also be given priorities.

R&D of production facilities at the actual production line will not be supported.

(Assumed applications)

R&D approaches are required to be based on clear targets for needs of industries and to create societical and economic impacts on resource recycles. Therefore, it is necessary to see a specific (group of) product as an example of application of R&D achievements. At the same time, because this program expects wider imapcts of achievements, it is also extremely important to aim to develop technologies applicable to a wider range of products.

(R&D system)

Creating achievements attractive for industries is necessary for developed technologies to

be put to practical use, and for a resource and product recycle to actually function. Therefore, participation by industries is preferable in stages proceeding to a full-scale research.

(Contents required in FS proposal)

In propsal form 2, a clear idea has to be presented for a vision of a new cycle of resources and products and for an original solution of a bottleneck.

In proposal form 3, please clearly describe contents of R&D to be performed during the FS period and targets to be achieved by the end of a FS term, as well as perspectives of specific issues that required to proceed to the full-scale research but not clear yet at the begining of the FS phase.

For example, a proposal with the following contents is expected:

- An innovative technology at a development stage shall be verified for a scientific principle and subjected to manifestation of scientific and technological risks toward next step of full-scale research.
- A proposal will be made for the optimization scheme of resource and product cycle at a stage of an idea, to specify the idea of a cycle to maximize societical and industrial impacts during a FS stage and compose an optimal team involving academia and industries if possible.
- A proposal will be made concerning applications to (groups of) products to set an example of achievement application with big impacts, as well as to consider a collaboration system with industries during the FS.

**② Policies for R&D management**

Because adoption and application to society and the industries can be predicted to proceed rapidly by the projects on this prioritized theme, transition to a full-scale research shall be considered positively even during a FS stage, when large impacts of a bottleneck solution on society and the industries are foreseen, If the R&D Supervisor recognize that it is necessary to recompose for the maximization of societical and economic impacts, a number of R&D programs may be merged to an integrated team.

**③ R&D Period and Budgets**

For the research proposal submitted in FY 2017, please plan within a maximum period of two years. (However, time spent in FY 2017 is calculated to be one year regardless of when R&D starts.) Please make a plan with a maximum total budget of 40 million JPY (including indirect expenses) for the whole FS period.

For a full-scale research, please plan within five years with a maximum total budget of 2 billion JPY (including indirect expenses).

## 2. Improving intellectual capability to enhance a "Societally Active life"3 for overcoming the reducing laborer force

### (1) About the theme

In the era of super aging and decreasing population of Japan, counter measures are needed urgently against for the decrease of labor population and the increase of welfare cost, which may weaken the industrial competitiveness and the country itself. In order to activate an untapped labor force, these phenomena require new approaches, such as an enhancement of "societically active life," which allows various people, including the elderlies, to play more roles in society.

Examining elderly people, for example, shows that 70% of them intend to work even after reaching the retirement age. However, decreased physical and intellectual functions are said to be a factor reducing their morale and opportunities. R&D's in academia and industries to mainly support physical functions have made progress in these days. However, the enhancement of intellectual functions has not been explored so much yet.

Moreover, changing to a new job requires to get new skills. In addition, the tacit knowledge, such as special technique or expert skills, will be lsot if they are not transfred to the next generations.

As described above, the creation of labor population and maintenance and expansion of intellectual productivity are urgent issues to be addressed immediately to respond to the super aging and decreasing population. Hence, this prioritized theme aims to retrieve diverse untapped labor force and then to strengthen industrial competitiveness, by createing a system that allows science and technology to utilize "intelligence" for personal and public use at a proper timing and place.

Moreover, Looking at the world, one finds that SDGs (Sustainable Development Goals) of the United Nations include "Goal 8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all," as many countries face similar situations. Solving probelms for participation in society, including labor, and improving the Quality of Life (QoL) and Quality of Work (QoW), have become common goals of the world.

Services related to supporting "intellectual activity" provided by the system, which this prioritized theme aims to create, are expected to improve participation in society by various people, including the elderlies, to increase opportunities for employment, and to improve the quality of life and work. It is believed to enrich the mind of each person through connection to society and people. In addition, a future society in which humans and machinery are predicted to collaborate is believed to provide an environment in which people are able to keep their humanity. For that purpose, this prioritized theme aims to realize a society in which everyone has meaning in living to give full play of one's role in the society for a long time.

[3] Societically active longevity means longevity during which an individual can stand on herself or himself to participate actively in societical activities, including a job. It is different from "biological longevity" or "healthy longevity," which means the ability to live a daily life without restriction, owing to health problems.

**(2) Policies of the R&D Supervisor for proposal selection and R&D management**

**① Policies for proposal selection**

This prioritized theme requires R&D of a system for supporting human intellectual activities with a clear object of the creation of new labor force and intellectual productivity.

A clear vision of the services to be provided has to be demonstrated beyond the development of individual technologies. Specifically, the followings are the examples expected to be newly possible:

i. Maintenance and improvement of personal intellectual activities

In a series of intellectual activities, including labor of an individual, there are cases in which a smooth intellectual activity may be disturbed, owing to a decreased level of an intellectual function, such as inability to recall a memory (a simple lapse of memory) or inability to perform something that could be completed in the past. The acquisition or improvement of a new skill by an individual tends to become difficult for elderlies. When such incidents happen frequently, it not only becomes an obstacle for actual work but also decreases the willingness to work or participate in society, a concern that further alienates her or him from society.

Databases based on an accumulated general information, such as dictionaries or internet search, have been mainly utilized to support memory retrieval[4] by using information technologies in the past.

Meanwhile, R&D has not advanced much for a system to accumulate personal information to serve the memories one wishes to retrieve in a timely manner. Once a support system to maintenane and improve such intellectual performance is established, it will become possible to improve the intellectual productivity of an individual and extend her or his “societical active life.” In addition, increasing number of individuals, who play their role actively for a long time, are expected to lead to the decrease of the societical burden, such as medical expenses and societical welfare costs.

ii. Support system for getting new jobs

Certain levels of knowledge or experience are required for jobs, such as operation of a processing machine or an OA equipment. An obstacle of learning skills of a new job for young people, who have no experience, may prevent unskilled laborers from employment. Moreover, as introduction of AI proceeds, there may be cases in which individuals are forced to change jobs or positions owing to the change of societical systems. Certain individuals may find it difficult to respond to the changes.

Many of the jobs mentioned above can be described in a manual. However, it is difficult to perform the job by referring to the manual alone. Many jobs require a process for acquiring intellectual and technical knowleges by oneself through practicum, technique acquisition training, or training with a simulator, which provide a person with a process to learn knowledgs and skills by herself or himself.

A system to support individuals is expected for gaining intellectual and technical knowledges effectively, based on the understanding of the mechanisms to learn intellectual and technical knowledgs. Such a system allows possibilities to retrieve new

[4] Retrieval refers to recalling things or related images experienced in the past.

labor force which was not visible in the past and to promote labor mobility to respond to the change of labor distribution in the future, and then to improve the intellectual productivity of whole society.

iii. Transfer of high-level skills

The so-called “professionals,” ”skilled workers,” and ”master artisans” possess a hunch or a knack, which is a high-level intellectual knowledge, technique, action, and viewpoint and cannot be imitated easily. The difficulty to tansfer is due to the fact that the key controling points of the process have not been well understood and not been crystalized to tranferable knowledge. If such knowledge and techinique can be understoood and reproduced by the basic measuring technology, it becomes possible to transfer and share the original high level techinique, which has belonged only to the master. Sharing the technique by the public improves dramatically productivity and commpetitiveness of the society. Examining the mechanism of such a high-level intellectual activity is believed to make it possible to build a base for creating values of society, such as skills and culture that people of a future society transfer.

The above descriptions are merely simple examples. A proposal is not restricted to them. We expect a variety of proposals based on your original ideas.

Target technology fields range from basic research, to high-level application research of information technology. Collaboration is also expected between various research fields, including cognitive science, psychology, and neuroscience.

Respecting the will of an individual (freedom of choice, agreement and its revoking and so on), consideration for privacy, and examinations of physical and psychological influence, ethical issues, and issues of a societical system are essential in accessing and utilizing memories and experiences of individuals. Therefore, a clear scenario for solving ELSI[5] issues is necessary at the developmental stage of individual technology.

In addition, studies on robustness and reliability of a system, and avoiding disperity such as a digital divide, are necessary to be started from the beginning for societical application of research results. Therefore, approaches, such as inclusive design (exclude nobody and include everyone), and thinking design together (Co-design) and thereafter are considered useful.

To meet the rapid changes in relevant science and technology and a societical situation, this prioritized theme expects proposers to survey adequately domestic and international trends, and to have dialogues with users, and to organize a team for flexible reviews and R&D plan.

As this prioritized theme includes many immature level of R&D, relatively small-scale yet challenging research proposals are welcomed as feasibility studies and then they could be merged and integrated with other projects for the next step of a full-scale research.

[5] Ethical, legal, and social issues manifest at the interface with society when conducting research.

The following type of R&D projects are not the target ones of this theme:

- Those aiming to support physical activities only
- Approaches including direct action to the “brain” or the “nerves”
- Those including “mind (feeling)” as a subject

### ② Policies for R&D management

Societical trends and rapid progress in science and technology in Japan and overseas are to change the environment and requirements of this prioritized theme. Therefore, we plan to collaborate with related projects in Japan and to arrange collaborations among projects in this prioritized theme, and to share information to deepen discussions with a wide range of domestic and overseas parties openly and continuously.

We may also instruct R&D projects to merge or changes of R&D plans (including team structure or budget), if necessary. In addition, we will accelerate movement to a full-scale research, if the R&D Supervisor judges it is adequate even before completion of a FS term.

### ③ R&D Period and Budgets

For R&D projects starting in FY 2017, please propose a plan based on a maximum FS period of three years (time spent in FY 2017 is calculated to be one year regardless of when R&D starts) and a total budget for a whole FS period of about 40 to 60 million JPY (including indirect expenses).

A full-scale research must be completed within a maximum of five years and a maximum total research budget of 2 billion JPY (including indirect expenses).

## 5.1.3 “Realization of the most Safe and Secure Society in the world” area

R&D Supervisor (Program Officer; PO):
Ken-ichi TANAKA
(Executive Fellow, Mitsubishi Electric Corporation)

### I Goal of “Realization of the most safe and secure society in the world” area

Our society is changing every day.

The Internet service has dramatically improved communication methods, so that people can now easily communicate with everyone all over the world. However, the risks of cyber-attack and terrorism are growing, therefore security must be more secure. The essential things for human lives, such as air, water and foods, are needed to be supplied for our daily lives concurrently with the measures against natural disasters such as earthquake, guerilla storm, and typhoon. Since Japan currently faces an aging society, more than one fourth of population is aged over 65. It is an urgent task to build a society which elderly people can live actively and heartfully. With these social changes, we are always needed to explore how to improve “Safety and Security” in our society.

When considering “Safety and Security”, we must keep in mind that “Security” is based on our individual sense, so that scientific data cannot ensure “feelings of security” in people's lives; however, “Safety” can be evaluated by scientific indicators. The evidence of safety does not necessarily mean the indicator of “sense of security”.

Based on the above, the aim of this research area is to realize a society in which everyone can feel secured, by providing people with “Safety and Security”.

To decide a prioritized theme of call for research proposal in FY 2017, we interviewed experts in various fields and analyzed proposed themes. (There were about 500 proposals, which were related to the area of safety and security.) In consequence, two themes have developed; (1) Development of the crisis navigator for individuals-- for safety and security in emergency, (2) Creation of humane* service industries-- for people’s security in their daily life.

*Humane means merciful, sympathetic, and making a person noble.

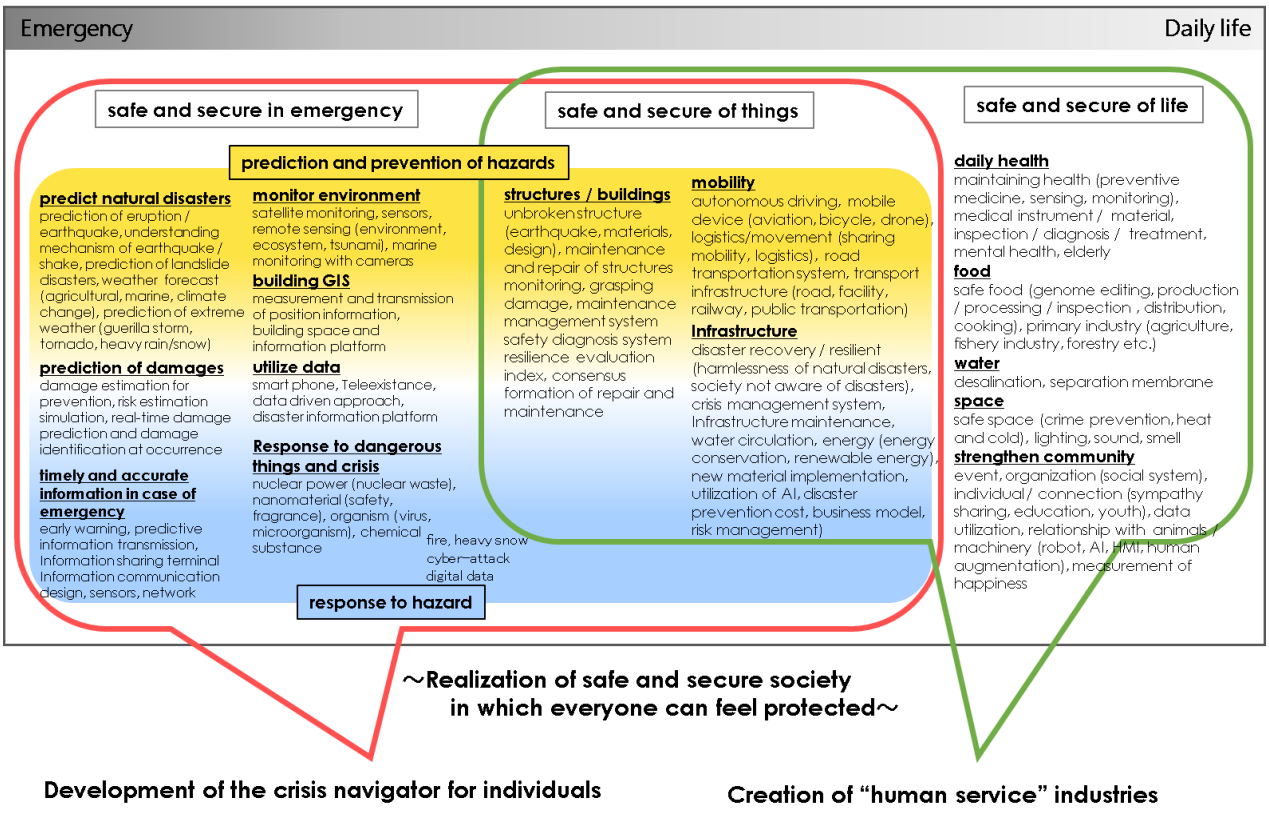



Fig.1 Structure of the values expected to be created in this area

# II Prioritized themes

## 1. Development of the crisis navigator for individuals

### (1) About the Theme

**There are three types of hazard approaches such are prediction, prevention, and response phases. We focus on "response phase". Our goals are to improve the accuracy of decisions by organizations using technologies and to develop "navigator" which delivers options of actions to individuals.**

The word "Hazard" indicates not only natural disasters but also every dangerous factors that cause unexpected emergency such as accidents, incidents, and cyber-attacks. Our society is increasingly becoming more diversified and complex, for example, accelerating the globalization and expanding of the internet makes us easy to access to cyber-space. Under such circumstances, hazard and risk would not be eliminated naturally. To consider scientific approaches to eliminate the hazard or minimize damage, we must recognize that we are surrounded with various risks.

The approaches can be grouped into three phases: prediction of hazard (sensing hazard), prevention (preparing for damage), and response (responding to crisis to overcome it quickly). In the phase of those, prediction and prevention of hazard, have recently been upgraded by technologies. On the other hand, the response phase still tends to depend heavily upon "human decision." We consider a basic process of the response phase as follows; 1)people take action relying on decision of organizations[6] 2)people take action to secure her or his own safety(escaping and hiding) or to secure safety of society(helping others, protecting something). Our goal is to establish high-level technology which supports these processes.

Also we aim at developing a "navigator" to support decision of organizations and action of individuals.

[6] An organization means an entity that is responsible for securing safety of relevant individuals (members, users at the time). For example, the government, a municipality, a large-scale facility, an event manager, a building manager, a private company, and similar entities.

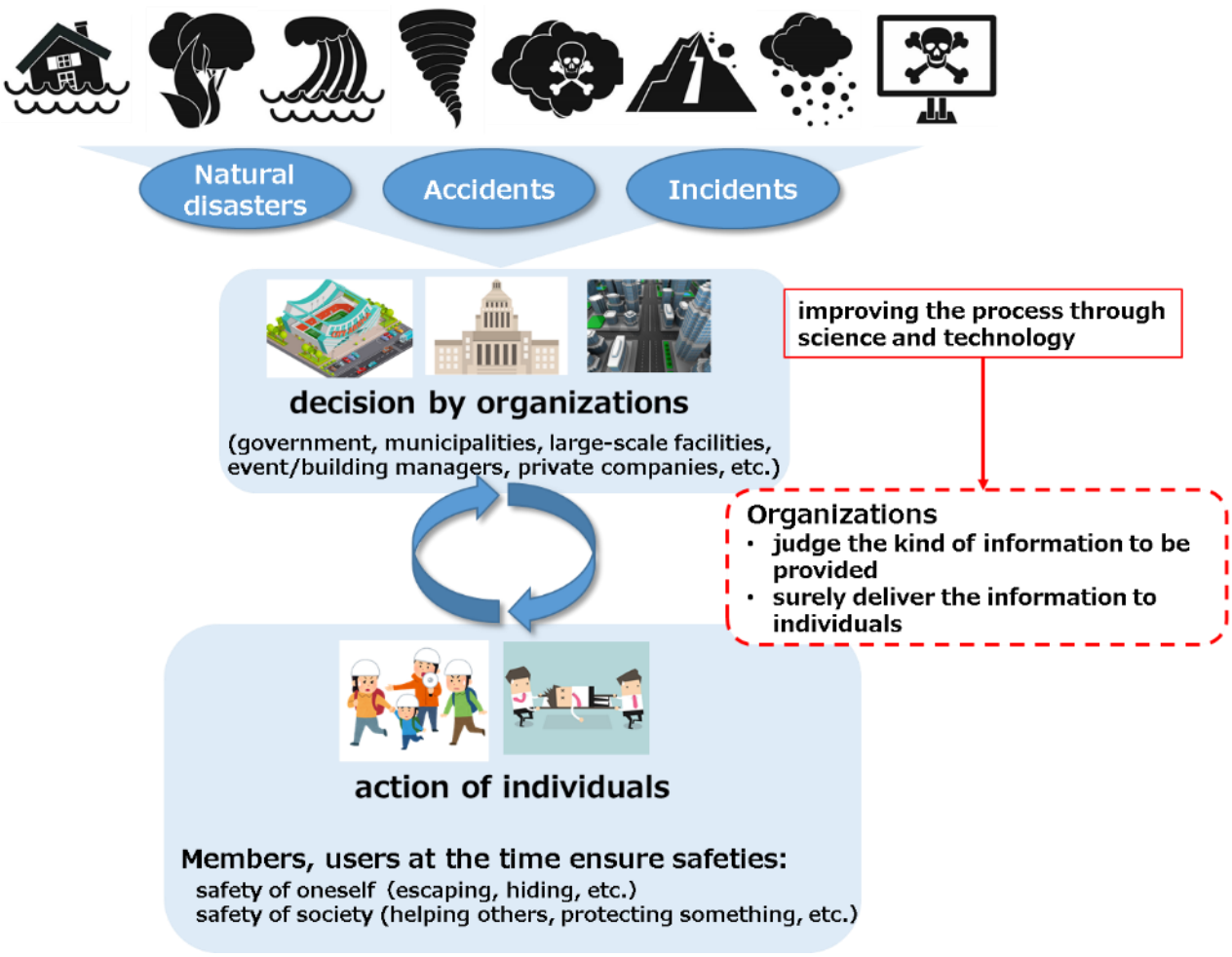



Fig.2 The aim of the crisis navigator for individuals

This navigator system would be able to provide not only the options for individuals with guide evacuation, but also each member of organizations, such as employee, with proper options for urgent responses, such as evacuation guidance. Therefore, it would give significant impacts to both individuals who want to secure safety in their daily lives and organizations which want to be recovered from damages caused by hazard. Also it is presumed that navigator would contribute to develop new markets in recipients of its research outcomes; service industries (specifically, security companies), information and communications industries, and construction industries.

To add the useful functions for daily life other than emergency, the crisis navigator would be able to appeal additional values to the companies and administrative organizations which are introducing the navigator.

**(2) Policies of the R&D Supervisor for proposal selection and R&D management**

**① Policies for proposal selection**

We aim at developing a navigator to greatly support response to hazard, mainly on initial response stage, by science and technology. Its realization needs the following technologies:

1) Observe, measure, determine and collect various information in a timely manner (prediction, prevention)
2) Integrate different kinds of information (information processing)
3) Derive options from the integrated information (information analysis)
4) Assured delivery of the options to individuals in a timely manner (information infrastructure, communications device)
5) Integrate the above technologies (systemization)

Improving accuracy of decision by organizations requires collecting quickly as much information as possible, visualizing situations and making a situation understandable (analyzing) and usable. It takes upgrading and optimizing of technology 1)-3). An assured delivery of decision to individuals also needs an upgrading and optimization of technology 4) as a stable means for communications under any situation and means for communications that can be used without power supply. For developing a system as a "navigator," 5) is essential. Therefore, 5) is the must for the research proposals. It is not necessary to renew all of the 1)-4) technologies. It is welcomed to take advantage of existing research achievement.

Also, the research proposals should presume an image of specific implementation and practical use. Please describe clearly and specifically an image of implementation in the society in 2030 for research proposal in Application Form. Moreover, please describe the target hazard as well. It is not necessary to choose a single hazard. We welcome proposals of "navigator responding to crisis" that can be implemented for several or all hazards.

For example, in the case of an earthquake, an emergency center of a building follows a manual prepared in advance to decide what instructions a person (manager at the center) must give to people inside. However, the extremely small number of managers have experienced an unprecedented earthquake, and they will conceivably be at a loss in decision making. Moreover, the manager needs to surely deliver the decision (instruction to evacuate) to people inside. The manager may deliver different information to varying persons, instead of issuing the same information to all the people inside. Such a situation may call for the development of a technology that surpasses conventional means of communications, such as broadcasting inside a building or a smartphone. Therefore, it is expected to build a "navigator responding to crisis," which integrates the above described functions. A conceivable specific example is given below for the research and development problem. However, this is a mere example. Please submit a proposal based on free ideas without being influenced by the example.

(An example of R&D under this theme)

**Development of a navigator responding to crisis for security guards by the gate-free and real-time entry security system and decision making system**

Develop a “detection system for gate-free and real-time entries and exits” that is a security system for closed space, such as a stadium with a capacity for 10,000 people, by using metrical and measuring techniques to detect all kinds of hazards (harmful chemical substances, organisms including viruses and bacteria, lethal weapons, and arms) without stresses on audience, such as stranding or going through a security gate. Use the detection system and high-level information processing techniques to improve the accuracy of judgement by a contingency center. Moreover, build a navigator system, which responds to crisis, in a large-scale facility that integrates communication techniques for transmitting to each security guard to one’s deployment position, conveying a proper way of preventing incidents and accidents depending on one’s expert skills and equipment, and guiding evacuation.

An important issue in the implementation of a navigator system in a society is how to guarantee reliability against such risks (for provider and user), including malfunction or false information. Concerning this, we encourage to consider where legal liability lies and to assess the users’ acceptance with technology development.

### ② Policies for R&D management

Conducting challenging R&D activities, we encourage the diversity of a research team for incorporating innovative ideas, including the interdisciplinary approach, global activities and collaboration between industry and academia. R&D Supervisor and the committee members will review your research activities and visit the research site and give you support and advices. We aim at realizing “safe and secure society in which everyone can feel protected.”

When transitioning from FS phase to full-scale research, optimization of R&D plan will be considered again through restructuring research teams and so on.

### ③ R&D Period and Budgets

For the research proposal submitted in FY 2017, please plan within a maximum period of three years. However, time spent in FY 2017 is calculated to be one year regardless of when the research and development starts. We evaluate your R&D activities for a full-scale research at a time specified by the R&D Supervisor in charge until the end of FY 2019. Please make a plan with a maximum total budget of 60 million JPY (including indirect expenses) in principle.

Please plan a maximum period of five years and a maximum total budget of 2 billion JPY for a full-scale research.

## 2. Creation of “human service” industries

### (1) About the Theme

**We aim at realizing “humane* services” that allow everyone feel safe, comfortable, and being secured by promoting human relations and controlling the environment around people.**

**(*Humane means merciful, sympathetic, and making a person noble.)**

Science and technology have made our lives safe, secure, and abundant for years. The 5th Science and Technology Basic Plan (FY2016-FY2020) proposes “Society 5.0” as the image which Japan must aim for. In other words, following the hunting, agricultural, industrial, and information society, innovations based on science and technology lead changes to a new society. In our daily lives, science and technology are presumed to play increasingly larger roles in the future.

Proposed themes related to “safety and security” contained not only sudden environmental changes, such as disasters, but also anxiety and dissatisfaction associated with progress in science and technology. Several people have voiced their concerns of the possibilities which the communication taken by five senses might be diluted because of frequent use of IoT and AI technologies, and it might bring mentally and physically adverse effects to people in the future.

In considering the above, we would like to create new services using science and technology. To accomplish such goal, we have to verify what kind of services the future society will need and how science and technology will contribute to those services. For example, voice and letters are major means of our communication, whereas the way of communication in future may be able to share tactile impressions, tastes, and olfaction, which cannot be expressed in words. Many people have probably experienced having wonderful idea run through mind at bathtime or in the train. The future society may be able to create the space which people can get ideas more easily and readily. Recent progress in science and technology combined with our imagination must be able to create many wonderful services which will deliver safe, secure, and comfortable society.

### (2) Policies of the R&D Supervisor for proposal selection and R&D management

#### ① Policies for proposal selection

R&D under this theme aims at the services that recipients can accept without prejudice. The R&D is expected to contribute the society in which services based on advanced science and technology are naturally available in our life. A human interface is presumed that service recipients would accept it without any changes of their lifestyle nor acquire new skills.

We encourage proposer to clearly describe an image of implementation in the society at 2030 by using the application form.

This theme presumes roughly four categories for the call for proposals in this fiscal year. Presumed examples of research and development problems are given below. However, it is just an example, so please submit a proposal based on free ideas.

(1) Reinforcing communities: services to support adequate communications for close and comfortable connections among people, and improvement of imaginations and ideas of people through effective dialogues among them
(2) Controlling Atmosphere: services to control atmosphere for mitigating stresses that people receive unconsciously, and building an environment in which people can express their maximum abilities
(3) Monitoring physical and mental health: services to measure, determine, and control humans themselves and the environment around them to grasp their mental and physical conditions, detect latent disorders, including psychological diseases, at the early stage, and advise them to take proper actions for health maintenance such as sleep, rest, diet, and physical exercise.
(4) Keeping water and dietary safety: services to improve food safety, improve security with proper information, and services to advise individuals to take adequate drinks and food

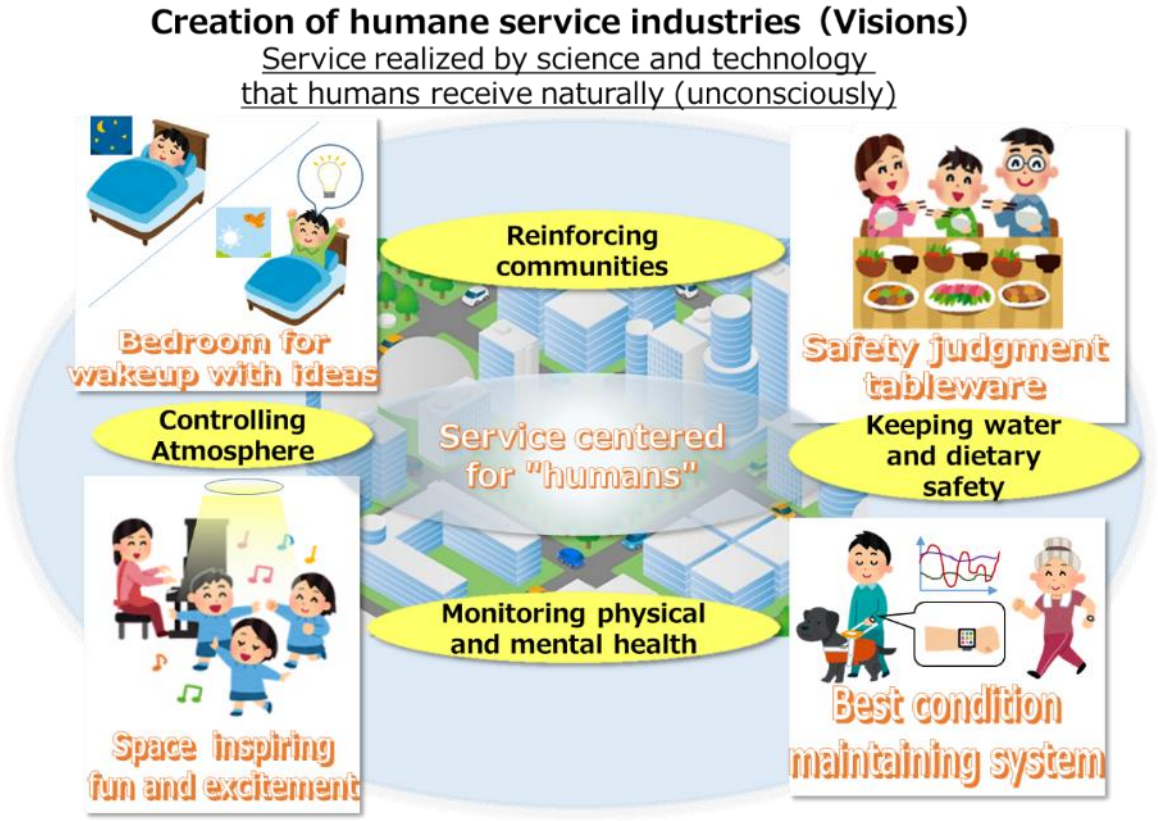



Fig.3 The aim of "humane service" industries

For planning and developing new service, we need to have comprehensive views of these ideas and expect business development such as delivering POC. Our goal is to implement services in society, therefore it is considered desirable to start with services which have evidence proving of safety, security, and comfort by basic researches and verification tests.

Along with research and development, we would like you to consider that specific activities are necessary for standardization to implement of the society.

### ② Policies for R&D management

Conducting challenging R&D activities, we encourage the diversity of a research team for incorporating innovative ideas, including the interdisciplinary approach, global activities and collaboration between industry and academia. R&D Supervisor and the committee members will review research activities and visit the research site and give you support and advices. We aim at realizing “safe and secure society in which everyone can feel secured.”

To increase chances for success in new service creation, we would like to repeat short-term challenges even at the FS stage to search for better possibility under this theme.

When transitioning from FS phase to full-scale research, optimization of R&D plan will be considered again through restructuring research teams and so on.

### ③ R&D Period and Budgets

For the research proposal submitted in FY 2017, please plan within a maximum period of two years. However, time spent in FY 2017 is calculated to be one year regardless of when the research and development starts. We evaluate your R&D activities for a full-scale research or a continuation of the FS at a time specified by the R&D Supervisor in charge until the end of FY 2018. Please make a plan with a maximum total budget of 20 million JPY (including indirect expenses) in principle.

Please plan a maximum period of five years and a maximum total budget of 2 billion JPY for a full-scale research.

## 5.1.4 “Realization of a low carbon society, a global issue” area

R&D Supervisor (Program Officer: PO):
Kazuhito HASHIMOTO
(President, National Institute for Materials Science)

### I Goal of “Realization of a low carbon society, which is a global issue” area

Building a low carbon society is a global challenge that must be met in order to control the emission of the greenhouse gas (GHG), carbon dioxide, which is a major cause of global warming. The Conference of Parties of the United Nations Framework Convention on Climate Change (COP21) held in December 2015 adopted the Paris Agreement, which demanded that the increase in global temperature to be kept below 2°C above pre-industrial levels and that efforts be made to limit the temperature increase even further to 1.5°C above pre-industrial levels.

In response to this resolution, Japan adopted the following goal: “to decrease GHG emissions by 26% relative to that in 2013 by 2030.” In December 2015, the Global Warming Prevention Headquarters declared its intention to work toward that goal.

Furthermore, the Council for Science, Technology and Innovation agreed on “National Energy and Environment Strategy for Technological Innovation towards 2050” (NESTI 2050), which identified promising technologies for decreasing emissions and put together a promotions team for long-term research and development, while keeping an eye on 2050.

To achieve these targets, it is necessary to develop innovative technologies based on entirely new concepts and science, or game-changing technologies.

In the effort to realize game changing technologies, entirely new proposals by researchers from different fields were considered in addition to challenging proposals for which researchers in relevant fields merge, take advantage of, and develop advanced research techniques.

This area has received 344 proposals. Based on these proposals and interviews with experts in related fields, the research and development management conference evaluated potential themes for its call for proposals for fiscal year 2017 to promote creation of game changing technologies.

The theme chosen was the realization of a low carbon society through game-changing technologies. To invite specific proposals to realize a low carbon society, “bottleneck issues,” which are issues that prevent the implementation of technologies in society, were set out to identify potential solutions.

# II Prioritized theme

## Realization of a low carbon society through game changing technologies

### (1) About the theme

This area aims to develop game-changing technologies, rather than extensions of conventional technologies, and implement these through collaborations with other projects of the JST and efforts made by other ministries. The goal is to contribute to the realization of a low carbon society with fundamentally low carbon dioxide emissions in order to meet the expected demands for services for 2050.

Fig.1 illustrates the whole scheme of prioritized theme in this area.

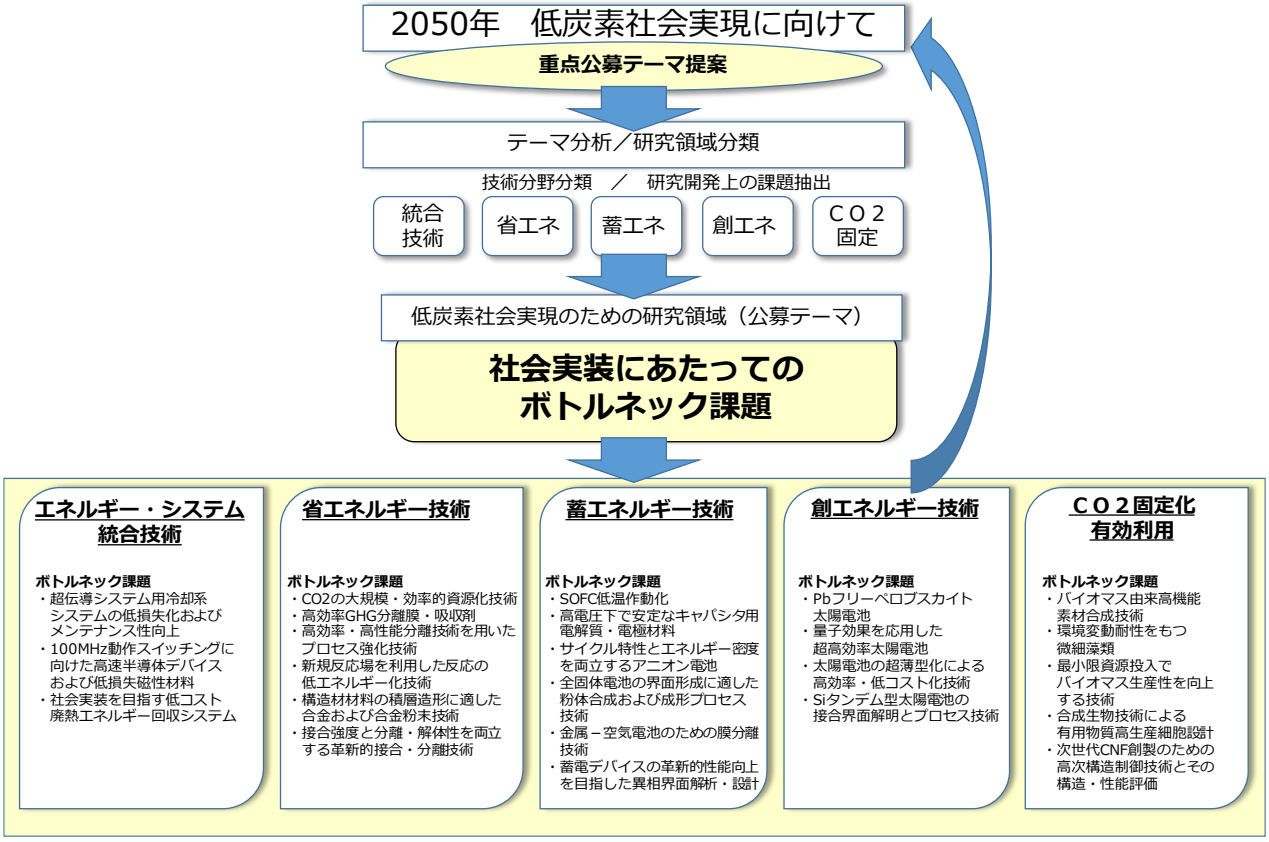



Fig.1 Overviewof the prioritized theme in “Realization of a low carbon society, a global issue” area

As described previously, the Paris Agreement adopted by COP21 in 2015 set a target of keeping the increase in global temperature to below 2°C above pre-industrial levels. This requires the “development of innovations, including technologies discrete from conventional technologies for decreasing carbon emissions, for realizing global and fundamental decreases in emissions.” Japan's role would be “to bring together the wisdom and knowledge of industry, academia, and government to promote medium- and long-term research and development in energy and the environment to realize innovations that will decrease carbon dioxide emissions and spread these achievements throughout the world.” This idea is incorporated in NESTI 2050. This research and development strategy is in accordance with the idea to create game-changing technologies. This area promotes research and development for the benefit of the wider public.

Regarding the contribution to the international community, this area may be presumed to develop approaches for collaboration with willing developing countries; for example, using advanced technologies that can play a key role in decreasing global carbon dioxide emissions through Japanese technological ability.

Japanese industries have drawn up the "An Action Plan for a Low-carbon Society of Japan Business Federation toward 2030" (prepared in April 2015, revised in April 2017). The federation is said to consider the "development of innovative technologies" as a pillar of the plan to "positively approach medium- and long-term development and practical applications of innovative technologies, with an eye toward 2030 and thereafter, while taking advantage of collaborations between industries, academia, and the government." If innovative technologies contributing to the solution of bottleneck issues inhibiting the realization of a low carbon society are created and passed on to private companies, they would be expected to not only contribute to achieving the goal of decreasing carbon dioxide emissions but also directly improving the industrial competitiveness of Japan.

**(2) Policies of the R&D Supervisor for proposal selection and R&D management**

● **Policies for invitation and selection**

To adopt issues to meet the concept of the project (verification of concept by innovative research and development), selection is based on the following criteria:

(1) Can the technology make a significant contribution to decreasing carbon dioxide emissions (not only in scientific terms)?
(2) Do private companies in charge of implementation in society need the technology?
(3) Is it innovative research that academia, such as a university, should perform?

This area will collaborate with the programs of other ministries, if necessary, to achieve the goal of implementation in society.

This area will implement the above approaches and the aim to create "game changing technologies" for fundamentally decreasing carbon dioxide emissions while meeting the demands for services presumed for 2050 and implement the technologies to help realize a low carbon society.

● **Contents of research and development**

The solutions to global warming may be grouped into two types, those that try to adjust the ways of nature and society in order to reduce the impact of global warming, and those that try to control GHG emissions. Science and technology are expected to contribute to mitigation measures. This area also aims to create game-changing technologies that contribute to the realization of a low carbon society by mitigation measures.

Various trials have been conducted for technologies aimed at decreasing carbon dioxide emissions. However, many of these technologies have not come to fruition. The causes of "bottleneck issues," have been summarized by those involved in this area and specifically shown to researchers. This method is based on the "Advanced Low Carbon Technology Research and Development Program" (ALCA), an approach of the JST.

In this area, POs of ALCA analyzed the contents of 169 proposals related to the area of low carbon societies from those emphasized themes applied by the public. ALCA took into

consideration both new and existing bottleneck issues as a full-scale research. These bottleneck issues, classified into technological fields ①-⑤ below, are specified in NESTI 2050 to publicly invitation of research proposal. The specific descriptions are as follows:

**① Energy and system integration technology**

**1) Low loss and improved maintenance of cooling systems for superconductivity application instruments**

Superconductivity systems are approaching the stage of real-world application. However, the performance of not only the main body of the superconductivity instrument but also the whole system, including the cooling system, must be improved to beat the performance of conventional non-superconducting systems. Specifically, technological improvements are needed to realize low loss, low operating costs, and low maintenance for each instrument, including freezers of cooling systems. The development of superconductivity systems requires not only research and development in cooling systems but also meeting the requirements of the systems including their practical use. The choice of cooling methods depends on the conditions of the system. On the other hand, much is expected from innovative technologies that do not rely on application instruments but are common and basic cooling technologies to lead to a breakthrough of cooling systems. Therefore, the properties of heat transfer and flow properties of He, $H_2$, and $N_2$; cost, size, and maintenance of low temperature instruments, such as freezers, compressors, purifiers, flow meters, level gauges; and upgrading the performance of insulated piping systems are adequately considered to perform research and development in cooling systems for superconductivity instruments that use $MgB_2$. REBCO, or Bi wire materials. The public is invited to submit implementation proposals.

**2) Development of high-speed semiconductor device and low-loss magnetic material for realization of a 100 MHz action switching power source**

At present, the total loss of electric energy supplied from power plants reaches approximately 5% of total electricity generated. Therefore, electric power converters for ① automobiles and trains need to be made smaller and lighter for reducing transmission energy; and ②conversion efficiency must be improved to control heat generation. Reactors (including inductors and converters) and capacitors made smaller and lighter by high-speed switching are effective for the former. Improved conversion efficiency for the latter is effective in two ways: it reduces power consumption owing to reduced heat generation and eliminates the need for cooling devices. The main reason for maximum operating frequency of the present switching power source remaining at MHz levels is response speed of the switching device and hysteresis loss and eddy current loss of magnetic materials. This grows clearer as switching frequency increases. One challenge that needs to be overcome is the development of low loss magnetic materials actionable at a frequency of 100 MHz and high-speed power devices. Ni-Zn ferrite currently used as a high frequency magnetic material has low saturated magnetic flux density or magnetic permeability, and is inadequate as a switching power source. In addition, power semiconductor devices such as Si-IGBT, power-MOSFET, or SiC-MOSFET have problems with switching speed and current driving force. Proposals are invited for new low loss magnetic materials that can lead to the development of promising power switching devices with wide bandgap lines and super small and high-efficiency electric power converters.

**3) Development of low-cost recovery systems for waste heat energy to be implemented**

**in society**

The energy contained in medium- and low-temperature (below 300°C) waste heat comprises two thirds of the total energy consumed in Japan. The recovery of waste heat energy is key to decreasing GHG emissions that cause global warming.

Binary power generation, magnetic heat pumps, thermoelectric conversion materials, and acoustic engines have been devised as techniques for recovering medium- and low-temperature waste heat energy. However, none of them can generate enough electric power to cover the costs of system production or maintenance. The implementation of a waste heat recovery system in the future requires ① improvement of thermoelectric conversion efficiency and ② reduced system production, operating, and maintenance costs in order to recover enough energy and cover the costs of system production and maintenance.

In the case of binary power generation, for example, liquid leaking that may occur during conversion of the expanded volume caused by hydraulic liquid evaporation to mechanical energy is the main obstacle (barrier in operation and maintenance cost) to practical application. This problem can be solved by developing a mechanism for removing mechanical motion inside the tightly closed space while controlling liquid leakage when moving a piston or turbine inside the space. Proposals are invited for an innovative system that can efficiently recover waste heat energy without hydraulic fluid leakage, and devises a mechanism to recover the energy produced by binary power generation, such as ① using magnetic fluid bearings to prevent seawater leakage from the screw bearings of a ship, or ② taking energy out of motion by transmitting the reciprocating motion of a piston in a tightly closed space to an outside magnet.

For a thermoelectric material or magnetic heat pump whose material properties affect conversion efficiency, proposals are invited for the development of materials that can to recover more electric power than the costs of used elements or system production, regardless of the thermoelectric conversion index (ZT) or magneto-caloric index.

### ② Energy saving technology

#### 4) Large-scale, efficient technology to recycle carbon dioxide

At present, chemicals produced from fossil resources are produced as carbon and energy sources, and then eventually released into the atmosphere as carbon dioxide. The ideal process for chemical production in a low carbon society is a carbon cycle in which chemicals are synthesized from chemical materials resulting from the carbon dioxide emitted by the energy sector and the like, and reduced with hydrogen free of carbon dioxide. Technologies to separate and recover carbon dioxide have been actively researched and developed as part of carbon capture and storage (CCS) development in each country, with some in verification testing stages. Except for polycarbonate production, however, the development of technologies to convert recovered carbon dioxide into resources has made very little progress.

This kind of large-scale resource production from carbon dioxide requires technologies for the massive production of hydrogen as a reducing agent using renewable energy without carbon dioxide emissions. However, because such technological development is a long-term solution, this issue accepts combinations with existing technologies, including the utilization of methane, which emits small amounts of carbon dioxide. Proposals are solicited for building important element technologies with priority given to large-scale and efficient conversion of carbon dioxide into resources.

Specific examples include methanol synthesis from carbon dioxide gas, Fischer–Tropsch

synthetic reactions from carbon dioxide gas, carbon dioxide reforming, and improving the efficiency of the partial oxidation reaction of methane.

**5) Development of efficient separation membrane and absorber for greenhouse gas**

Huge amounts of GHGs particularly carbon dioxide, are emitted by the combustion of fossil fuels. To decrease GHG emissions, energy-saving technologies are being developed and the shift to renewable energies is in progress. However, the current situation indicates that the dependence on fossil fuels will last for a long time. Some simulations indicate that CCS (Carbon dioxide Capture and Storage) might account for approximately 14% of carbon dioxide reduction in the future. The current cost of CCS is over 6,000 yen/t-CO2. Substantial cost reductions are necessary for its practical application.

The separation and recovery of carbon dioxide comprise 50-60% of total CCS costs. The development of innovative separation and recovery technologies is a bottleneck to the widespread application of CCS. Various techniques are now available, such as chemical absorption, physical absorption, membrane separation, cryogenic separation, adsorption separation, etc. However, innovative technological developments are necessary for each of them.

The approaches are conceivably diverse because the operating conditions and required properties for carbon dioxide separation and recovery vary depending on the kinds of fuel used and their applications. Proposals are invited to clearly define the operating conditions and scale for each exit application and develop innovative absorption fluids, adsorption materials, and separation membranes to reduce the costs of operation and facilities, while taking into account the difference between theoretical and actual values of separation energy. In addition, proposals related to the development of new modules enabling the efficient utilization of these materials are acceptable. Proposals for the techonologies of separation and collection of the gas with the greater temperature coefficient other than carbon dioxide are also accptable.

**6) Process improving technologies using efficient and high-performance separation techniques**

Productivity and energy savings in chemical manufacturing processes are restricted by the energy demands and costs of separation, recovery, and recycling of non-reacted raw materials, products, and solvents. Costs prevent non-reacted raw materials and solvents from being recycled, which are a major source of carbon dioxide emissions. The development of energy-saving and cost-cutting processes requires innovative separation processes with high efficiency and performance for enhancing processes. A bottleneck in strengthening processes is the development of innovative separation and purification processes that are hybridized with various separation techniques. The technologies in question are reaction and separation techniques, including membrane reactors, reaction absorption, and reaction distillation, high-performance membrane separation, as well as membrane separation, phase separation, adsorption, extraction, crystallization, and their corresponding hybrids.

Membrane separation in particular is expected to replace distillation as an efficient and energy-saving separation technology. Various materials, such as organic polymers, inorganic materials, and compounded organic and inorganic materials, are available for membrane separation. Each one requires technological innovations in permeability, selectivity, and tolerance to enable practical applications as a separating membrane. This area invites

proposals for research and development in new separation membranes, substrates to support separation membranes, and new membrane module structures and materials to save energy and reduce costs. Proposals must include the advantages (predicted) of the developed separation technology and reaction separation technology over conventional processes in terms of energy savings.

**7) Technologies for lowering reaction energy using a new reaction field**

C1 chemistry is a reaction system for producing chemicals via conversion of various carbon sources into carbon monoxide or hydrogen molecules, or directly from methane. However, the system has many problems. For example, methanol synthesis is an irrational process consisting of the steam reforming of methane (an endothermic reaction) at high temperatures above 750°C followed by a methanol synthesis reaction (an exothermic reaction). This process consumes a large amount of energy and emits a huge amount of carbon dioxide. Research is also underway on direct methanol synthesis by methane oxidation. However, it is not easy to stop the reaction of highly reactive methanol in methane oxidation, which has low reactivity aside from being a highly difficult reaction.

Demand exists for reducing the energy consumption of high energy processes and improving the selectivity of difficult reactions. Active research is being conducted on these kinds of chemical reactions. Rapid improvement in catalyst performance is needed.

In general, it is assumed that a catalyst is used in a thermally equivalent field. However, this area focuses on thermally non-equivalent reaction fields and the development of catalysts that are active in such fields. Proposals are invited for new reactions and reaction processes that cannot be carried out in conventional reaction fields. The means of supplying energy to new reaction fields include electromagnetic waves, supersonic waves, magnetic field, electrical fields, and their combinations. Reactions include those that are currently used for the mass production of universal chemicals despite large energy consumption as well as improved yield combined with decreased energy consumption of difficult reactions. Proposals are required to compare the energy input (predicted) for a production system using a proposed manufacturing technology.

**8) Development of alloy and alloy powdering technologies suitable for lamination of structural materials**

The 3D printer is a promising technology for the development of the field of heat-resistant materials. However, a supply system for high-quality and clean powders and lamination technology have not been established. For example, when a powdering technique is applied to Ni group alloys containing Al or Ti, oxides or nitrides form and cause a marked decrease in creep strength and toughness. Unlike porous ceramics such as plastics and biosystems, alloys need fundamental reexamination and tissue forming technologies combined with thermal history simulation when a 3D printer is used to avoid problems in the machinability of structural or heat-resistant materials. This is the bottleneck. Considering the above, this area invites challenging proposals for research and development in manufacturing technologies for clean powders and for the development of robust alloys that are effective in reducing contamination in powder production and lamination process, and against oxides and nitrides originating in powder surface.

**9) Innovative bonding and separation technologies that possess both bonding strength and separation and decomposition functions**

Industries in Japan emit the largest amount (34% in 2014) of carbon dioxide, 60% of which comes from the materials sector. Carbon dioxide emissions from material production are increasing. Recycling technologies that promote reuse and remanufacturing are effective for decreasing carbon dioxide emissions from new material production. However, bonding and separation techniques are a major bottleneck.

Innovative technologies for bonding and separation, with both bonding strength and the ability to separate and decompose, can decrease the energy consumed by decomposition and help realizing a low carbon society that recycles many products. This issue invites proposals for technologies that allow the effective utilization of existing resources, such as public infrastructure materials, their quick decomposition and reassembly, and extension of infrastructure longevity, as well as proposals that contribute to the development of bonding and separation of multiple materials by taking into consideration the recyclability of weight-reducing materials that require large amounts of energy for production.

**③ Energy storage technologies**

**10) Low-temperature operation of solid oxide fuel cell battery (SOFC)**

Although the SOFC is an efficient power source that does not require a platinum catalyst, its intrinsic technological problem is that it requires high operating temperatures of 700-900°C. Therefore, lowering operating temperatures to 500-600°C to extend longevity is needed, while retaining advantages such as high efficiency and the non-use of a platinum catalyst. To meet this objective, search and material design methods are important for rate-determining dispersion of carrier ions in the medium- and low-temperature range in electrolytes and electrode materials and for determining the optimum structure of defective structures that facilitate dispersion. Research and development in materials and structures is also important to facilitate the development of activation and stopping systems.

Proposals are solicited for a solution to the bottleneck problem; for example, science-based research and development to identify the correlation between optimum structural design and fuel cell battery performance.

11) Stable electrolytes and electrode materials for electrochemical capacitors under high voltage or high capacity electrode-electrolyte systems

Electrochemical capacitors, which excel in rapid charge and discharge, are expected to have a variety of applications including smoothing of electric power obtained from renewable energy. However, because they have lower energy density than batteries, improving energy density by developing high capacity electrochemical capacitors that can be operated at high voltage is called for. Specifically, the following proposals are expected:

- Stable electrolytes and electrode materials under high voltage (e.g., over 4 V)
- Development of electrode-electrolyte systems with higher capacity (e.g., more than double) than existing capacitors using carbon materials
- Research and development in new pre-drape technologies for Li ion capacitors to improve performance

**12) Anion batteries with cycle properties and energy density combined**

Insertion batteries, represented by lithium ion batteries, allow repeated charging and

discharging. However, heavy and voluminous host materials limit their energy density. On the other hand, among reserve batteries using intact metal as an electrode, new batteries (anion battery) that use an anion as a mobile ion do not need a host material. Hence, they allow substantial improvements in energy density. However, their bottleneck is inadequate cycle properties. Proposals are solicited for research and development in anion batteries.

**13) Technologies for synthesis and formation process of powders suitable for interface formation of all-solid-state batteries**

In all-solid-state batteries, powders such as active substances for the positive electrode and electrolytes are pressed to form electrodes and electrolyte layers. These powders require specific compositions, particle sizes, crystal conditions, and optimum interfacial conditions of particle boundaries. However, these conditions are difficult to achieve and have created a bottleneck. Proposals are solicited for research and development in the synthesis of powders with optimum properties and in process technologies to form interface and compound membranes.

One example is research and development in compound membrane formation near ambient temperature for controlling the side reactions of active substance-electrolytes near the compound membrane interface. Proposals must also elucidate, based on science, the correlation between the ion conductivity of the compound membrane and its formation process.

**14) Membrane separation technology for metal-air batteries**

Metal-air batteries, which are expected to have the largest capacity among next-generation batteries, are operated using atmospheric oxygen as a positive electrode substance. However, steam $H_2O$ and carbon dioxide cause metal-air batteries to degenerate, thus creating a bottleneck. Research and development in membrane separation technologies is important.

The placement of a metal-air battery in an automobile and utilization of stationary batteries are presumed to invite proposals on technologies for producing compact and light membrane separation apparatuses that can efficiently remove the above-mentioned gases.

**15) Technology development for analysis and design of interface between different phases toward innovative and improved performance of electricity storage device**

In the development of all-solid-state batteries, it is important to visualize and reflect on battery design information for lithium ion distribution, conductivity, and electric potential distribution in the case of lamination. Synchrotron radiation has clarified part of lithium ion distribution and conductivity in charging and discharging. However, laboratory analysis methods for lithium, which is the third lightest element, are limited. Furthermore, measurement in the direction of membrane depth is difficult, thus reducing the speed of battery development.

In the case of fuel cell, the bottleneck in its implementation is maintaining high durability while keeping the resistance to reaction and substance transfer low in the three phase boundaries essential for battery operation, including fuel-electrode catalysts or electrode-ion exchange membranes.

For example, approaches to solve these problems for all-solid-state batteries require the development of techniques for *in situ* measurement of the depth direction with a universal laboratory apparatus instead of the large ones used for synchrotron radiation. Fuel cell

require technology development specifically regarding the interface between different phases, including experimental and calculation analysis and interface design of 2D or simulated 3D interfaces to control and elucidate the functions of interphases between different phases, which interact in a complex manner. The solution to these issues will have a major impact on the application to all energy conversion devices, improve performance, and accelerate implementation.

Proposals should include not only an analytical technique but also a scenario on what was revealed and how battery properties can be improved.

### ④ Energy creation technologies

**16) Pb-free and high durable perovskite solar cell (*be sure to read "3. others")**

Solar cell containing Pb have special requirements for production and disposal, thus increasing their cost. Eliminating Pb to reduce its environmental impact is essential for the increased use of solar batteries in homes. Pb-free perovskite solar batteries have been studied but have not acquired sufficient properties.

High durable solar cells, which can be used for a long time, are in demand because solar batteries with zero durability need to be replaced within a short time. Solar batteries in practical applications are guaranteed for 20-25 years. The durability of perovskite solar batteries has been improved through process optimization but not to an adequate level.

For the reasons above, challenging proposals are solicited for the realization of Pb-free perovskite solar cell with high surability.

**17) Quantum effect solar cells (control of size and sequence of quantum dots and so on)(*be sure to read "3. Others")**

Si solar cells have reached a conversion efficiency of approximately 25%. The theoretical maximum conversion efficiency is said to be approximately 29% for single bonding solar cells.Because an ordinary solar cell cannot absorb lower energy than the bandgap and loses excess energy of higher energy levels. In contrast, a quantum dot solar cell can form an intermediate band in the bandgap to convert the major portion of light energy into electricity. A light collection-type quantum dot solar cell is said to have an efficiency of over 75%. On the other hand, the actual conversion efficiency remains low, requiring the optimization of quantum dot materials and their formation methods, in addition to basic studies.

Proposals are solicited for using new concepts of quantum dot effects to realize solar cells with conversion efficiency that is twice as good or better than conventional Si solar cells. Proposals should include various solar cells using quantum dots, nanowires (wall), and near-field light (dressed photon), and photon up-conversion. No restrictions are imposed on materials or mechanisms. Proposals are expected to cover the superiority over conventional solar cells and specific manufacturing methods.

**18) Manufacturing technology for super thin film crystal Si solar cells (light confinement technology, passivation technology, and production of silicon wafers thinner than 40 μm)( *be sure to read "3. Others")**

Silicon wafers as thin as 180 μm have been produced. If these could be made thinner than 40 μm, the cost of polycrystalline Si materials could be reduced substantially. Furthermore, thin solar cells could be placed at sites where conventional Si crystal solar cells cannot be placed, because thin solar cells are as flexible as existing thin membrane solar cells. This

would expand the range of sites for placing Si solar cells with high conversion efficiency and durable to introduce increased numbers of Si solar cells.

Si wafers may be made thinner than 40 μm by methods including crystal growth, slicing, exfoliation, smart cut, etc. Solar batteries using Si wafers made as thin as possible to minimize the amount of Si waste at production need to possess operational quality.

For the reasons described above, proposals are solicited for technologies to produce highly efficient Si wafers thinner than 40 μm, while retaining the current features solar cells for the purposes of cutting costs and expanding the range of sites for their placement.

**19) Elucidation of bonding interface in Si tandem solar cells and process technology (*be sure to read "3. others")**

Tandem solar cells, with absorption wavelength regions expanded by laminating semiconductors with different bandgaps, are effective for realizing solar cells with improved conversion efficiency. A Si solar battery (bandgap of 1.1 eV) with high conversion efficiency and excellent durability is optimal as a bottom layer solar cell. Solar cells of semiconductor layer with bandgap 1.5-1.7 eV are studied for top layer solar cells. Specifically, perovskite solar cells (bandgap of 1.5 eV) are used for the top layer. However, adequate improvements in efficiency have not been achieved.

The optimum bonding interface, output current, and voltage properties for combinations of different solar batteries need to be determined in order to develop tandem solar cells.

To find a solution, correlations between manufacturing process allowing optimum interface formation, structure of formed membrane, and optical/electrical performance need to be elucidated to design an optimal bonding interface for a tandem solar cell. Proposals are solicited for research and development in tandem solar cells using a Si as the bottom layer.

**⑤ Fixation and effective utilization of carbon dioxide**

**20) New synthetic technologies for efficient production of high-performance and high-functional materials from biomass raw materials**

The development of new technologies for the efficient production of chemicals and polymer materials used in daily life and industries from sugars and lignin is important to realize a low carbon society. The sugars and lignin are obtained through the separation of biomass (wood, grass) components using energy saving processes. Various processes have recently been proposed to treat wood or grass materials to separate three components: cellulose, hemicellulose, and lignin. Rapid progress in characteristic separation techniques has led to relatively low-cost production of cellulose nanofibers, polysaccharides, sugars, and lignin.

A bottleneck in biorefinery systems is the development of new chemical and biological synthetic methods for efficient conversion of sugars and lignin into high-performance and high-functional materials. Challenging proposals are solicited for new synthetic technologies to produce high-performance or high-functional chemicals and polymer materials through energy-saving and efficient processes.

For example, the following proposals are expected:

Sugars and lignin are not converted into low cost and universal chemicals or energy materials but into

・functional chemicals or high-function polymers by technologies for chemical and biological synthesis to take advantage of the six-member ring structure of sugars and lignin, and

・chemical raw materials, such as C4 compounds or aromatic compounds, which are not readily produced from natural gas or shale gas using low cost and efficient production technologies

**21) Development of fine algae robust to environmental changes toward large-scale production**

The production of chemicals and fuel from fine algae, which can be produced from carbon dioxide through photosynthesis is very expected. Research has been conducted on culture conditions and genetic control techniques for efficient manufacturing of target substances. These achievements are expected to be used for practical applications, such as the production of value-added chemicals. Various attempts have been made to conduct verification tests on large-scale production. These tests have demonstrated the existence of major obstacles that are different from laboratory-scale problems and need to be overcome. The biggest problem is the markedly lower productivity of large-scale culture systems compared to systems for laboratory-scale analysis. The proper light intensities are different from kinds of fine algae. The ideal light and temperature conditions can be provided for fine alga in a laboratory. However, outdoor light intensities vary significantly depending on weather and are difficult to control artificially. Variations in light intensities make it impossible to culture fine algae at high density, leading to problems of low productivity, contamination, and high recovery costs. These problems are not confined to outdoor cultures. Large-scale cultures in closed indoor systems also face problems entirely different from those of analytical systems in laboratories, such as different environments for cells in surface layers and deep layers in a culture tank, mixing problems, illuminating deep layers, etc.

Proposals are solicited for the development of fine algae robust to environmental changes in order to overcome the bottleneck of large-scale production. The development of fine algae that can maintain productivity regardless of light intensity or depth in a culture tank, or those that can grow to high densities even under weak indoor illumination would have a significant impact on society. Furthermore, effective crushing techniques linked to the extraction of compounds from recovered fine algae would further improve the chances for practical applications.

**22) Technologies for improving biomass productivity with minimum resource input**

Methods for increasing biomass production, which greatly contribute to decreasing carbon dioxide, include the expansion of growth fields and improvements in productivity. An effective method is to develop plants that can adapt to limited water and nutrient supplies and maintain productivity and growth under adverse or changing environmental conditions, as well as resistance to diseases and insects. However, technologies are not yet available to obtain a fundamental solution. The input of resources, such as water and nutrients, means energy input. Decreasing inputs is important from the viewpoint of energy input per yield.

Hence, proposals are solicited for the development of epoch-making plant breeding methods for plants that grow well even with markedly small resource inputs and are robust to the environment. Various ways are conceivable, including promoting substance incorporation into plants and substance movement in plants or addition of new metabolic pathways to allow plants to utilize untapped nitrogen sources. Technology development is also expected for optimum design and breeding that allows plants to maintain their total balance at high levels through links with photosynthesis, metabolism, and hormones.

Proposals are solicited for technology development for compounds controlling environmental microflora and for understanding not only the abilities of plants but also the interactions between plants and microbes in order to isolate and identify symbiotic microbes that promote plant growth or contribute to resistance to disease and insect damage so that they can be utilized for microbial agents. Differences between microflora are important factors that contribute to plant growth due to soil quality. A future issue is to elucidate and efficiently control the actual situation. For instance, the development of plant culture technologies to maximize microbial functions as well as determining the compositions of microflora in excellent fields can facilitate the utilization of microorganisms as a practical technology for increasing plant biomass. Research on the use of metagenome information for plant modification is also welcome.

**23) Synthetic biology technologies for designing cells with high productivity for useful substances**

Decreasing manufacturing energy by introducing bioprocesses for substance production is expected to decrease carbon dioxide emission. Progress in universal application of bioprocesses, omics analysis, systems biology, flux analysis, genome editing, and genome synthesis technology for scaling up has enabled artificial metabolic pathways to be introduced into microbes and new substance producing ability to be provided to microbes. Such research has attempted to synthesize chemicals from various sugar materials and low molecule gases such as carbon dioxide or methane. However, the introduction and modification of a metabolic pathway frequently results in inadequate productivity owing to reasons such as dissipation into transiency and redundancy, no expected effect, and slow growth resulting from broken balance of metabolism, energy, and oxidation and reduction. In addition, it is necessary to decrease energy input in substance production. This requires the development of new methods based on the functions of autotrophic microbes. Furthermore, there is a problem that targeted products are toxic, which prevents their production. Proposals are solicited for the development of synthetic biology for designing a whole cell that is optimal for substance production, such as building an optimal combination of an artificial pathway with a system for producing energy and reducing power supply. For instance, the following proposals are expected:

- Development of an efficient ATP-reducing power regeneration system that is common to several kinds of microbes and can be introduced into them
- Technologies for utilizing the functions of autotrophic microbes, including electron supply, chemical energy supply, and carbon fixation
- Establishing techniques for efficient creation of artificial enzymes that are necessary for artificial metabolic pathways
- Establishing reasonable designing techniques for a genetic circuit that can produce toxic substances while improving yield and energy utilization efficiency
- Development of synthetic biological designing tools using the abovementioned techniques.
- Development of platform host cells that are suitable for synthetic biological development

**24) Technologies for controlling multiple dimension structures for creating next generation cellulose nanofiber materials**

Technology development has allowed for progress in efficient separation and purification

of cellulose nanofibers (CNFs) with a diameter of approximately 20 μm from wood materials to initiate industrial trials for CNF production in Japan. The tensile strength (3 GPa) and elastic modulus (140 GPa) of CNFs are close to those of aramid fibers. CNFs have considerable potential as a high function material. Furthermore, as the surface of CNFs can be chemically modified for introducing various functional groups or for high density adhesion of metal ions or metal particles, CNFs have considerable potential as a high function material. However, the manufacture of a high performance and high function material from only hydrophilic CNFs or from their combination with a resin requires technology development of precise structural control of laminated multidimensional structures on CNF substrates in each layer. Challenging proposals are invited for technology development to use CNFs for designing and creating next generation materials.

Public invitation of research upon setting out the above-mentioned bottlenecks would build a research system that sets appropriate issues and shares objectives that contribute to the realization of a low carbon society in the entire area while researchers use various viewpoints and methods.

The costs and merits of a relevant technology must be adequately considered for solving these bottlenecks and implementing achievements in society. Reasonable prediction and evaluation of the carbon dioxide emmission decreasing effects of a technology is required for the technology to be introduced and applied widely in society, according to the issues considered by ALCA in the past and those considered by the future society creation project (low carbon society) in this fiscal year. The following proposals are invited in addition to the abovementioned bottlenecks:

**⑥ Cost engineering for low carbon technologies**

From the viewpoint of the focused input and impacts of limited resources on society, it is important to introduce the functions of the research and development issue, i.e., “cost engineering for low carbon technologies,” into project promotion in this area. Cost engineering of low carbon technologies refers to the reasonable technological prediction and evaluation of the effects of decreasing $CO_2$ emission. The systems for research and development in this area will be introduced into future society. It is an indispensable approach for the widespread use/application of achievements in a society in 2040s and for reaching the target of “80% decrease in greenhouse gas emission in 2050.” Proposals are invited for issues in the execution of cost engineering in relation to the development of technologies to be promoted in this area.

Cost engineering evaluation includes the research and development fields aiming at a low carbon society, including issues adopted by ALCA. Low carbon technologies and systems are selected to estimate cost perspectives, the time required for establishing and industrializing a technology, and market size. Specifically, technology levels corresponding to the developmental stages of low carbon technologies and systems are estimated to calculate system cost. In addition, the cost of implementation in society is calculated by considering the market size of the presumed product.

Evaluation will cover the relevance of the analysis and policies about whether a promoted technological field and a research and development issue should be a priority subject of cost engineering. Furthermore, it is desirable for a method to be applicable to a wide range of

technological fields.

The results of cost engineering are planned to be utilized for the recoordination of targets for related issues and stage gate evaluation for promoting this area.

**⑦ New approaches for a low carbon society**

In addition, proposals are solicited for issues that are independently set by researchers for the “the realization of a low carbon society.” However, as this area aims to achieve a low carbon society by applying mitigation measures through technology development, proposals related to adaptation measures, including observation of climate changes and ecological influence, are excluded from subjects.

<Presumed applications of achievement>

This area promotes challenging research and development to solve the abovementioned bottlenecks. It contains technologies that require considerable time before practical application. Therefore, this area collaborates with other JST projects and the programs of other ministries at an early stage and the study will be made, in addition to the transfer of the results to the industry, on the possible transfer to the program close to practical application for those programs that requires a longer period of approach in a research and development. Specifically, this area aims at collaborating with ALCA, which is presently in progress at JST, to aim for synergy.

In addition, this area aims to collaborate with “Unexplored Challenge 2050,” which was initiated in FY 2017, among lNEDO’s leading program for energy and environment programs. To initiate innovative research and development toward the realization of a “low carbon society” in 2050, JST promotes basic research mainly with universities and NEDO aims to implement achievements primarily from collaborations between industries and academia. The coordination is in progress at present.

● **Implementation System**

FS adopts challenging research topics while firmly considering exits. Stage gate evaluation analyzes whether research is moving toward the realization of a low carbon society. Stage gate evaluation is not a method of "weeding out," but of evaluation for "Enhance awareness toward a correct direction of good research for effectively encouraging and enlightening." It should be noted that it is a method for developing a technology that could significantly contribute to decreasing carbon dioxide emission in future.

In full-scale research, this area consists of "the possibility of contributing to a low carbon society" in management and accelerates research and development toward implementation in society.

● **Contents to be contained in FS**

The requirements that have not been met or are not predicted to be met should be clearly described in the context of selection criteria, research and development contents, a performing team, and the contents of research and development to be carried out during the FS stage, in addition to the targets to be achieved upon the completion of FS.

For instance, proposals containing the following contents are presumed:

·A FS shall perform theoretical verification of an innovative technology and set a target for making scientific and technological risks evident toward POC.

·The optimization of an entire resource and product cycle should be proposed at a stage of ideas, concrete ideas should be prepared for a cycle that maximizes societal and industrial impacts during FS, and an optimum team of private companies and academia should be created.

·Application to products should be proposed at an idea stage, a collaboration system with industries should be developed during the FS stage, and a product with high impact should be selected as a case of achievement development.

● **Policies for promoting research and development**

JST has been carrying out ALCA since 2010. As ALCA is intensely conscious of the "exits" of a research program specified for the development of low carbon technologies for decreasing greenhouse gas emission, it is developing various approaches that have not been observed in conventional basic research projects. A characteristic example is a "small start and stage gate method."

This method considers several issues of a relatively small funds (small starts). Issues that pass stage gate evaluation are accorded emphasis to be expanded at research scale.

Furthermore, ALCA develops approaches to accelerate measures for research and development toward the implementation of achievements in society and passing achievements for practical application, including promotion of top down research, development aiming at clear exits, collaboration with related programs and projects of other ministries including the Ministry of Economy, Trade and Industry, and bottom up (small start & stage gate evaluation) research and development. Figure 2 illustrates the framework of ALCA projects including the abovementioned.

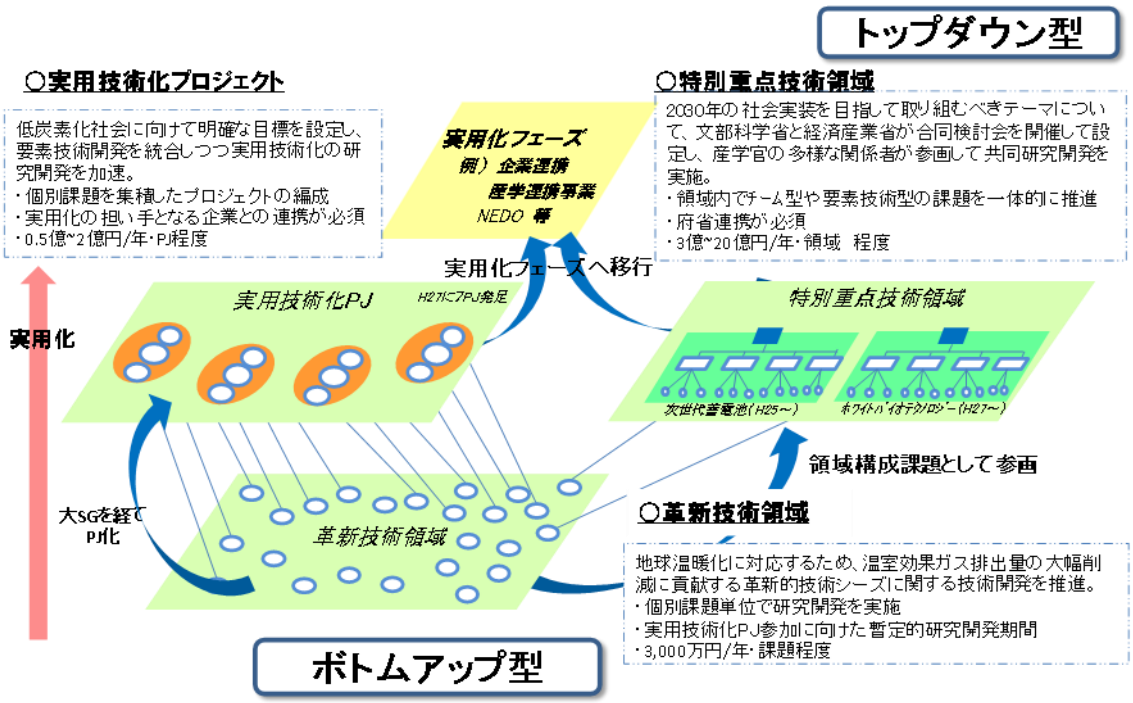



Fig.2 Sructure of ALCA

It is expected that this area will rapidly progress to application to society and industries at a stage where the solution of a bottleneck has significant impact on society and industries. Therefore, transfer to full-scale research is positively examined during FS stage. Furthermore, the rearrangement of a research team by merging several research and development issues may be presumed when a R&D Supervisor judges that it is necessary for the maximization of societal and economic impacts.

## ● R&D Period and Budgets

The standard research period for research and development issues initiated in FY 2017 is four and a half years to the end of FY 2021. The maximum research fund is 140 million yen (direct expenses) for the entire research period. The proposal should be based on the following maxima of the research fund:

| R&D budget plan (maximum direct expenses) | | | | | |
|---|---|---|---|---|---|
| FY 2017 | FY 2018 | FY 2019 | FY 2020 | FY 2021 | |
| 10 million | 20 million | 30 million | 40 million | 40 million | (JPY) |

The viewpoint concerning whether a FS can be transferred to full-scale research after completion is a judgment criterion.

**(3) Other matters**

Please ensure that you read this description for proposing following bottleneck issues:

Bottleneck issues
④ Energy creation technologies
16) Pb free and tolerant perovskite solar cells
17) Quantum effect solar cells (size and sequence of quantum dots)
18) Manufacturing technologies for extremely thin skill crystals and Si solar cells (light confining technologies, passivation technologies, production of silicon wafers thinner than 40 μm)
19) Elucidation of the bonding interface in Si tandem solar cells and process technologies

1) Types of proposals for call

The research environment (hereafter referred to as "core facility")[*2], which was set up by the Ministry of Education, Culture, Sports, Science and Technology (MEXT)atFukushima Renewable Energy Institute, AIST (FREA) (Koriyama City, Fukushima Prefecture), will be utilized to accelerate research for a "Fukushima Top-level United centre for Renewable Energy Research – Photo Voltaics Innovation (Future-PV Innovation)"[*1] to invite the following two types of proposals:

(a) Proposals for "platform type" research and integrated activities of operating, maintaining, and managing the core facility[*3]

(b) Proposals for "research type" research only

(a) "Platform type" research

This type is for proposals for integrated activities of operating, maintaining, and managing the core facility, based on the assumption of utilizing the facility to promote research for solving bottleneck issues. Furthermore, a researcher whose proposal to (b) is accepted may use the instruments at the core facility to work as a platform of this field. Attempts are expected for accelerating the research associated with solar cells in this project. Expenses for operation, maintenance, and management will be added to the research fund.

(b) "Research type" research

This type is for proposals for solving bottleneck issues. Visitors may use the instruments at the core facility operated by the platform type.

Selection is consistently based on evaluation items and criteria described priviously and by the evaluation of research aspects only. JST separately examines proposals to (a) for appropriateness in maintenance and management centered at safety after evaluation based on research aspects. Ultimately, only one platform type proposal will be accepted. A proposal to (a) may be accepted as research type.

*1 “FUTURE-PV Innovation” is commissioned by MEXT to JST in FY 2012-2016. JST set up a research environment associated with efficient Si solar cells at FREA (Koriyama City, Fukushima Prefecture) to carry out research and development.

*2 At this core facility, instruments are collectively set up for an integrated series of research. These include processing apparatuses (such as a CVD that uses special high pressure gas, a sputter, and an imprinter) and basic facilities such as clean rooms, drat chambers, and evaluation apparatuses (such as a sun light simulator and a scanning electron microscope). The availability of important apparatuses for relevant bottleneck issues is expected to effectively and efficiently promote research and development in relevant fields for this project. The space and instruments at the core facility are assets of AIST and MEXT. They may be rented for use on contract.

*3 The operation, maintenance, and management of the core facility includes maintenance and management of instruments, safety and compliance with related laws, duties related to contract, and other activities at the core facility. Furthermore, the operation of the core facility must follow the rules, safety reviews, and safety advice provide byAIST. At the completion of a project, the original condition of the space should be restored (details specified by JST) and the space should be returned to AIST. Instruments may be transferred to an organization that the proposer is affiliated with or disposed upon approval by MEXT. The expenses for operating, maintaining, and managing the core facility are assessed and added to the research fund.

2) Notes for the preparation of proposal documents

ⅰ Please ensure that the name of a bottleneck issue and the type of research, i.e., “platform type” or “research type”, are stated in the column labeled “Prioritized theme” in a proposal document when proposing the abovementioned bottleneck issues.

(example)

| | |
|---|---|
| Prioritized theme | Realization of a low carbon society through game changing technologies, B16: Pb-free and high durable perovskite solar cell [Research type] |

ⅱ In case of a proposal to “platform type,” please ensure that the contents of using the core facility (in relation to research), operating system (maintenance and management), and response system as an organization (remote response) are described in the column labeled “other specific matters” in the proposal document. However, no funding plan is required for maintenance and management.

3) Details of core facility functions

A briefing about the details of instruments and laboratory is planned to be conducted at the core facility. An announcement will be made at our website later.

## 5.2 Large-scale Type: Technology Themes FY2017

The technology themes of large-scale type that are believed to be important for forming the bases of future technologies, has been determined by The Ministry of Education, Culture, Sports, Science and Technology based on the information analysis on science and technology innovations. For the 2017 fiscal year, proposals are sought for large-scale R&D projects relating to the technology themes described herein.

R&D supervisor (Program Officer, PO):
Yoshio Hayashi
(Program Director, JST)

### 5.2.1 Management policies for projects in large-scale type

**(1) Policies for requesting and selecting proposals and R&D (common to all themes)**

To achieve the realization of the three technology themes presented, projects should include an adequate R&D process to reach a stage (proof of concept, POC) where application feasibility can be judged by society and/or industry. Continued development of research achievements after the POC stage is expected to result in the enhancing of relevant base technologies that will exert impacts on a wide range of sectors.

Therefore, technology themes for technology fields are stipulated and relatively clearly defined. The R&D representatives (program manager, PM) themselves are expected to define the POC that will lead to the implementation of these technologies in society. The PM is requested to choose a high-level, challenging goal; create, protect, and utilize intellectual property strategically; and depict the overall cause as noble so that its achievement would be considered “marvelous” by business firms and investors. The PM is also expected to describe their vision for the project’s development after POC, an outcome in which the technology creates innovations in society and industries in the future, and to plan an exit strategy, such as collaboration with business firms or participating in a related business venture.

It is crucial for projects to boast the highest level of R&D capability and knowledge. See “4.1.3, Selection viewpoints” for a description of the evaluation criteria for the adoption of proposals. Management is expected to be constantly alert during the R&D process for opportunities to merge with various technology fields or collaborate with researchers or research organizations, including opportunities to recruit new members or obtain new findings or technologies.

Projects are also expected to attract investment from private sectors during the R&D process preceding the POC. projects should encourage cooperation and active participation from business firms, as well as the introduction of funding at the beginning of or during R&D. At the first stage gate, an evaluation will be conducted that will include an assessment of the

project's ability to attract private investment (see "3.1.3 (9) Stage-gate evaluation"). The PM is requested to set a mid-way goal (a goal and a milestone for the first stage gate) that can attract cooperation from such firms and to engage in active and flexible dialogue with such enterprises in order to ensure the achievement of the POC.
It is also advised to collaborate and cooperate with such firms at the stages of defining the POC, studying visions for the future development of the POC, planning R&D, and promoting R&D.

**(2) Policies for seeking proposals, selecting projects, and R&D (by technology theme)**

**Theme1. Laser-plasma acceleration technology that will assist in the creation of innovative, downsized, and high-energy particle accelerators**

Japan leads the world in terms of stability and reproducibility in electron acceleration using laser-plasma acceleration technology, and is possibly closest to actually applying this technology in society and industry. Japan also leads the world in the practical application of heavy-particle therapy apparatus. If such apparatus can be substantially downsized, it would allow the increased application of ion acceleration in society, which would make great contributions to national health.

As these technologies are currently in the theory-verification stage, the PM is requested to collect and effectively utilize a wide range of R&D findings relating to topics such as lasers, particle acceleration, plasma diagnosis, and beam diagnosis. It is also necessary to merge the project with research being conducted on existing particle accelerators and to constantly take into account specifications relating to this technology's application in society and industries. Therefore, the PM is expected to promote R&D in close collaboration with existing research communities (researchers focusing on particle accelerators) and users (those involved in cancer therapy).

Create an R&D plan that includes a budget (including indirect expenses) of approximately two billion yen over four years (500 million yen/year) and six billion yen over a period of 10 years.

**Theme2. High-temperature, superconducting wire-joining technology that can assist in achieving the innovative reduction of energy loss**

High-temperature, superconducting wire-joining technology can be used in direct-current superconductive power transmission or in super-high magnetic-field-formation technology. It is expected that technology and findings made available by Japanese research groups will be utilized in this regard. Further, various ideas concerning joining technologies that have extremely low resistance may also be tested. The PM is expected to conduct appropriate study in order to determine a method of efficiently collecting the ideas and findings of research groups concerning joining superconductive wire. Certain challenging goals set during this project may require the adoption of basic approaches, including research into the improvement of electric current densities of currently used wire materials, low-temperature engineering related to cooling wires, and the properties of the wire materials used in magnetic fields. The PM is expected to conduct this project while keeping in mind the need to elucidate the principles of wire-joining technology and its relation to superconductivity theory.

Create a R&D plan that includes a budget (including indirect expenses) of 1.4 billion yen (approximately 350 million yen/year) for the first four years, and a total budget of four billion yen over 10 years.

**Theme3. Quantum inertial sensor technologies that can assist in the development of innovative, high-precision, and downsized self-localization units**

Few studies have focused on substantially improving the performance of angular velocity sensors, which are core components of inertial sensors. However, Japan currently leads the world in element cooling and atomic-wave control, which are integral parts of this technology theme, as they are currently being used in an attempt to substantially improve the precision of the ring laser method, the most precise form of angular velocity sensor commercially available at present. Therefore, the PM is expected to provide an original and highly feasible plan for an R&D approach for achieving this especially challenging goal. Also, because this is a new avenue of research, seemingly unexpected element technologies may be occasionally required. Therefore, the PM is expected to flexibly perform R&D by keeping aware of developments in the field and collaborating with related disciplines.

Create a R&D plan that includes a budget (including indirect expenses) of 1.4 billion yen for the first four years (approximately 350 million yen/year) and approximately four billion yen over 10 years.

## 5.2.2 Technology Themes

### 1. Laser-plasma acceleration technology that will assist in the creation of innovative, downsized, and high-energy particle accelerators

#### (1) Outline

Particle acceleration is applied to a wide range of research areas, including physics, chemistry, biology, engineering, agriculture, medicine, pharmacology, and archaeology. It is generally conducted to perform research focused on solving the mysteries of substances and life; further, there have also been attempts to determine the means of utilizing this technology in closely related industrial sectors and society. In recent years, progress has been made in laser-plasma acceleration technology, as high-intensity lasers have been used to innovatively shorten the length of apparatus required to accelerate particles. As this technology will lead to the downsizing of particle accelerators, it is expected that opportunities for their use will consequently be expanded.

#### (2) Goal

Laser-plasma acceleration technology, which allows apparatus featuring particle accelerators, such as synchrotron measurement devices or particle ray therapy units, to be innovatively downsized, will be researched and developed to a stage (POC) where the feasibility of further developing it into a universal base technology used in a wide range of fields may be judged. In the process, it is desired that collaboration and merging between the laser and accelerator communities occur, as this will help to build a system that can fulfill the needs of the entire accelerator community.

#### (3) Future society image to be kept in mind while conducting research

The promotion of R&D projects relating to this will conceivably lead to the realization of a future society such as that described below:

- Accelerators, which were formerly quite large in size, will become readily accessible at a nearby site. This will result in benefits for people in regard to their health; for example, cancer could be treated through particle therapy or the use of new materials or drugs that facilitate the utilization of X-rays emitted by accelerated electrons, forgoing the need for the surgical removal of cancerous tissue.
- R&D related to accelerated particles will spread to technologies not only related to physics but also to engineering, chemistry, and medicine, thereby accelerating the development of science and technology innovations.

#### (4) Specific research examples

Specific research examples may include the following:

**① Electron acceleration**

- R&D not only concerning the use of a single laser for the emission, control, and acceleration of electrons, but relating to the verification of a booster that can connect modules of a single function and accelerate electrons over multiple steps.
- R&D concerning the stabilization of lasers or plasma, increasing electric charges, and controlling femtosecond systems.

- R&D concerning lasers of approximately 100 Hz that can be stably operated while maintaining high output.
- R&D concerning the downsizing of practical measurement apparatus by substantially improving monochromatic properties (expanded energy) and increasing the number of photons produced per pulse. Concurrently, it should also focus on improving the electric charge of (X-ray-free electron laser) XFEL through increasing the vibration of accelerated electrons.
- R&D concerning the use of 100 Hz repeated lasers and plasma gas jets as electron-acceleration systems.

**② Ion acceleration**

- R&D concerning the verification that heavy-ion particle beams obtained through laser plasma acceleration can be precisely injected to the post accelerator.
- R&D concerning the use of 10 Hz repeated lasers and plasma gas jets as ion acceleration systems.
- R&D concerning the verification of the technology required to produce small injectors that can emit a beam of heavy-ion particles "containing 108 ions within a 1% bandwidth at an energy level of 4 MeV/u or higher within two seconds" and directly inject the beam into heavy-particle-therapy units.

### (5) R&D trends

**① Electron acceleration**

Progress in developing highly excited lasers using plasma excitation allowed the U.S.A. to demonstrate electron acceleration up to 42 GeV in 2007. Subsequently, countries around the world competed to achieve maximum electron velocity, attempting to reach an acceleration gradient of 52 GV/m, or 500 times as fast as obtainable with an ordinary high-frequency accelerator (100 MV/m) used in an ordinary acceleration facility. However, none of this research focused on enhancing the technology's practical application, such as through improving efficiency or stability. In contrast, technology to substantially improve the pointing of an electron beam was devised in 2006 and more efficient energy conversion through stepwise acceleration of laser plasma was demonstrated in 2010. Further, the R&D-promotion program initiated in 2014 by Japan's cabinet office (ImPACT) was given the objective of demonstrating by 2018, when the program is completed, electron acceleration up to 1 GeV at a distance of 10 meters, with this electron beam emitting an XFEL. The R&D for this project is proceeding smoothly.

**② Ion acceleration**

In 2012, Japan succeeded in achieving the stable emission of a proton ray of 40 MeV from a TW-class small laser. Then, in 2016, a Korean group succeeded in emitting a 93 MeV proton ray. This technology is expected to be expanded to achieve the emission of a heavy ion beam combined with a cyclotron, which will result in the building of practical technology for creating the small ion gun therapy units targeted under this theme. However, as of now, there has been no report of such a beam successfully being introduced into a cyclotron to conduct heavy-particle therapy.

## 2. High-temperature, superconducting wire-joining technology that can assist in achieving the innovative reduction of energy loss

### (1) Outline

Superconductivity technologies are used in NMR and MRIs, as well as in superconducting magnetic levitation railway. However, low-temperature superconductivity materials, which are commonly used in society, require expensive liquid helium as coolant; this represents an obstacle to the popularization of superconductivity technologies. Considering this, liquid nitrogen, which has a relatively low cost, and high-temperature superconductivity materials, which can form higher-level magnetic fields than low-temperature superconductivity materials, would be more effective for achieving full-scale implementation in society. However, because high-temperature superconductivity wire materials can only be manufactured in lengths of a few hundred meters, the technology that can join wires keeping superconductivity or extremely low resistance is required to achieve their practical application. Such joining technology, if established, would bring the creation of efficient, high-magnetic-field coil and long-distance, direct-power transmission close to realization, qualities that are expected of superconductive materials.

### (2) Goal

Considering the premise of applying high-temperature, superconductive wire materials to systems requiring long superconductive wire materials, such as NMRs or MRIs, which also need high magnetic fields, or electric railway, which also require direct-current power transmission cables, this theme involves conducting R&D on joining technologies for high-temperature, superconductive, copper oxide wire material that has extremely low resistance. This R&D should bring this technology to a stage (POC) where its application feasibility and its prospects of spreading successfully to a wide range of universal base technologies can be judged. In the process, it is desired that concurrent R&D on other joining technologies be conducted, as this will help determine techniques that have a high probability of success, and also that the PM keeps abreast of basic research trends relating to joining theories, such as analysis of the conditions and properties of fine tissues in joints at nanometer levels, as well as R&D trends relating to other superconductivity materials, including iron compounds. R&D on joining principles is also expected to lead to the elucidation of scientific principles concerning superconductivity phenomena.

### (3) Future society image to be kept in mind while conducting research

The promotion of R&D projects relating to this theme is believed to lead to the realization of a future society similar to that described below:

- Achieving the maximum performance of superconductivity materials will lead to the development of small- and high-magnetic-field NMRs, which can help provide an understanding Alzheimer's disease and assist in drug creation; further, its application in MRIs will allow medical therapy to be upgraded and neuroscience research to extend people's longevity. Additionally, it can also lead to the popularization of superconductivity-technology-related R&D in chemistry, medicine, and related industrial technology fields. Moreover, the pace of science and technology innovations will be accelerated.

- The introduction of high-temperature superconductivity cables will make powering railroad vehicles more energy-efficient, improve transportation power, and contribute to the development of basic infrastructure technologies relating to transportation. Further, improved international competitiveness in this regard will allow Japan to make great contributions to global railroad transportation infrastructure.

**(4) Specific research examples**

Specific research examples are as follows:

- R&D concerning the creation of extremely low-resistance joints (resistance<10-9 Ω) while maintaining the cables powering railroad vehicles in situ through as simple a method as soldering.
- R&D concerning the creation of a superconductivity joint (resistance<10-12 Ω and current at 100 A) that allows a superconductivity magnet to form a strong magnetic field that does not mitigate current, although it does not make handling easy.
- R&D concerning a superconductivity joint that has a resistance level of 10-13 Ω under non-magnetic conditions.

**(5) R&D trends**

In 2014, Korea University reported the development of a superconductivity surface joint that was created by fusing diffusion under low partial pressure of oxygen. However, there seems to be a problem in regard to the reproducibility of this joint. In November 2016, a Japanese group succeeded in creating a 10-12 Ω level joint, and this attracted much attention. The level to which current density can be raised and the level of magnetic field it can tolerate remains an issue for the future; however, the Japanese group's achievement represented great progress in terms of bringing superconductive wire joints closer to reality.

Projects related to superconductivity (super electrical conductivity) have been undertaken by JST S-Innovation (NMRs, accelerators, boat motors, superconductive quantum interferometers (SQUID), railroad cables); the Ministry of Economy, Trade and Industry's NEDO (power transmission, boat motors, superconductive power-storage apparatus, transformers, power generators, flywheels); and the Ministry of Land, Infrastructure, Transport and Tourism (power wires for railroad vehicles).

## 3. Quantum inertial sensor technologies that can assist in the development of innovative, high-precision, and downsized self-localization units

### (1) Outline

Self-localization has been used to assist in the automatic and autonomous positioning of things and humans; examples exist in various services, such as global navigation satellite systems (GNSS), autopilot systems for airplanes, and the information on surroundings provided by mobile devices. Further, its utilization has been rapidly expanded to provide services to people in society. However, GNSS relies on radio waves to operate; as a result, in certain situations, such as underground, in buildings, or at sea, where radio waves cannot reach, inertial sensors that can accurately measure the angular velocity of a moving object to estimate where it is and in what direction it is moving are an effective replacement or supplement. Furthermore, the creation of a high-precision inertial sensor would have a wide range of applications; for example, as a position control for satellites and robots.

In recent years, research into inertial sensors that feature quantum effects has been making progress in regard to the innovative improvement of the accuracy of self-localization as well as downsizing, and this is expected to lead to the creation of high-precision inertial sensors in the future.

### (2) Goal

R&D concerning this theme aims to improve element technologies, including element interference and laser cooling, as well as the systemization of their combinations and systemization technologies, in order to obtain high sensitivity while controlling the size of the instruments in question. The R&D is being pursued to a stage (POC) where application feasibility can be judged and where the development of universal base technologies for a wide range of related fields can be considered. In the process, it is desirable to concurrently create a number of new ideas and research approaches. An attention should be paid that, if other R&D is conducted on improving the precision of acceleration-measurement devices, particularly those that can incorporate quantum technologies, such R&D shall be conducted as a secondary R&D.

### (3) Future society image to be kept in mind while conducting research

The promotion of the R&D projects relating to this theme is believed to lead to the realization of the future society described below:

- The realization of navigation devices featuring small- and high-precision angular velocity sensors that take advantage of quantum effects will result in an expansion into automation and autonomy, and this technology will be applied to large instruments, such as automobiles, drones (in the air and water), and robots, and will assist in accurately estimating the position and movement of things and humans in certain situations, such as underground, in buildings, or at sea, where the radio waves GNSS require cannot reach. Further, such instruments' expanded automatic and autonomous movement will facilitate the upgrading and optimization of the transfer, transportation, and distribution of necessary materials at appropriate times, thereby vitalizing economic and social activities.
- In addition, great contribution is expected to the development of geophysics and

astrophysics through precise measurement of wavering earth's rotation and precise detection of lens shilling effects (a phenomenon in which spacetime is dragged by rotation of huge mass).

### (4) Specific research examples

Specific research examples are as follows:

- R&D concerning the development of the improved interferometers. This involves using the Sagnac effect and Mach-Zehnder interferometers to improve the present performance of apparatus with a capacity of less than 50 liters and the improvement of a bias stability of one digit or more.
- R&D concerning the creation of new technologies that are substantially superior to technologies researched and verified thus far. This is conducted with the goal of improving apparatus capacity to less than 10 liters and bias stability by 2-3 digits.

### (5) R&D trends

Few studies in Japan or overseas have focused on the theme of quantum angular velocity sensors; however, many achievements have been yielded from closely related research into element technology, such as that into element interferometers. JST's funding-management database states that it provided funding for research on the theme of quantum angular velocity sensors in 1993 ("Trial production of an element gyroscope, experimental research B, scientific research fund"). On the other hand, there are also reports of world-leading achievements from research into element technologies, such as element cooling and atomic wave control, which is strongly related to quantum angular velocity sensors.

Research on quantum angular velocity sensors has not been well funded in Japan; however, R&D on element interferometers and laser cooling has advanced to yield world–leading achievements. Therefore, developing the applications of these technologies is expected to produce high-level results concerning quantum angular velocity sensors.

# Chapter 6
# Key Points in Submitting Proposals

○ Violation of the guidelines provided in this chapter or any other inappropriate behavior may result in withdrawal of approval for the research project or cancellation of the research; return of all or part of the project's research funding, and measures taken to publicize the facts of the matter.

○ Violation of related laws or guidelines, etc., in conducting research may result in cancellation of your research funding allocation or withdrawal of the research funding allocation decision.

## 6.1 Enrolling in and Completing the Educational Program for Research Integrity

The research project applicant must complete the educational program for research integrity as a prerequisite for application. Note that if completion of the program cannot be confirmed, the application will be disqualified for failing to meet the requirements enrollment in and completion of the research integrity educational program by the time of application is not a prerequisite for Lead Joint Researcher applicants).

To enroll in the educational program for research integrity and to submit a declaration of completion, follow either procedure (1) or (2) below. For application instructions using e-Rad, refer to Chapter 7, "Recruiting via the Cross-ministerial R&D Management System (e-Rad)."

(1) For applicants who have completed an equivalent program at their institution

Applicants who have already completed an e-learning program or educational seminar on various aspects of research integrity (including the CITI Japan e-learning program) by the time of their application are requested to make the declaration on the e-Rad application information entry screen.

(2) For applicants who have not completed an equivalent program at their institution (including for applicants at institutions that do not have such a program)

a. Applicants who have in the past completed a CITI Japan e-learning program in a JST program.

Applicants who have in the past completed a CITI Japan e-learning program in a JST program by the time of their application are requested to make the declaration on the e-Rad application information entry screen.

b. For other applicants for whom a. above does not apply.

Applicants who find it difficult to enroll in an educational program for research integrity because their institution does not offer such a program at their institution or for other reasons may enroll in and take the condensed version of the CITI Japan e-learning program offered through JST. Instructions for enrolling in this program may be found on the Invitation of R&D Proposal website:

http://www.jst.go.jp/mirai/jp/application/research/

There is no cost for enrolling in and completing the program, which will take between one to two hours to complete. Once enrolled, applicants are expected to complete the

program without delay and then to declare the completion of the program and to also enter the certificate completion number from the completion certificate (the Ref # to the right of the completion date) in the e-Rad application information entry screen.

* Educational programs for research integrity are the responsibility of each research institution. JST does not specify the specific teaching material to be used in those programs.

(Reference)

According to the "Guidelines for Responding to Misconduct in Research Activities" (August 26, 2014, adopted by the Minister of Education, Culture, Sports, Sciences and Technology), which will be implemented from April 2015, research institutions are required to implement a structure for preventing misconduct, such as the installation of a Research Integrity Education Manager, and to conduct education at the institutional level. Further, the allocating institution is also required to confirm researcher enrollment in the institution's research integrity education program.

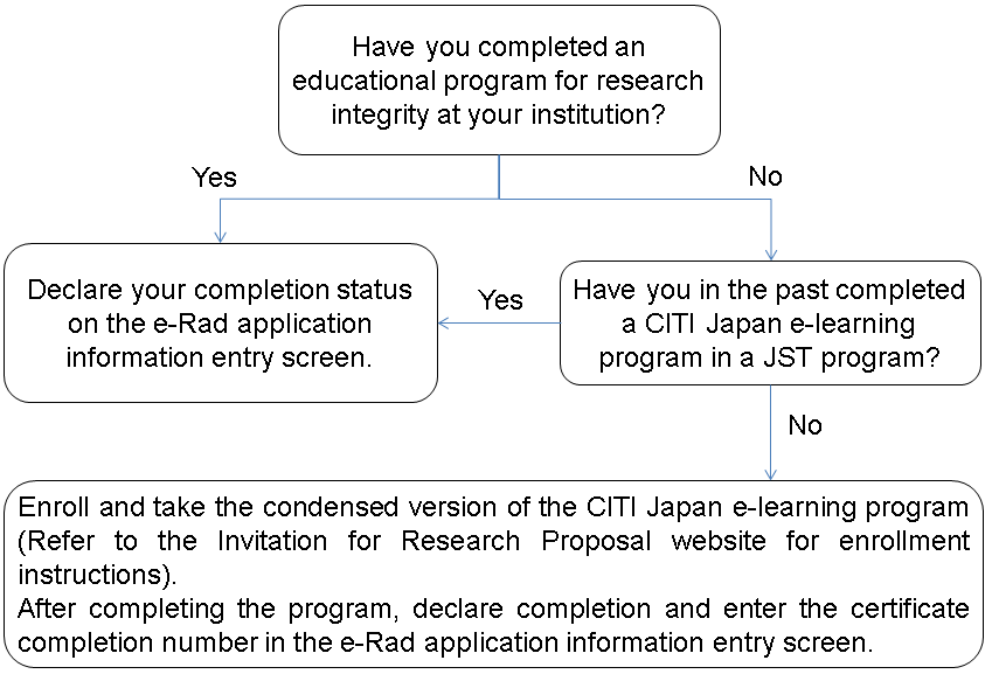
Note however that the details in the above guidelines focus on misconduct in academic papers and does not cover bioethics and conflicts of interest, which are different topics.

■ Contact for consultation on the educational program for research integrity
Japan Science and Technology Agency
Department of Audit and Legal Affairs, Research Integrity Division
E-mail： ken_kan@jst.go.jp

■ Contact for consultation on the public invitation for application
Japan Science and Technology Agency
Department of Research and Development reform
E-mail： kaikaku_mirai@@jst.go.jp

* Include the program name, e-Rad project ID, research applicant name and the project name in the body of the email.

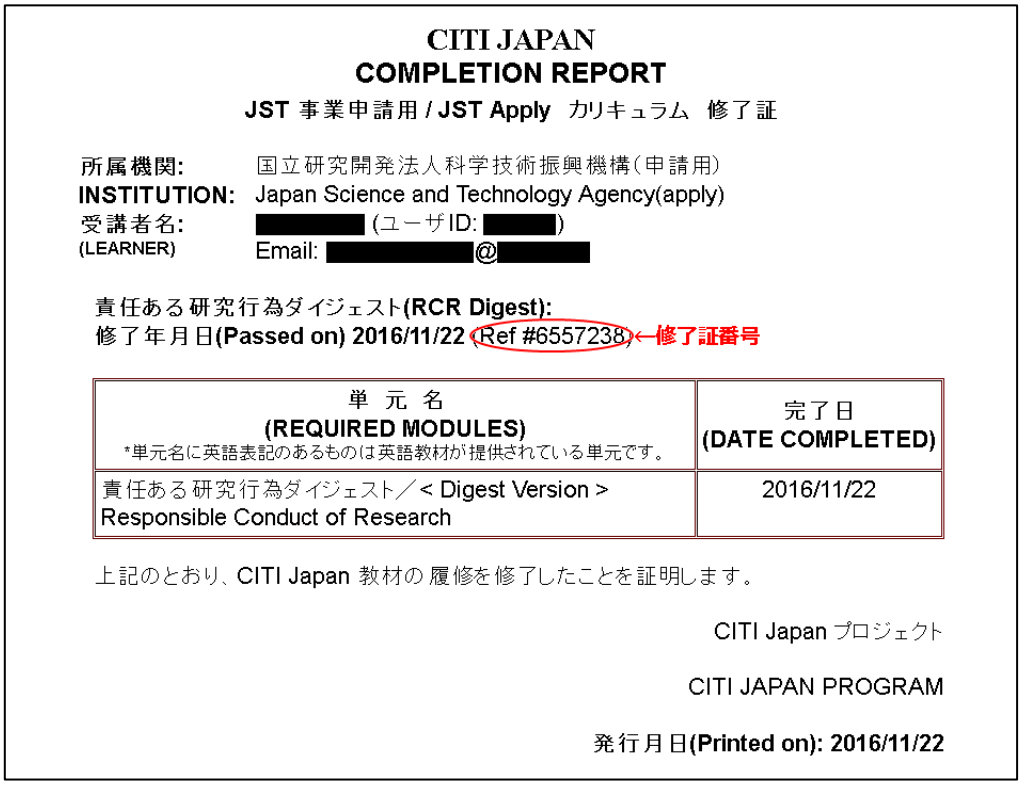
[Flow chart for declaring enrollment and completion of the educational program for research integrity]




*Declaring completion with the certificate completion number

To view the completion certificate, click the link for the completion certificate in the Completion Report column on the Main Menu. The Ref # printed to the right of the completion date is the certificate completion number.


↑ Main Menu for the condensed CITI Japan e-learning program digest



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COMPLETION REPORT
JST 事業申請用 / JST Apply カリキュラム 修了証

所属機関: 国立研究開発法人科学技術振興機構(申請用)
INSTITUTION: Japan Science and Technology Agency(apply)
受講者名: [redacted] (ユーザID: [redacted])
(LEARNER) Email: [redacted]@[redacted]

責任ある研究行為ダイジェスト(RCR Digest):
修了年月日(Passed on) 2016/11/22 (Ref #6557238) ←修了証番号

| 単 元 名 (REQUIRED MODULES) *単元名に英語表記のあるものは英語教材が提供されている単元です。 | 完了日 (DATE COMPLETED) |
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CITI Japan プロジェクト

CITI JAPAN PROGRAM

発行月日(Printed on): 2016/11/22

↑ Sample of certificate of completion

JST has required researchers participating in JST-Miral program to enroll in and complete seven designated modules of the CITI Japan e-learning program. Since the requirement will remain unchanged for FY2017, in principle all research participants will be required to enroll in and complete the seven designated modules from the CITI Japan e-learning program (excluding applicants who have already completed the seven designated modules from the CITI Japan e-learning program at their institution or in a JST program).

## 6.2 Handling of Information Provided in Research Proposals, Etc.

○ From the standpoint of maintaining the interests of the applicant, the “Act on the Protection of Personal Information Held by Independent Administrative Agencies, etc.”, and other standpoints, research proposals shall not be used for any purpose other than the selection process. Confidential information regarding research proposal details shall be strictly maintained. For details, please refer to the following website.
http://law.e-gov.go.jp/htmldata/H15/H15HO059.html

○ Handling of Information Regarding Selected Projects
Information regarding individual projects that have been selected (name of system, name of research project, name of affiliated research institution, name of Research Director, budget amount, implementation period, etc.) shall be deemed to be “information that is scheduled to be made public” as prescribed under Article 5, Paragraph 1, Item (a) of the “Act on Access to Information Held by Independent Administrative Agencies” (Act No. 140 of 2001).

The name of the researcher, name of the affiliated research institution, name of the research project, and the research project overview summary are scheduled to be made public. In addition, the research proposals of selected applicants may be used by the JST to promote the research after the proposal's approval.

○ Provision of Information from the Cross-ministerial R&D Management System (e-Rad) to the Government Research and Development Database

The Fifth Term Basic Plan of Science and Technology is said to attempt to complete the registration of funds for public solicitation for the promotion of science and technology innovation policies based on objective evidence in a research and development management system common to ministries in order to perform evaluation and analysis. Information registered in e-Rad is utilized for properly evaluating research and development with the country's fund and for planning effective and efficient comprehensive strategies. For the purpose, CSTI and relevant ministries have decided to complete registration of achievement information and accounting achievements, such as papers and patents, in e-Rad in order to connect output and outcome information related to inputs to the publicly solicited research fund system.

Information on research achievement and accounting and on use of indirect expenses related to competitive fund for adopted issues shall be input in e-Rad every year. The information necessary for macroscopic analysis, including information on research achievement and accounting performance, will be provided to the the cabinet office.

## 6.3 Measures against Unreasonable Duplication and Excessive Concentration

○ Measures against "Unreasonable Duplication"

In the case that a researcher is unnecessarily receiving competitive funding from multiple sources for the same research project (name or content of research receiving competitive funding; hereinafter the same shall apply) being undertaken by the same researcher and any of the following applies, the researcher shall be made ineligible to apply for this program, selection of their research project withdrawn, or their research funding reduced (hereinafter referred to as "withdrawal of research project selection").

① In the case that simultaneous proposals have been submitted for multiple competitive research funds and duplicate approval granted for essentially the same research project (including cases in which there is a considerable degree of research content duplication; hereinafter the same shall apply).

② In the case that a duplicate application is made for funding of a research project that is essentially the same as another research project that has already been selected and has already received competitive research funding.

③ In the case that there is overlap in the intended application of research funding between multiple research projects.

④ Other cases equivalent to the above

Although at the application stage for this program there are no limitations regarding the submission of proposals to other competitive funding programs, etc., in the case that a

research project is selected by another competitive funding program, please report this promptly to the JST at the contact address given at the end of this document. If reporting is omitted, the approval decision for the research project may be revoked.

○ Measures against "Excessive Concentration"

Even if the content of the research proposed for this program differs from the content of research being carried out under another competitive funding program, in the case that the overall research funding allocated to the same researcher or research group (hereinafter referred to as "researchers") in the relevant fiscal year exceeds an amount that can be utilized effectively and efficiently and cannot be used within the research period, and any of the following applies, selection of the research project under this program may be withdrawn.

- In the case that an excessive amount of research funding is being received in light of the capabilities of the researchers and the research methods being used, etc.
- In the case that an excessive amount of research funding is being received in comparison with the amount of effort (percentage of the researchers' overall working time[7] that is required for carrying out the said research project) being allocated to the research project.
- In the case that highly expensive research equipment is purchased unnecessarily.
- Other cases equivalent to the above

For this reason, in the case that you submit proposals to other competitive funding programs, after submitting your application for this program, and the research project is selected by another competitive funding program, or if any information provided on your application changes, please report this promptly to the JST at the contact address given at the end of this document. If reporting is omitted, the approval decision for the research project may be revoked.

○ Information on proposal contents provided to eliminate unreasonable duplications and excessive concentration

In order to eliminate unreasonable duplication and excessive concentration, to the extent necessary informationregarding some proposals (or selected projects/programs) may in some cases be provided through the Cross-ministerial R&D Management System (e-Rad) to other departments in charge of competitive funds, including other government ministries. Furthermore, when it is required that checks be made for duplicate project applications under other funding programs, information may be provided in a like manner.

○ In the case that the researcher is receiving Grants-in-Aid for Scientific Research or other competitive research funding operated by the national government or independent administrative agencies (including national research and development agencies), or other research grants (including funding for which applications have been submitted), please provide information about this funding on the research proposal in accordance with the

[7] This is based on the Council for Science, Technology and Innovation's definition of 'effort', which is "the percentage of working hours required for conducting the relevant research when the researcher's total annual working hours are 100%". Note that "total working hours" does not refer only to the number of hours spent in research activities but to the substantive total working hours, including educational and medical activities.

prescribed format (Small start Type: Form 6; Large scale Type: Form 8).

Based on information regarding the content of the research proposal and effort (research time allocation rate), in the case that either unreasonable duplication or excessive concentration of competitive funding has occurred, the research proposal may not be selected or selection may be withdrawn, or research funding may be reduced. Furthermore, the research proposal may also not be selected or selection may be withdrawn, or research funding may also be reduced in the case that the information provided on the research proposal is found to be false.

○ In order to eliminate the unreasonable duplication or excessive concentration of competitive funding mentioned above, in the case that a researcher is receiving other competitive funding operated by the national government or independent administrative agencies (including national research and development agencies), or other research grants, or in the case that a researcher has been selected for such funding, the researcher may not submit proposals for this program for research with the same project name or content.

○ In the case that the applicant is scheduled to receive 100 million yen or more in research funding under other systems or research grants, etc. in FY2017 or 2018, in view of the purpose of eliminating unreasonable duplication and excessive concentration, as a general rule final selection of the research project and budget amounts are decided in an integrated manner. In the case that the applicant is scheduled to receive a total of 100 million yen or more from multiple funding systems/grants, he/she is given individual consideration accordingly within the selection process.

Although not relevant for research projects at the application stage, the research proposal may be removed from the selection process for this program or the selection decision withdrawn depending on the outcome of selection for other competitive funding or research grants. Furthermore, when it is discovered, during the selection process for this program, that the research project has been approved/rejected for another competitive funding system, please report this promptly to the JST at the contact address given at the end of this document (kaikaku_mirai@jst.go.jp).

## 6.4 Measures against Inappropriate Usage of Research Funds

Inappropriate use and reception (referred to as “inappropriate use and the like” hereafter) of research expenses related to implemented issues are strictly treated as described below.

○ Measures to be taken in case inappropriate use and the like of research expenses are found

(i) Measures to cancel contracts

Contract research agreement is cancelled or altered concerning issues in which inappropriate use and the like are found and a request is made for refunding all or part of trusted expenses. Contract for the following year and thereafter may not be concluded.

(ii) Measures to restrict application and participation[8]

Restriction measures set out in the table below depending on the levels of inappropriate use and the like are taken against application and participation by researchers[9] (including researchers who conspired, referred to as ("researchers who conspired inappropriate use and the like")) who exercised inappropriate use and the like of research expenses of this project or those whose involvement in inappropriate use and the like is not proven but who violated the duty of good care.

Furthermore, the outlines of pertinent inappropriate use and the like (names of researchers who exercised inappropriate use and the like, project names, affiliations, research issues, amounts of budget, fiscal year of research, contents of inappropriate use and the like, contents of measures taken) are provided to persons of other prefectures and their independent corporations in charge of competitive funds, who may restrict application and participation in other systems for competitive fund of the prefectures. "Application and participation" means proposal, subscription, and application of a new issue; participation in research as a new joint researcher; and participation in an ongoing research issue as a joint researcher.

| Details of Research Funding Usage | : Period of Limitation on Application (starting from the next fiscal year in which the misconduct in research activities is deemed to have occurred[10]) |
|---|---|
| 1. Cases in which the extent of the inappropriate use of research funds, etc. is deemed to have had minimal effect on society and the maliciousness of the action is deemed to be low. | : 1 year |
| 2. Cases in which the extent of the inappropriate use of research funds, etc. is deemed to have had a large effect on society and the maliciousness of the action is deemed to be high. | : 5 years |
| 3. Cases apart from 1 and 2 in which the impact of the action on society and its maliciousness are taken into consideration. | : 2-4 years |
| 4. Cases in which the research funds were used to attain personal economic gain, regardless of 1 to 3. | : 10 years |
| 5. Cases in which dishonest means, such as deceit, were used to have the research project in question selected for the program. | : 5 years |
| 6. Although not directly involved in the inappropriate use of research funds, cases in which the use of research funds is deemed to have violated the due care of a prudent manager. | : 1-2 years |

(iii) About public announcement of a case of inappropriate use and the like

Regarding those researchers whose application to or participation in this program, among those who make inappropriate usage of the program's research funds or those who are in breach of their duty for diligence, information regarding the outline of the

[8] "Application and participation" means proposal, subscription, and application of a new issue; participation in research as a new joint researcher; and participation in an ongoing research issue as a joint researcher.

[9] "researchers who violate the duty of good care" means those whose involvement in inappropriate use and the like is not proven but who violated the duty of good care a good manager should exercise.

[10] Limitations shall also be placed on participation for the fiscal year in which the misconduct in research activities is deemed to have occurred

misconduct etc. (name of researcher, name of program, name of affiliated institution, fiscal year of research, details of the misconduct and details of measures taken) will be disclosed in principle by JST. Moreover, details of the misconduct (the title of the case, type of misconduct, the research area of the misconduct case, the name of the funding in regard to which misconduct occurred, the outline of the misconduct case, the measures taken by the research institution, the measures taken by the funding organization, etc.) will be disclosed in principle by MEXT.

Furthermore, according to the "Guidelines of Management and Audit of Public Research Funds in Research Institutes (Implementation standards)", once misconduct is determined as the outcome of an investigation, it will be the responsibility of the research institution to announce the results of the investigation; hence, we ask each institution to deal with the matter appropriately.

http://www.mext.go.jp/a_menu/kansa/houkoku/1364929.htm

## 6.5 Measures taken for researchers whose application and participation are restricted in another competitive fund system

Researchers on whom restriction is imposed for the reason of inappropriate use and the like of research expenses in another competitive fund system [11] under the central government or independent corporations are subject to restricted application to and participation in this project while their qualifications are restricted for application in the competitive fund system.

It includes systems that finished in 2016 fiscal and those that publicly invite proposals in 2017 fiscal. "Other competitive fund systems" include those systems that publicly begin inviting proposals newly in 2017 fiscal and those that finished before 2016 fiscal.

## 6.6 Regarding implementation of systems based on the "Guidelines of Management and Audit of Public Research Funds in Research Institutes (Implementation standards)"

○ Regarding implementation of systems for managing and auditing public research funds

In implementing the program research institutions must stringently observe the "Guidelines on Management and Audit of the Public Research Expenses in Research Institutions (Implementation standards)" (decided by the Minister of Education, Culture, Sports, Science and Technology on February 15, 2007; revised February 18, 2014)[12].

There is a need for the research institutions to take responsibility, having implemented a system for managing and auditing public research funds, to make every effort to properly

[11] See the table of competitive fund systems in the URL below for other specific systems.
http://www8.cao.go.jp/cstp/compefund/
Note that some the systems described above may be altered.

[12] Please refer to the following URL for the details of the "Guidelines on Management and Audit of the Public Research Expenses in Research Institutions (Implementation standards)".
http://www.mext.go.jp/a_menu/kansa/houkoku/1343904.htm

spend the contract research fund in line with the aforementioned guidelines. If the Ministry of Education, Culture, Sports, Science and Technology recognize the system of a research institution for managing and auditing as insufficient based on the investigation according to the guideline, there is a possibility that measures such as reduction of overhead costs of competitive funding could be taken on the said institution.

## 6.7 Regarding the "Self-evaluation Checklist for Implementation of Proper Systems"

In concluding the contract for this project, research organizations[13] need to prepare a management and auditing system for research expenses based on the captioned guidelines and to submit "Self-evaluation check list for system preparation" ("check list", hereafter), which is a report on situation and so on (research undertaking is not approved unless the check list is submitted).

It is necessary for a research organization to use the research and development management system (e-Rad) common to ministries in order to submit the check list in the form given on the website below to the Competitive Fund Coordination Office, Promotion Planning Section, Promotion Bureau, Ministry of Education, Culture, Sport, Science and Technology by the date of concluding the contract research agreement. However, submission of a new checklist is not necessary if it has been submitted on another occasion after April 2016.

See the website of Ministry of Education, Culture, Sports, Science and Technology below for details of a method for checklist submission.

http://www.mext.go.jp/a_menu/kansa/houkoku/1301688.htm

*Note: a perfect environment for using e-Rad is necessary for check list submission. Organizations that have not been registered in e-Rad should make the registration soon. (Note it usually takes about two weeks. See the website below in addition to the website given above for detailed procedure for using e-Rad).

http://www.e-rad.go.jp/shozoku/system/index.html

Because the captioned guidelines contain viewpoints of "promotion of issuing and sharing information," describe the checklist on the websites of research organizations to actively issue information.

## 6.8 About duty to complete education for research ethics and compliance

Researchers who participate in research issues of this project shall receive lectures on research ethics education for the prevention of misconduct in research activities required in "Guidelines for responding to misconducts in research activities" and on compliance education required in "Guidelines for management and audit of public research expenses in

[13] Research organizations include not only those whose Principal Investigator is affiliated with but also those of major joint researchers to whom research expenses are distributed.

research organizations".

During the process of concluding a contract research agreement after the adoption of proposed research issues, it is necessary for all researchers participating in research issues of this project including Principal Investigator to receive lectures on research ethics education and compliance education and submit a document to confirm that they understood the contents of the lectures.

## 6.9 Regarding implementation of systems based on the "Guidelines for Responding to Misconduct in Research Activities"

In applying to this funding program and conducting research activities, research institutions are required to adherence to the ""Guidelines for Responding to Misconduct in Research Activities"(decided by the Minister of Education, Culture, Sports, Science and Technology on August 26, 2014, hereinafter referred to as the "guideline").

In case the Ministry of Education, Culture, Sports, Science and Technology finds defects in the situation of system preparation by organizations as a result of survey on the situations based on the guidelines, the Ministry may take measures including reduction of indirect expenses of the whole competitive fund for the pertinent organization.

## 6.10 About submission of a checklist related to the situation of approaches based on "Guidelines related to responding to misconducts in research activities"

When concluding the contract for this project, research organizations[14] need to submit "a check list related to the situation of approaches based on "Guidelines for responding to misconduct in research activities"" (referred to as a "check list of inappropriate research conduct, hereafter"). (Research undertaking is not approved unless a checklist of inappropriate research conduct is submitted).

Therefore, it is necessary for a research organization to use the research and development management system (e-Rad) common to ministries in order to submit the check list in the form given on the website given below to the Office of Equitable Research Promotion, Human Resources Section, Academic Policy Bureau, Ministry of Education, Culture, Sport, Science and Technology by the date of concluding the contract research agreement. However, there is no need to submit a check list of inappropriate research conduct, if it is already submitted on a different occasion after April 2017.

See the website of Ministry of Education, Culture, Sport, Science and Technology (MEXT) for details of the method for submitting a checklist of inappropriate research conduct.

http://www.mext.go.jp/a_menu/jinzai/fusei/1374697.htm

*note: A perfect environment for using e-Rad is necessary for the submission of a checklist for inappropriate research conduct. See the website given below for details of the

[14] Research organizations include not only that the Principal Investigator is affiliated with but also those of major joint researchers to whom research expenses are distributed.

procedure related the use of e-Rad:
http://www.e-rad.go.jp/shozoku/system/index.html

## 6.11 Measures taken for misconducts in research activities based on "Guidelines for responding to misconducts in research activities"

Misconducts in research activities in this project are treated strictly as described below.

(i) Measures to cancel contract

In case this project finds specific misconducts (fabrication, fraudulent alteration, theft,) in research issues, it cancels or alters the contract research agreement and requests refunding all or part of trusted expenses. Furthermore, there may be no contract in the following years.

(ii) measures to restrict qualification for application and participation

Measures given in the table below depending on the level of inappropriateness and responsibility of specific misconduct to restrict application to and participation in this project are imposed upon researchers involved in certain misconduct in research papers or reports of this project and those whose involvement has not been established but who are found responsible to an extent for the violation of the duty of good care as a manager of pertinent papers and reports. Furthermore, in case such restriction measures are taken on qualification for application and participation, information is provided to pertinent sections of competitive fund systems (referred to as "competitive fund system related to Ministry of Education, Culture, Sport, Science and Technology" hereafter) distributed by Ministry of Education, Culture, Sport, Science and Technology and independent corporations of the ministry and to pertinent sections of competitive fund systems (referred to as "competitive fund systems related to other ministries" hereafter) distributed by other ministries and their independent corporations, which may similarly restrict qualification for application and participation in competitive fund systems related to Ministry of Education, Culture, Sport, Science and Technology (MEXT) and to other ministries.

<table>
<tr><th colspan="3">Persons incurring limitations on applications due to Specific misconduct</th><th>Extent of Specific misconduct</th><th>Period of limitation on applications[15]</th></tr>
<tr><td rowspan="2">Person Involved in the Specific misconduct</td><td colspan="2">1. Especially malicious individual who intentionally engages in Specific misconduct from the outset of the research</td><td></td><td>10 years</td></tr>
<tr><td>2. Author of academic paper, etc. related to research in</td><td>The author responsible for the academic paper in question (supervisor, first</td><td>The impact on the advancement of research in the relevant field or society is large, and the maliciousness of the misconduct is deemed to be high.</td><td>5-7 years</td></tr>
</table>

[15] Imposed from the fiscal year following the year in which misconduct is officially recognized. Limitations on participation will also be imposed in the fiscal year that the Specific misconduct is officially recognized.

| | | | | |
|---|---|---|---|---|
| | which there has been Specific misconduct | author, or other position of responsibility deemed equivalent) | The impact on the advancement of research in the relevant field or society is small, and the maliciousness of the misconduct is deemed to be low. | 3-5 years |
| | | Author other than that listed above | | 2-3 years |
| | 3. An individual involved in misconduct other than that stipulated in 1 or 2 | | | 2-3 years |
| An author responsible for academic papers, etc. related to research in which there has been Specific misconduct but who was not involved in the Specific misconduct (supervisor, first author, or other position of responsibility deemed equivalent) | | | The impact on the advancement of research in the relevant field or society is large, and the maliciousness of the misconduct is deemed to be high. | 2-3 years |
| | | | The impact on the advancement of research in the relevant field or society is small, and the maliciousness of the misconduct is deemed to be low. | 1-2 years |

(iii) measures taken to researchers whose qualification is restricted for application to and participation in competitive fund system and base expenses

Qualification is restricted for application to and participation in this project by researchers whose qualifications are restricted for application to and participation in competitive fund systems related to Ministry of Education, Culture, Sorts, Science and Technology; management grant to national university corporations, university joint use organization corporations and independent corporations under the ministry; base expenses including private school subsidies; or competitive fund systems related to other ministries during the period while the restriction is in effect.

(iv) Public announcement of misconducts

In principle, JST makes a public announcement with regard to the outline of a pertinent misconduct in research activities of this project (name of researcher, project name, affiliation, research year, contents of misconduct, and measures taken). Ministry of Education, Culture, Sorts, Science and Technology also makes a public announcement concerning the contents of the pertinent misconduct (name of misconduct, kind of misconduct, research field of misconduct, name of expense account of misconduct, outline of misconduct, measures taken by research organization, measures taken by fund distributor, and so on).

The captioned guidelines state that a research organization announces the survey result immediately. Each organization is requested to handle the case accordingly.

http://www.mext.go.jp/a_menu/jinzai/fusei/1360483.htm

## 6.12 Measures for Protecting Civil Rights and Complying with Laws and Regulations

In the case that, in implementing a research initiative, the initiative involves research requiring the consent/cooperation of other parties, research requiring particular care in handling personal information, research requiring bioethical or safety measures to be taken, and other research requiring procedures required by laws and regulations, be sure to carry out the necessary procedures, such as obtaining the approval of an external and internal ethics committee of a research institution. If research activities are conducted overseas or collaborative research activities with institutions overseas are conducted, please confirm the regulations and laws in advance adhere to them.

With regard to life science-related research in particular, the main laws and regulations prescribed by each government ministry are as follows. Please note that, depending on the research content, there are also cases in which laws and regulations other than these have been established.

- Act on Regulation of Human Cloning Techniques (Act No. 146 of 2000)
- Guidelines for Handling of a Specified Embryo (Public Notice of Ministry of Education, Culture, Sports, Science and Technology No. 173 of 2001)
- Guidelines on the Derivation and Distribution of Human Embryonic Stem Cells (Public Notice of Ministry of Education, Culture, Sports, Science and Technology No. 156 of 2009)
- Guidelines on the Utilization of Human Embryonic Stem Cells (Public Notice of Ministry of Education, Culture, Sports, Science and Technology No. 157 of 2009)
- Ethical Guidelines for Human Genome/Gene Analysis Research (Public Notice of Ministry of Education, Culture, Sports, Science and Technology/ Ministry of Health, Labour and Welfare/ Ministry of Economy, Trade and Industry No. 1 of 2001)
- Ministerial Ordinance on Good Clinical Practice for Drugs (Ordinance of Ministry of Health, Labour and Welfare No. 28 of 2009)
- R&D Using Human Tissue Extracted during Operations, Etc. (Report of the Health Science Council 1998)
- Ethical Guidelines for Epidemiological Research (Public Notice of Ministry of Education, Culture, Sports, Science and Technology/ Ministry of Health, Labour and Welfare No. 2 of 2002)
- Guidelines for Gene Therapy Clinical Research (Public Notice of Ministry of Education, Culture, Sports, Science and Technology/ Ministry of Health, Labour and Welfare No. 1 of 2002)
- Ethical Guidelines for Clinical Studies (Public Notice of Ministry of Health, Labour and Welfare No. 225 of 2003)
- Act on the Conservation and Sustainable Use of Biological Diversity through Regulations on the Use of Living Modified Organisms (Act No. 97 of 2003)
- Ethical Guidelines for Medical and Health Research Involving Human Subjects (Public Notice of the Ministry of Education, Culture, Sports, Science and Technology and the Ministry of Health, Labor and Welfare No. 3 of 2014)
-Laws and regulations on access or distribution of hereditary resources in each country

For information regarding Ministry of Education, Culture, Sports, Science and Technology measures on bioethics and safety assurance, please refer to the following website.

- Life Sciences no Hiroba “Measures on Bioethics and Safety Assurance” (only in Japanese)
  http://www.lifescience.mext.go.jp/bioethics/index.html

In the case that the research plan includes research or surveys that require

consent/cooperation of other parties and/or social consensus, be sure to take appropriate measures for protecting civil rights and interests prior to applying to this program.

## 6.13 Security Export Control (Measures against the Leakage of Technology Internationally)

○ Many cutting-edge technologies are studied at research institutions. Universities in particular have seen an increase in the number of international students and foreign researchers due to internationalization, and there is an increasing risk of cutting-edge technologies and/or research materials/equipment being leaked or used for bad purposes such as the development and production of weapons of mass destruction. For this reason, in carrying out their various research activities, including the relevant contract research, research institutions are required to take organizational measures to ensure that research results that could be used for military purposes do not fall into the hands of people who could carry out fearful activities such as developers of weapons of mass destruction or terrorist groups.

○ In Japan there are export controls* based on the Foreign Exchange and Foreign Trade Act (Act No. 228 of 1949) (hereinafter referred to as the "Foreign Exchange Act"). Accordingly, when attempting to export (provide) goods or technologies controlled by the Foreign Exchange Act, as a general rule it is necessary to obtain the license of the Minister of Economy, Trade and Industry. Be sure to comply with the Foreign Exchange Act and other laws, ministerial ordinances, and notices issued by government ministries and agencies.

*Currently, Japan's security export control system mainly comprises two systems based on international consensus: (1) systems under which the license of the Minister of Economy, Trade and Industry is required as a general rule when attempting to export (provide) goods (technologies) with specifications/functions that are above certain criteria, such as carbon fibers or numerically-controlled machine tools (list control); and (2) systems under which the license of the Minister of Economy, Trade and Industry is required when attempting to export (provide) goods (technologies) to which list controls do not apply and certain requirements (use application requirements, end-user requirements, and notification (inform) requirements) have been met (catch-all control).

○ Not only the export of goods but also the provision of technology is subject to Foreign Exchange Act controls. When providing list control technologies to foreigners (non-residents), license to provide the information must be obtained in advance. "Technology provision" includes the provision of technology information such as blueprints, specifications, manuals, specimens, and prototypes by means of storage media such as paper, e-mail, CD, and USB memory, and also includes the provision of operational knowledge through technical guidance and skills training as well as technological support through seminars. There are also cases in which technology provision includes a large amount of technology exchange that could be subject to Foreign Exchange Act controls in the acceptance of international students and joint research activities.

○ Detailed information about security export control is provided on the website of the Japanese Ministry of Economy, Trade and Industry (METI) and other organizations. Please see the list below for details.

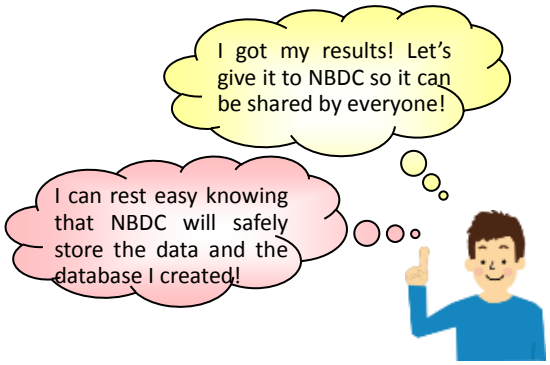
- Ministry of Economy, Trade and Industry (METI)：Security export control (general)
  http://www.meti.go.jp/policy/anpo/englishpage.html
- Ministry of Economy, Trade and Industry (METI)：Security Export Handbook
  http://www.meti.go.jp/policy/anpo/seminer/shiryo/handbook.pdf
- Center for Information on Security Trade Control
  http://www.cistec.or.jp/english/index.html
- Guidance on machine technology control in relation to security export control (for universities/research institutions)
  http://www.meti.go.jp/policy/anpo/law_document/tutatu/t07sonota/t07sonota_jishukanri03.pdf

## 6.14 Cooperation with the National Bioscience Database Center

The National Bioscience Database Center (NBDC)[16] hosts the Life Science Database Archive (http://dbarchive.biosciencedbc.jp), an archive that provides access to wholly downloadable datasets generated by researchers in Japan in the life sciences. Another hosted database is the NBDC Human Database (http://humandbs.biosciencedbc.jp), a platform for sharing various human data produced from human-derived specimens such as human genome data. We ask all researchers to provide NBDC with their data for publishing on the Life Science Database Archive and the NBDC Human Database so that data results from your life sciences research may be used extensively for a long time.

Contact information:

Japan Science and Technology Agency
The National Bioscience Database Center (NBDC)
Life Science Database Archive contact:
dbarchive@biosciencedbc.jp
Human Database contact:
humandbs@biosciencedbc.jp




Feel free to contact us with any questions you may have on using/publishing life sciences databases.

[16] The National Bioscience Database Center (http://biosciencedbc.jp/en/) researches, develops, and provides services for integrating and easily accessing life sciences databases generated in Japan. The objective is to stimulate research and development through extensive sharing and broad use of research data.

## 6.15 Regarding Registration with researchmap

JST-Mirai R&D Program plans to use the researcher information database (researchmap*) managed by JST as a master database in order to utilize it in various scenes including achievement reports and the like. In addition, the community function of researchmap is used for utilization in project management, including distribution of various files and event notices. Because registration in researchmap of researchers whose proposals are adopted is necessary for the purposes, those who have not are requested to make the registration soon.

Information registered in researchmap is effectively utilized for surveying national plans of academic, scientific, and technological policies and statistical purposes. Register and update achievement information and the like in researchmap.

* Researchmap (previously referred to as Read&Researchmap http://researchmap.jp/) is a largest database covering all Japanese researchers. As of January 2017, about 256 thousand researchers are registered in it. Registered profile information and achievement information are continually and stably managed as a service by a public organization in order to make them available to the public via Internet. Furthermore, researchmap collaborates with e-Rad and many databases of university instructors to render registered information available through other systems. Therefore, researchers do not need to register the same achievement repeatedly in various application forms and databases. That allows tasks associated with research activities to be performed efficiently.

See (1) below to confirm the state of registration in researchmap and the log-in procedure; see (2) below for the procedure of new registration of non-registered researchers; see (3) below for re-issuing procedure for passwords to register researchers; and see (4) below for the procedure of achievement data output in case a researcher prepares a list of achievements at proposal application using achievement information registered in researchmap.

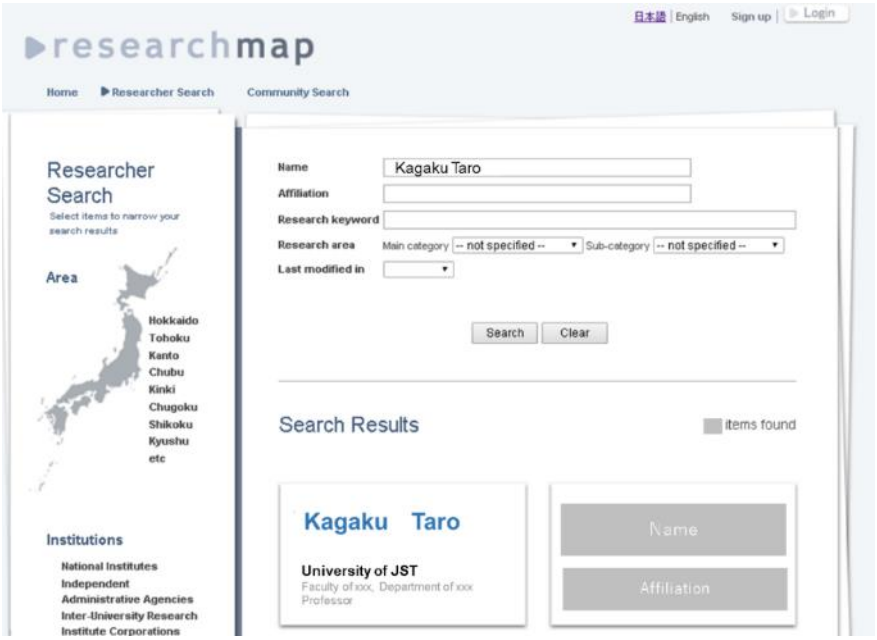
## (1) Methods for confirming state of registration in researchmap and for log in

(1)-1. Check whether registration already exists.

Even if a researcher him/herself has not registered, a research organization may have registered the affiliated researcher in researchmap. Names and so on may be searched for by researcher search.

Top page: http://researchmap.jp/search/

Use the search results to check whether information on a researcher him/herself exists. See (2) below to make new registration in case of no registration.



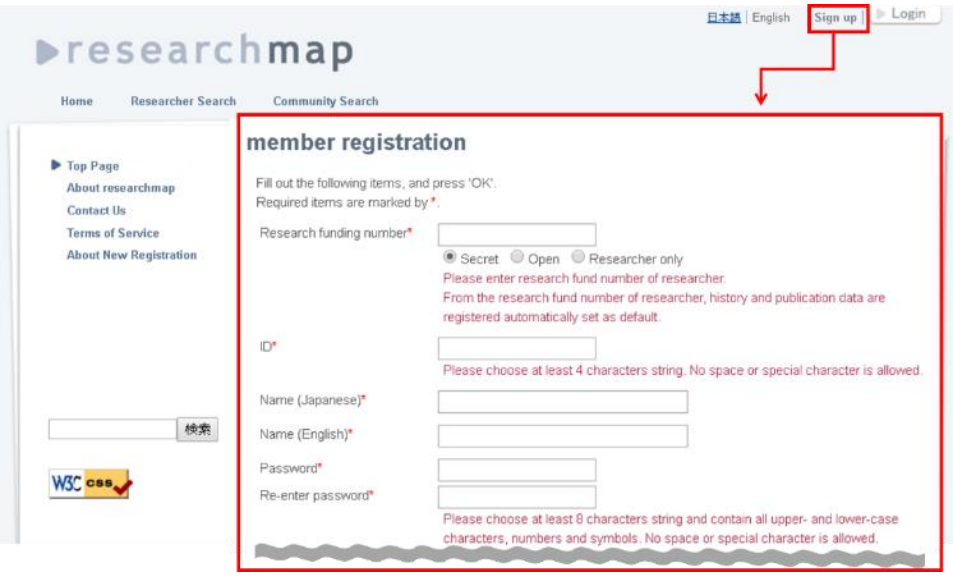

(1)-2. In case registration exists and log-in ID and password are known

Log-in ID and password are used to log in for researcher information in researchmap.


## (2) Method for new registration

(2)-1. In case a researcher has a researcher number

Click “new registration” upper right on the researchmap top page, input the researcher number and other relevant matters to complete new registration.

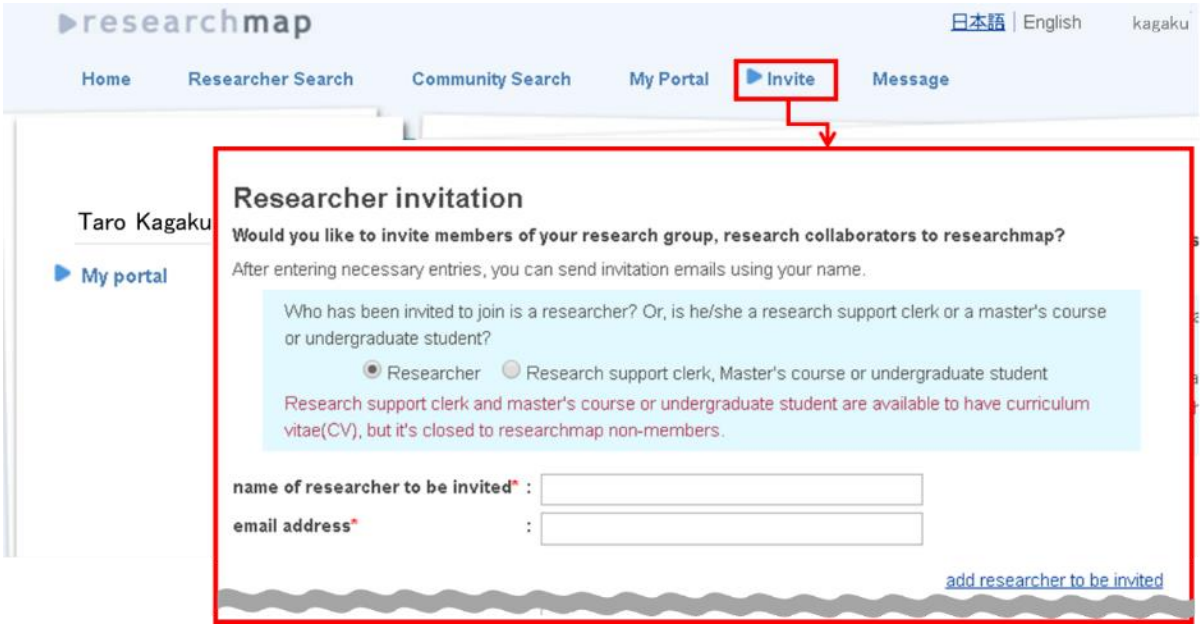



(2)-2. In case a researcher has no researcher number

Click “about new registration” link top left on the researchmap top pate to use “New registration form for a researcher who has not researcher number for scientific research expense.” Add titles of main papers (or books) and proceedings (or publishers’ names) for checking that the applicant is indeed a researcher. An invitation mail is sent upon confirmation by JST service center.


(2)-3. Invitation by researchers who have registered

An invitation by a researcher who has registered in researchmap allows new registration regardless of whether a researcher number exists. A researcher who has registered may use an “invite” link after logging in researchmap to send an invitation mail to a researcher who has not registered.




### (3) Procedure for re-issuing a password

(3)-1. In case a registered log-in ID or password is forgotten

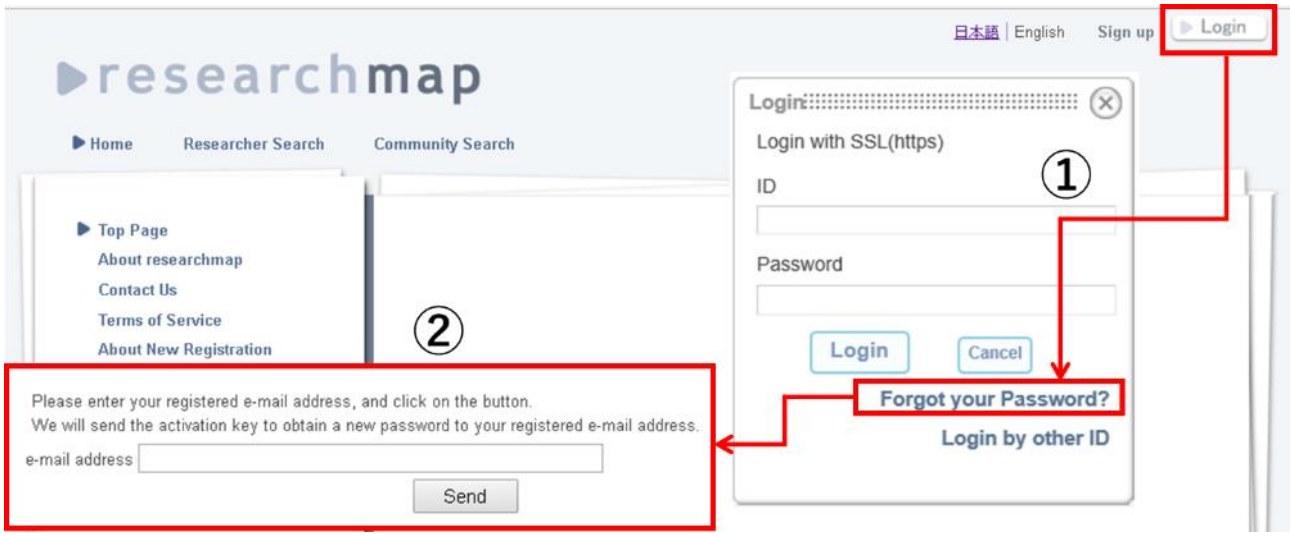
The procedure below allows a log-in ID or password to be re-issued.

① Click “log in” upper right on the researchmap top page and click “password re-issue.”

② A screen for inputting a registered mail address appears. Input your mail address and send the mail. A log-in ID and a password are sent to you in due course of time.

③ When an error occurs in the procedure of password re-issue for researchmap, use the question form to contact the researchmap top page.

https://researchmap.jp/public/inquiry/

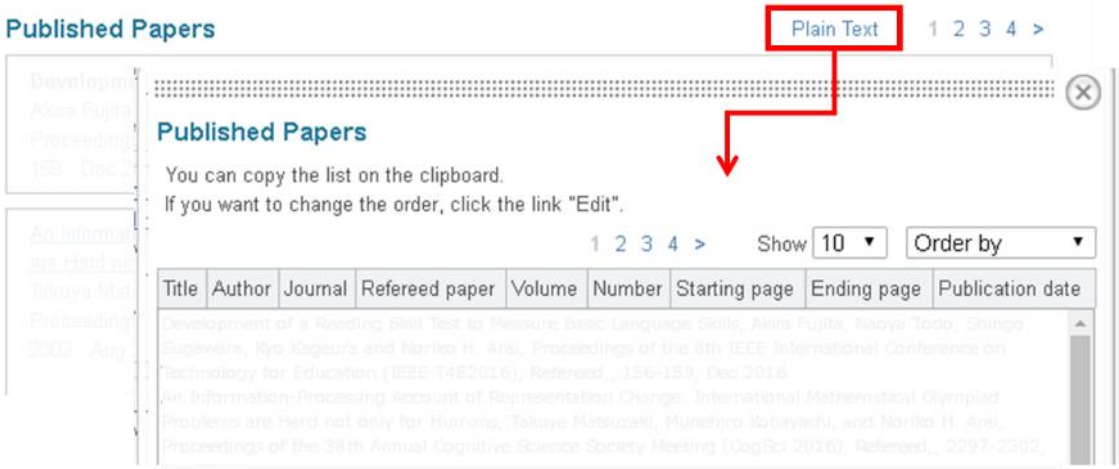



**(4) Output procedure for achievement information registered in researchmap**

Information registered in researchmap may be downloaded in (4-1) text style, (4-2) csv or an XML file.

(4)-1. Presentation in a text file

Achievement information may be presented in a text file from your own page. When you save data in your own PC, copy and paste the text data on the screen to use the data.

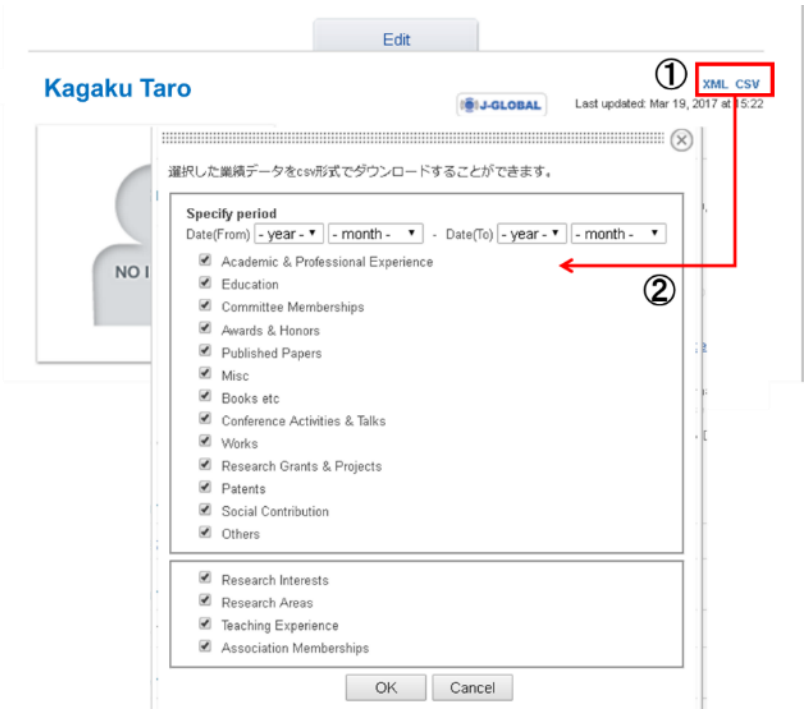



(4)-2. Downloading in csv or XML file

Logging in researchmap allows file output by the kind of achievement to be saved in your own PC.

① choose “SML” or “csv”

② Input a check mark for achievement wanted to be output and click “decision.”




## 6.16 About the use of JREC-IN Portal

The database of research human resources (JREC-IN https://urecinjst.go.jp/) is a largest website to support research human resources in Japan. It is a free service to carry information on human resources including researchers, their supporter, engineers involved in research for glancing.

At present, it annually carries more 16,000 pieces of information on wanted human resources by universities, public research organizations, and private business firms in addition to more than 100 thousand registered users. Utilize JREC-IN Portal by all means when looking for research human resources (post doctors, researchers, and so on) with high levels of knowledge to promote research projects.

Furthermore, JREC-IN Portal collaborates with researchmap. It may be logged in by ID or password of researchmap. Its functions for the preparation of résumés and achievement lists may use information registered in researchmap to prepare these documents.

## 6.17 Efficient promotion of research and development through effective use of currently available research facilities and equipment

The Ministry of Education, Culture, Sports, Science and Technology is promoting the development of the grounds for sharing research institutes and facilities and integrating different research fields in accordance with the Act on the Promotion of Public Utilization of the Specific Advanced Large Research Facilities (Act No. 78, 1994); the Act on Enhancement of Research and Development Capacity and Efficient Promotion, etc., of Research and Development, etc., by Advancement of Research and Development System Reform (Act No. 63, 2008); and other laws. If the uses and purchases of research facilities and equipment are being considered upon the application, please consider actively using facilities and equipment

owned by universities and national research and development agencies and made available to others and opportunities for cooperation among industries, academia, and the government from the perspective of effective promotion of consigned research in this program; effective use of already available facilities and equipment; and removing overlaps in purchasing facilities and equipment.

In addition, universities etc. are requested to actively promote sharing research facilities in research projects funded by competitive research funds. Please refer to 4.2.7-(3) in the application guidelines for details.

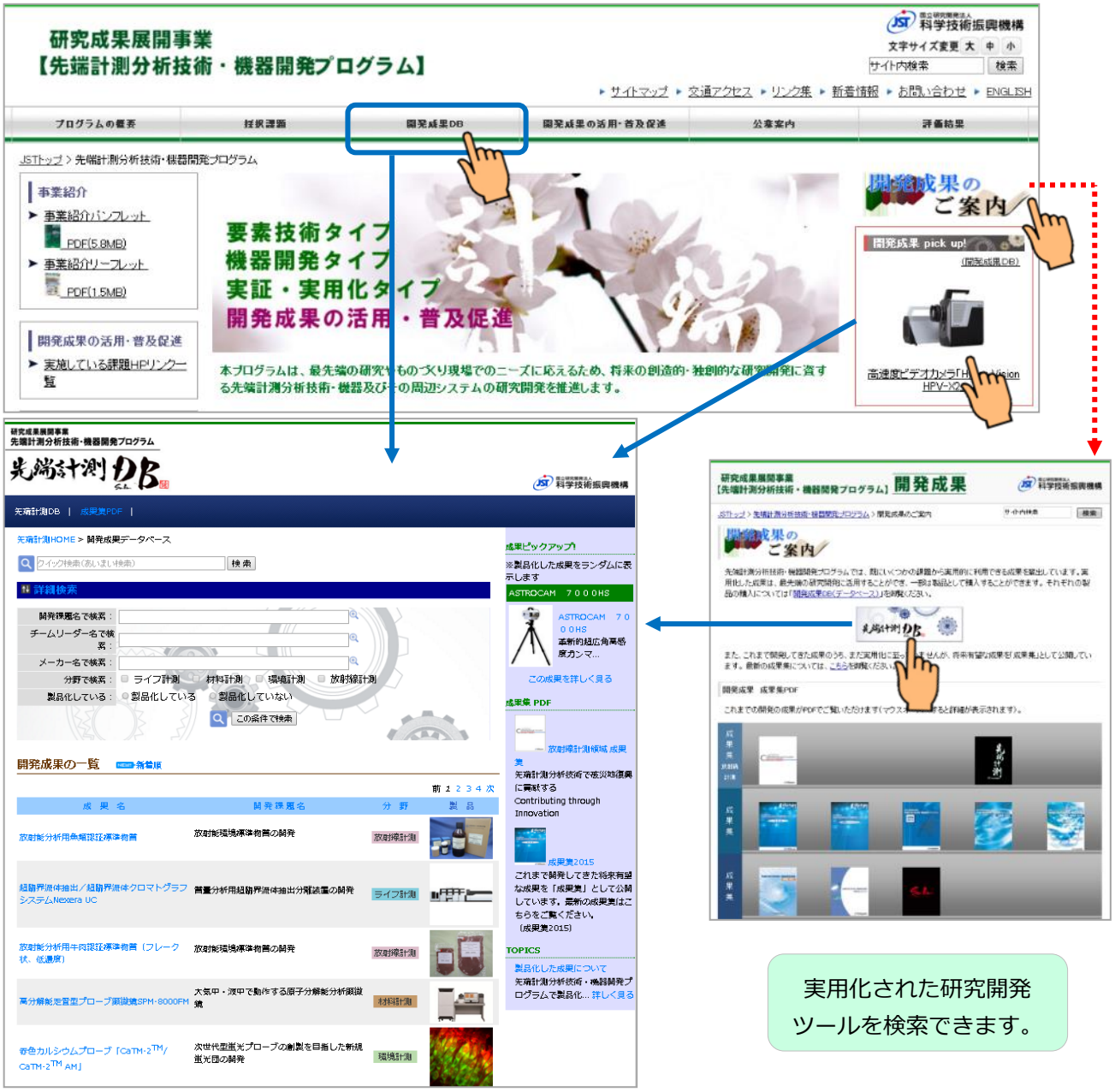
<Reference: Examples of shared facilities and equipment>

| |
|---|
| Facilities covered in the Act on the Promotion of Public Utilization of the Specific Advanced Large Research Facilities<br>(Please refer to the instructions from each facility for schedule of project proposal and other information related to utilization)<br>SPring-8, the large synchrotron radiation facility<br>(Applications are accepted around May and November every year.)<br>http://user.spring8.or.jp/?lang=en<br>SACLA, an X-ray free-electron laser facility<br>(Applications are accepted around May and November every year.)<br>http://sacla.xfel.jp/?lang=en<br>J-PARC, a large intensity proton accelerator<br>(Applications are accepted around May and October every year.)<br>http://is.j-parc.jp/uo/index_e.html<br>High Performance Computing Infrastructure (HPCI) including the K computer<br>http://www.hpci-office.jp/folders/english |
| Projects for promoting the sharing of advanced research facilities<br>*See URL below for information on this project, which started in 2016 fiscal. Also see URL below for information concerning “Platform formation project for joint use of advanced research base,” which finished in 2015 fiscal.<br>http://www.mext.go.jp/a_menu/kagaku/shisetsu/index.htm |
| Nano technology platform<br>http://nanonet.mext.go.jp/english/ |
| Development of research base network toward the construction of a low-carbon society<br>http://www.nims.go.jp/lcnet/ |
| Tsukuba Innovation Arena for Nanotechnology (TIA-nano)<br>https://www.tia-nano.jp/en/index.html |
| Project for Platform for Drug Discovery, Informatics, and Structural Life Science (four bases)<br>http://pford.jp/ |
| National BioResource Project<br>http://www.nbrp.jp/ |
| Japanese Experiment Module (KIBO) / International Space Station (ISS)<br>http://iss.jaxa.jp/kiboexp/participation/ |

## 6.18 Regarding the Results of JST's Development of Systems and Technology for Advanced Measurement and Analysis Program

- ○ JST implements a wide variety of research and development programs ranging from basic research to industry-academia collaborations and so on, and a great deal of these research results have been put into practical use already.
- ○ Among these, the development of systems and technology for advanced measurement and analysis program, which seeks to build and develop a basic research and development platform, has resulted in the practical use of many research and development tools.
- ○ It would be a pleasure if a researcher sees a research and development tool to be newly examined for the promotion of research and development.

Visit the Advanced Measurement website:
http://www.jst.go.jp/sentan/en/index.html) for details.



# Chapter 7
# Submission via the Cross-ministerial R&D Management System (e-Rad)

## 7.1 Points to Note with Regard to Submission via the Cross-ministerial R&D Management System (e-Rad)

Calls for research proposal applications are made via the e-Rad (http://www.e-rad.go.jp/en/index.html)[17] system. The process for submitting research proposal applications via e-Rad is described below.

Please pay attention to the following points in particular.

○ **Please submit your applications via e-Rad.**
**No proposal for which the application procedure has not been completed via e-Rad by the deadline is subject to examination for any reason.**

○ **Log in to e-Rad; recommended movement environment**
The recommended movement environment of e-Rad is IE, Firefox, Safari.

○ **Researcher registration is required in advance.**
For details, please refer to 10.4.1.

○ **Please allow several days or more after the application deadline for inputting information into e-Rad.**
Input of information into e-Rad takes a minimum of around 60 minutes. Furthermore, on the day of the application deadline, there is a risk that the e-Rad system may be crowded and inputting may take a long time. Please allow ample time before the application deadline to commence inputting information into e-Rad.

○ **It is possible to "temporarily save" input information.**
It is possible to discontinue input of and temporarily save application information part way through. For details, please refer to the "Saving and Reassessing your Application Information" section under "7.4.4 Entering the Required Information into the e-Rad System" and/or "Usage Manual for Researchers" or "Frequently Asked Questions" sections on the e-Rad portal site.

○ **"Retraction" is possible, even after the research proposal has been submitted.**
**Up to and including the day prior to the application deadline,** it is possible for researchers to retract and re-edit their research proposals. For details, please refer to the "Amending Submitted Application Information: 'Retraction' " section under "7.4.4 Entering the Required Information into the e-Rad System" and/or "Usage Manual for

[17] The e-Rad system is a cross-ministerial system that enables online completion of all processes (Application receipt → Evaluation → Selection → Management of selected research topics → Reporting of results, etc.) related to the management – referring primarily the competitive funding systems overseen by individual ministries - of research and development. "e-Rad" is 府省共通研究開発管理システムの略称で、derived from the words "electronic" and "research and development" (for science and technology).

Researchers" section on the e-Rad portal site.

**Do not "retract" research proposals on the day of the application deadline**. On the day of the application deadline, there is a risk that the e-Rad system may be crowded and re-editing the proposal after retraction may take a very long time.

## 7.2 Flow of Application Process Using e-Rad

(1) Enter information on the research institution and researcher

Applicants who do not have a login ID or password must request the administrative section of their research institution to register the institution in the e-Rad system. It should be noted that the registration process can take more than two weeks. →For more details, please refer to 7.4.1.

↓

(2) Obtain application requirements and research proposal forms

Check the list of current calls for research proposal applications on the e-Rad portal site, and download the application requirements and research proposal forms. → For more details, please refer to 7.4.2.

↓

(3) Prepare a research proposal (maximum file size of 3 MB） → For more details, please refer to 7.4.3.

↓

(4) Enter the application information into the e-Rad system

Enter the required information into the e-Rad system. Input takes around 60 minutes. → For more details, please refer to 7.4.4.

↓

(5) Submit the research proposal

Submit your research proposal by uploading it. → For more details, please refer to 7.4.5.

## 7.3 System Availability and Where to Direct Questions

### 7.3.1 How to use the e-Rad system

- The manual for e-Rad operation may be seen in or downloaded from portal site (http://www.e-rad.go.jp/). Apply upon agreeing to the rules of use.
- Please check (https://www.e-rad.go.jp/terms/requirement/index.html) before using the e-Rad system.

### 7.3.2 Where to direct questions on how to use the e-Rad system

Questions regarding JST's systems and programs should be directed to JST. Questions on how to use the system should be directed to the e-Rad helpdesk.

Please read carefully the explanation of the application process contained in this chapter, and the contents of the e-Rad portal site, before submitting a question.

No answer is given to questions concerning the review or adoption of a proposal.

| | | |
|---|---|---|
| Questions regarding matters like systems and programs, preparation of documentation for submission, and submission procedures | Department of Research and Development Reform | Please submit inquiries by email (except for urgent inquiries).<br><br>E-mail：**kaikaku_mirai@jst.go.jp**<br>Tel： +81-3-6272-4004 (Mon.-Fri. 10:00-17:00*)<br>* Except Saturdays, Sundays, and National Holidays<br>[Communication by e-mail may be requested even when a question is asked by telephone.] |
| Got questions regarding use of the e-Rad system | e-Rad helpdesk | Tel: 0120-066-877 (navi dial)<br>Hours: 9:00-18:00<br>●Except on Saturdays, Sundays, holidays, and the year-end and new year period<br>[In the case that the navi dial is unavailable]<br>03-6631-0622 (direct line) |

- Website for this program: (http://senryaku.jst.go.jp/teian-en.html)
- e-Rad portal website (http://www.e-rad.go.jp/en/index.html)

### 7.3.3 e-Rad system availability

Monday to Sunday 0:00-24:00　Available 24 hours a day, 365 days a year.

※ Maintenance and inspection schedules are announced ahead of time on the portal site.

## 7.4 Detailed Submission Instructions and Precautions

### 7.4.1 Entering information on research institutions and researchers

Research organizations need to be registered in e-Rad before application. They are requested to select an office representative concerning e-Rad, who downloads a registration form for research organization from the e-Rad portal site (referred to as “portal site” hereafter) to apply for registration.

Applicants must first register their researcher information and obtain an e-Rad login ID and password. For applications, registrants include the PL, PM and all Joint Researchers. (If registration via a system or program of another ministry or other government organization has already been completed, doing so once again is not required.)

The following registration procedures are required. **Please allow two weeks or more for completing procedures**. For details, please refer to the “Preparations for Using the System” or “Frequently Asked Questions” sections on the e-Rad portal site.

1) For researchers affiliated with a domestic research institution

, Operator: administrator at the research institution

Registration details: research institution and information on the researcher

2) For researchers affiliated with a foreign research institution, and researchers affiliated with no research institution

Operator: applicant

Registration detail: information on the researcher

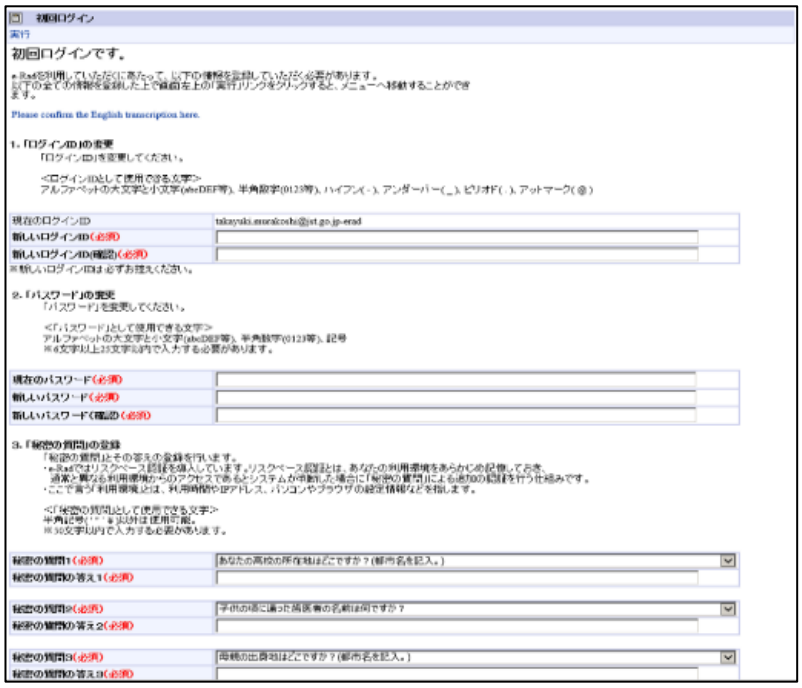
### 7.4.2 Obtain application requirements and research proposal forms

(1) Click “e-Rad login” on the portal site.

(2) Log in using the applicant’s login ID and password.

- Once this is done, information on the researcher who has logged in will be automatically displayed in areas showing information on the Research Director or Individual Researcher.

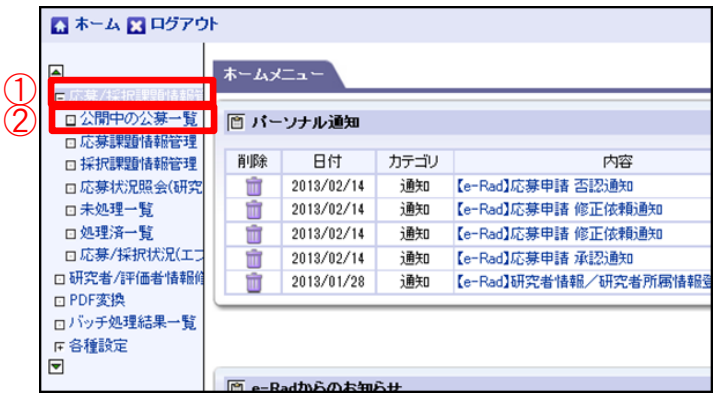
For first-time logins, it is necessary to enter initial settings. In addition, when logging in from a PC other than the one normally used for login, the login process will go to an additional authentication screen. On such occasions, the user may be asked to respond to a preset question.




（参考）初回ログイン画面

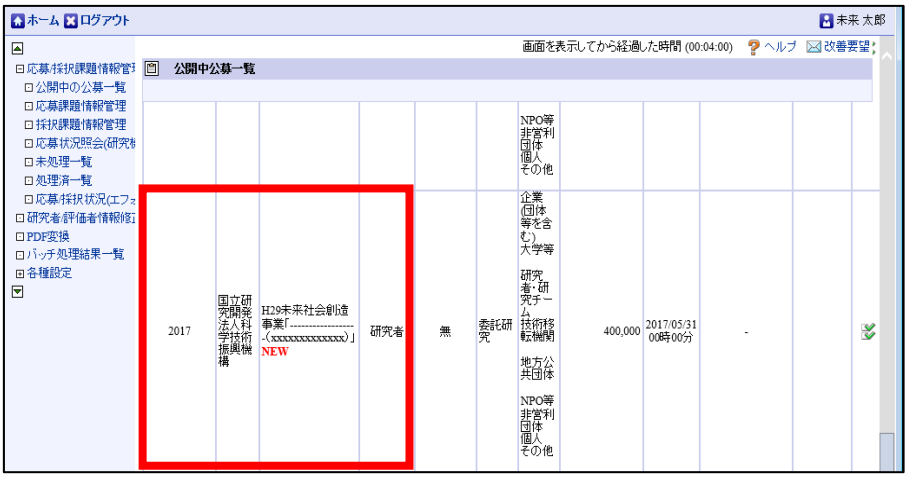
(3) Search for calls for proposals

Click on 1) “Application / Selection Information Management” on the left-side menu. Next, click on 2) “List of Current Calls for Proposals.”



(4) Click on “Details” for the call for proposals for which an application will be submitted.

Simple searches can be performed by clicking “Search Conditions”.
(Please search based on terms such as title of call themes)




(5) Download the research proposal forms and application requirements

Confirm that the call theme

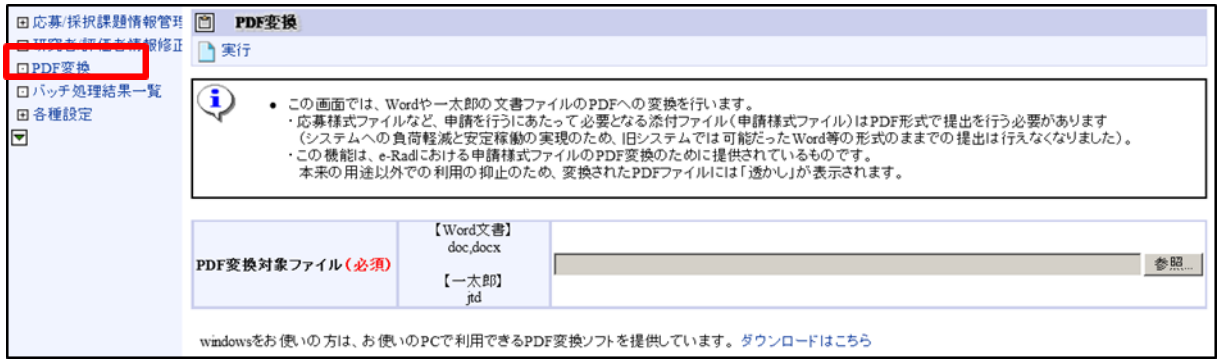
For the research proposal forms, click "Application Form File" and download the file.

- **<u>Be very careful to use the correct forms for the call theme for which the application will be submitted.</u>**


Application requirements (application requirements for the call for proposals) can be accessed from the same page. (Click on “Application Requirement File” to download the requirements.)

### 7.4.3 Preparing a Research Proposal

- Make sure that application requirements are understood before preparing a research proposal.
- Research proposals (doc format) must be converted to the PDF format before uploading to the e-Rad system. PDF conversion can be performed using the menu that appears after login. It is also possible to download the conversion software from the same menu and install it on the researcher's computer.




■NOTE:

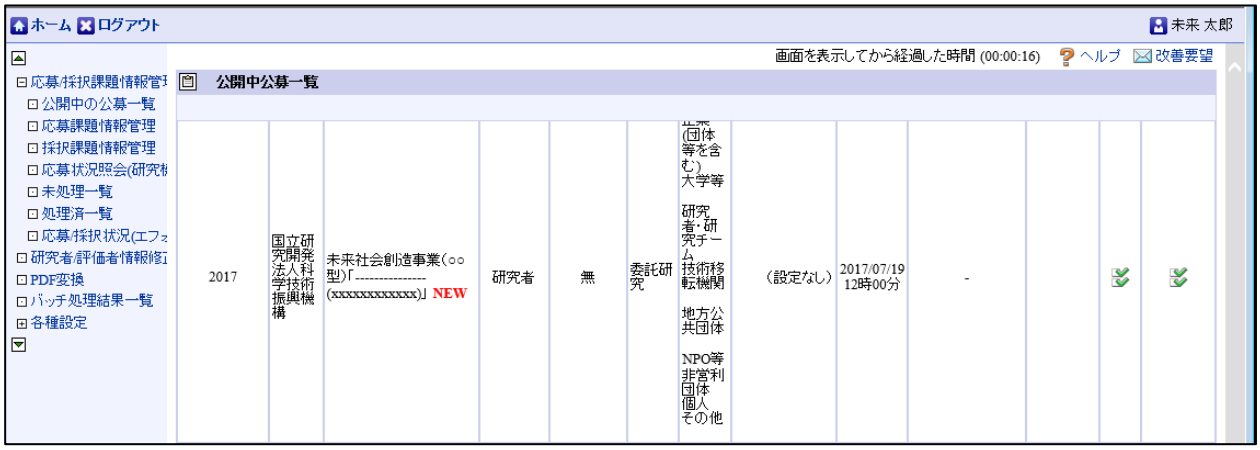
- Please confirm the recommended operating environment in advance to log in the e-Rad system. The recommended operating environment is IE, Firefox, or Safari.
- Research proposals converted to the PDF format should be no larger than 3MB. Files exceeding 10MB cannot be uploaded to the e-Rad system.
- Delete the conversion history.
- When creating PDF files, do not set a password for the research proposal.
- Make sure that page numbers have been attached to the file converted to PDF format.
- Confirm the creating PDF files. Following misconversion could be happen.

  * In the process of conversion, characters, such as those used in certain languages and special characters, may not be rendered correctly. It is necessary, therefore, to check all PDF files within the system. For more information on characters available for use, please refer to the "Usage Manual for Researchers" (downloadable from the e-Rad portal site).

### 7.4.4 Entering the Required Information into the e-Rad System

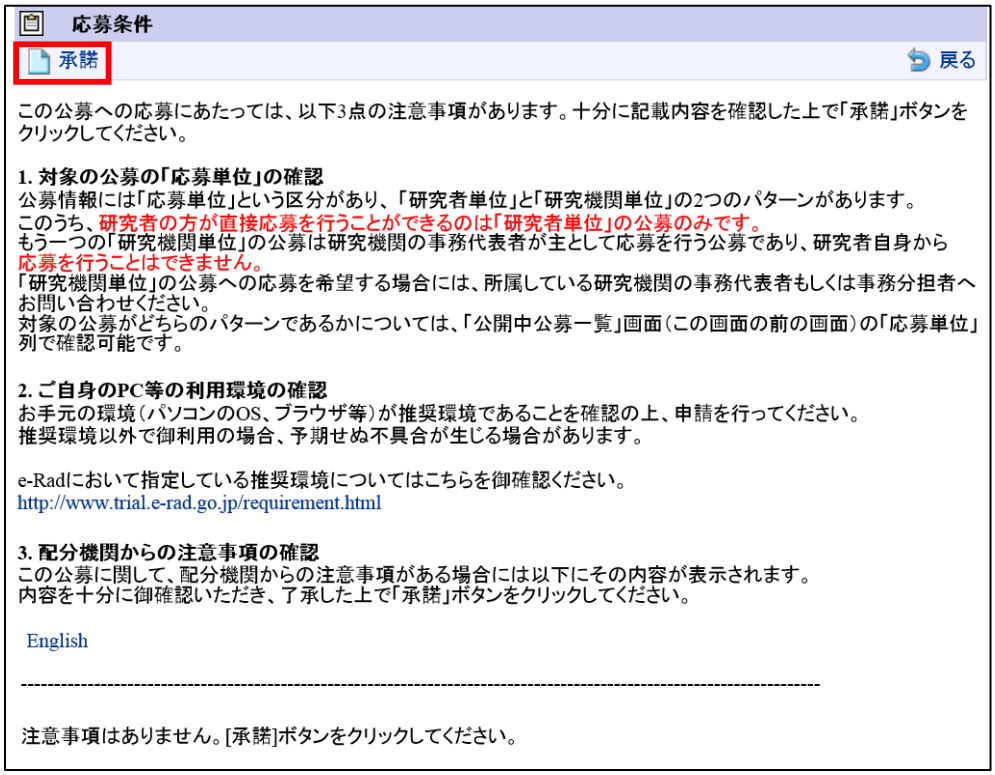
(1) Search for calls for proposals

After preparing a research proposal, log in once again, search for calls for proposals.




(2) Application conditions

After reading the cautionary note, click "Agree" on the upper left portion of the screen.



Saving and Reassessing your Application Information

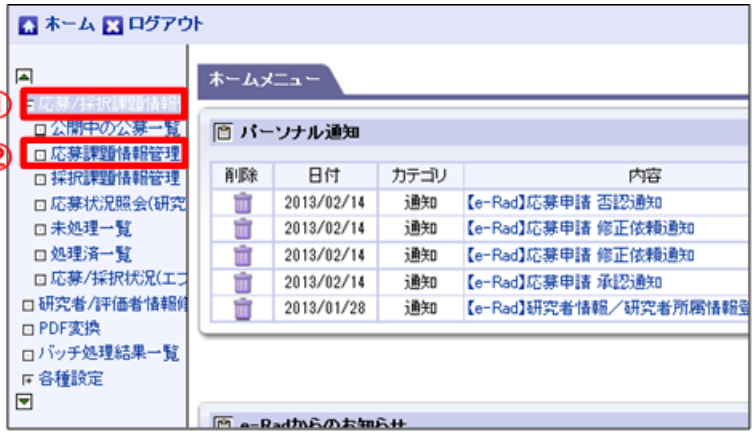
1. Saving Information Temporarily

In the case that you wish to temporarily store application information during input, please click on the “Temporarily Save” button at the top-left of the screen.

* Unless you fill in all items from (1) to (8) in “10.4.4 (3)”, you cannot temporarily store information.


2. Reassessing your Application Information

First click on “1) Application/Selection Information Management” in the right-side menu, then click on “2) Application Information Management”, which will be displayed.



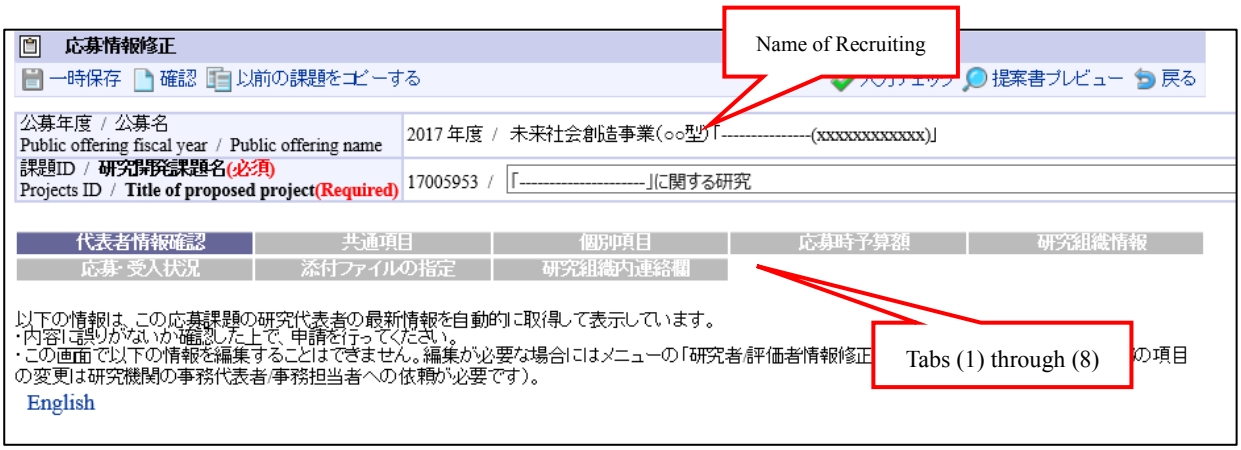

Input the recruitment year (2017) and research area name into the【Search Criteria】box and click the “Search” button.

If you click on the “Edit” button, the Application Information Registration (Amendment) page will appear.

(3) Enter application information

Enter the various types of information required to apply.

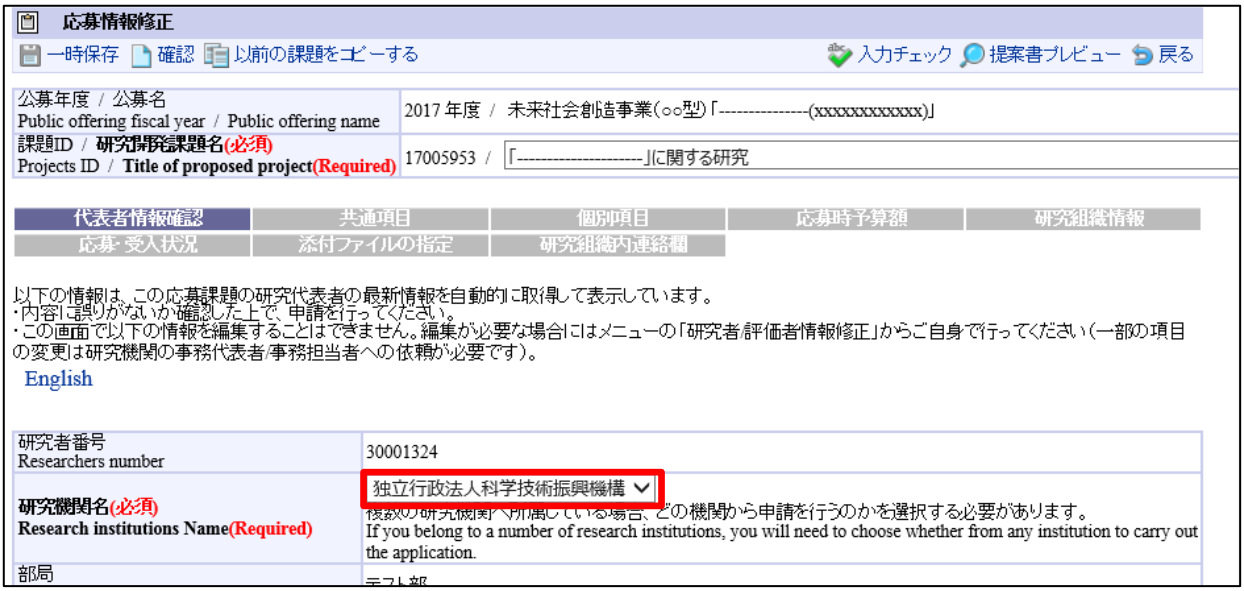
This screen is organized with tabs. Clicking the eight tabs shown below will display a related data entry screen. Unless you fill in all items from (1) to (8), you cannot temporarily store information.




Application information data entry screen (Accessed by clicking the “Research Director Information Confirmation” tab)

- In the space labeled “R&D Subject,” enter the "Research Project Name” from Research Proposal (Form 1).

(1) “Research Director Information Confirmation” tab

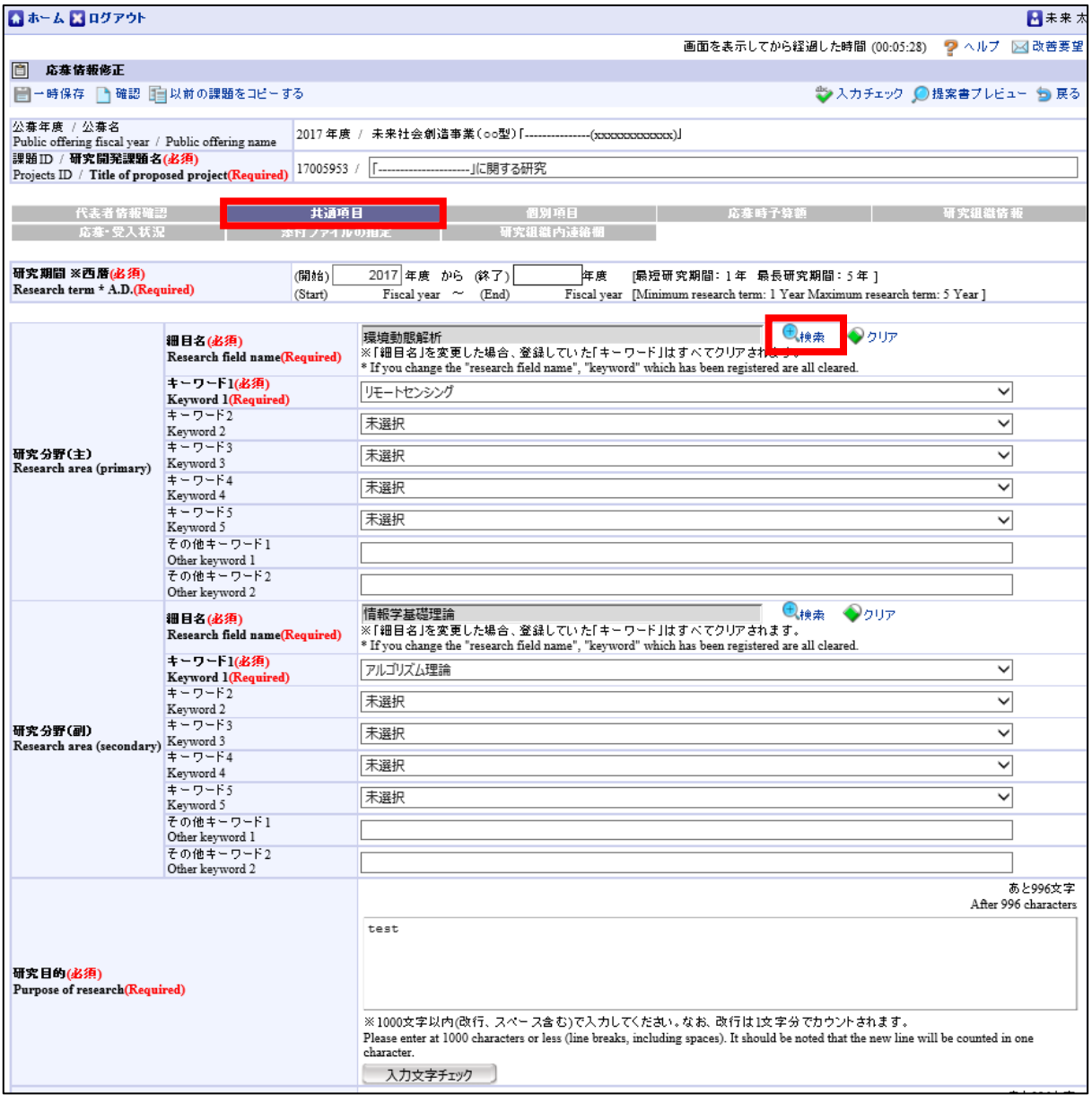



- Check whether the information on the Research Director is correct. Information registered on the e-Rad system is automatically entered.

- Researchers who are affiliated with multiple research institutions must select the institution from which the proposal will be made. This selection is made via this tab.

It is possible to amend researcher information from the e-Rad “Revise Researcher / Evaluator Information” menu. For details, please refer to the “Usage Manual for Researchers.”

(2) “Common Items” tab




Research Period (Start): 2017 (Fiscal year)

Research Period (End): Please refer to “Chapter 5 FY2017 Open Call Themes”

Research Field (Main, Secondary) / Specific Name: Click “Search” and use the new screen to perform a detailed search for the research field / specific name that apply to the proposed research. Select the appropriate

items.

Research Field (Main, Secondary) / Keywords: After selecting a specific name, select keywords from the list.

Research Objectives:

(Small-scale type) Please summarize the contents of “1. POC to be reached by these R&D projects” and “2. Reasons for setting the particular POC” on R&D proposal Form 2 , not exceeding 300 words

(Large-scale type) Please summarize the contents of “1. POC to be reached by these R&D projects” and “2. Reasons for setting the particular POC” on R&D proposal Form 3 not exceeding 300 words

Research Overview:

(Small-scale type) Please copy the contents of “2. Matters to be achieved in small-start-type research” on R&D proposal Form3, not exceeding 300 words

(Large-scale type) Please copy the contents of “2. Detailes of R&D plan and way of promotion” on R&D proposal Form4.

(3) “Individual Items” tab


Follow the screen to input. Placing the cursor over each item will cause a related explanation to appear. Please refer to these as necessary.

Points to Note when Inputting Information Using the “Individual Items” Tab

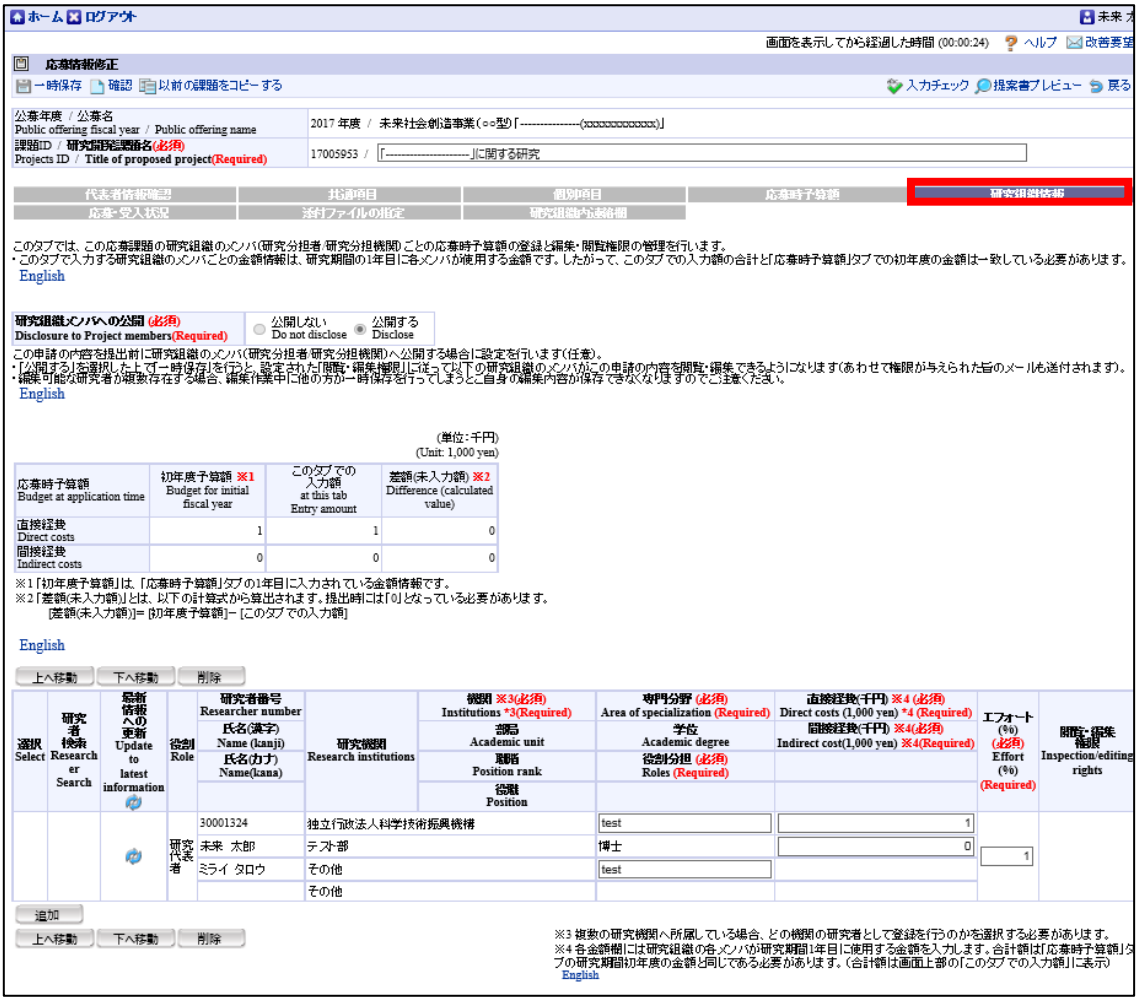
- For items marked【CHECK】, be sure to check the content carefully before clicking the “Check” button.
- With regard to programs related to Research Integrity Education, please refer to “6.1 Enrolling in and Completing the Educational Program for Research Integrity”.
- In the case that you have completed the condensed CITI Japan e-learning program, please be sure to input the Completion Certificate Number.

(4) Budget at Application Time” tab


【Precautions】

The frame for fiscal year ♦ in “” tab above is displayed to reflect the research period input in ② “common item” tab.

(5) “Research Organization Information” tab




(6) “Application and Acceptance Status” tab

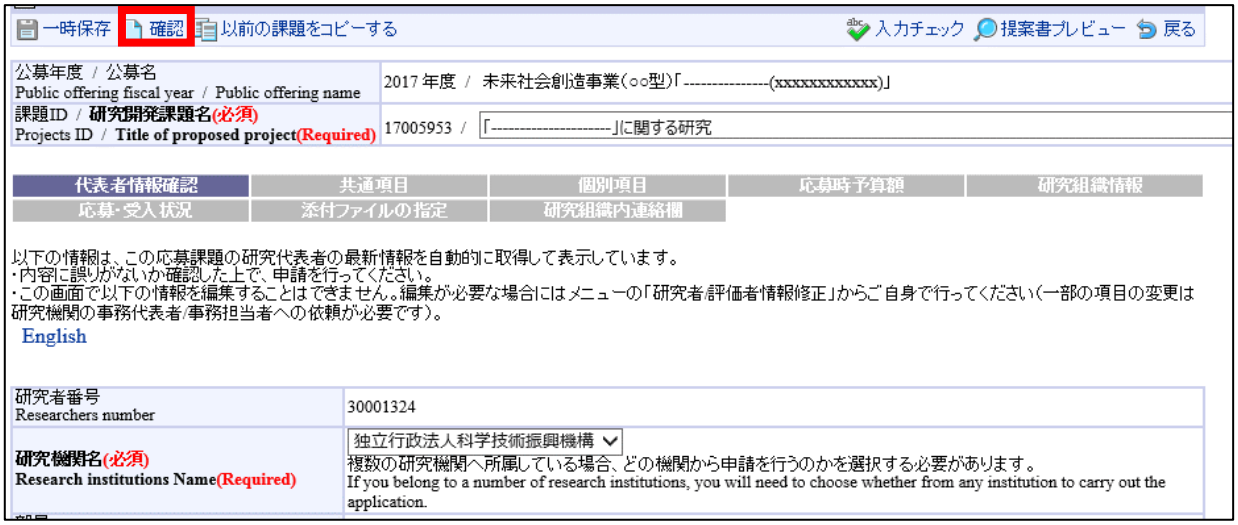
No entries are required for this tab.

※ For “Support from Other Organizations, etc.,” enter the information from Research Proposal (Form 5) for a small start type application, or the information from Research Proposal (Form 8) for a large scale type application.

(7) “File Attachment” tab

Click “Choose” to select and upload the PDF created in (3) Preparing a Research Proposal.

### 7.4.5 Research Proposal Submission




Click on the “Confirm” button at the top-left of the screen.

In the case that there are sections where the input information does not correlate with e-Rad’s input rule, an error message will appear at the top of the screen, the tab for the section where the problem occurred will appear in red, and the cell for the incorrectly input information will appear in yellow. Please make corrections as instructed in the message.


Confirm that all entered information is being correctly displayed and click on “Submit” in the upper left portion of the screen to submit the proposal. Substantial time is required to complete the submission process in some cases.

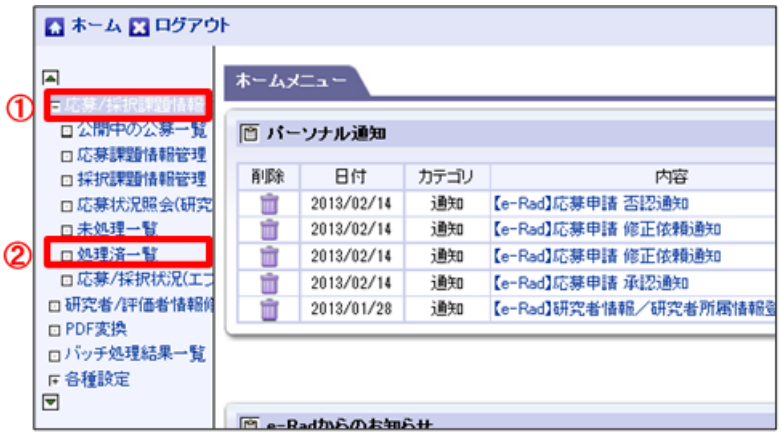
If the submission is successful, a message reading “Application Information Receipt Finalized” will be displayed. At that point, the Research proposal has been submitted to JST. It should be noted that MIRAI program do not require that the research institutions with which researches are affiliated provide approval via the e-Rad system.

Amending Submitted Application Information: “Retraction”

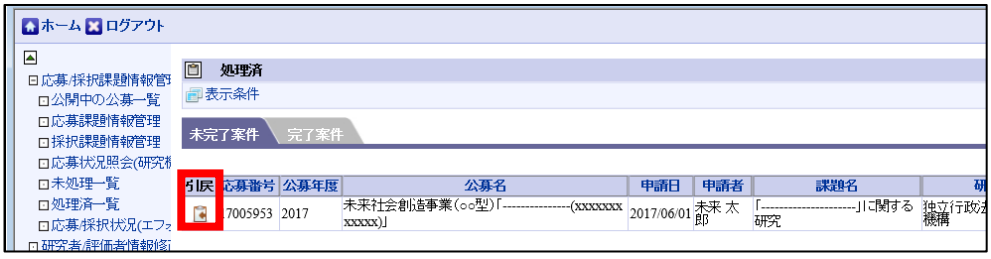
Researchers may retract or amend their proposals up to and including the day prior to the application deadline.

※ Do not “retract” research proposals on the day of the application deadline.

1) First click on “1) Application/Selection Information Management” in the left-side menu, then click on “2) List of Processed Items”, which will be displayed.




2) Click on the “Retract” button.




3) When the Retraction screen appears, click on the “Retraction” button.

After retraction is completed, the proposal will be “temporarily saved”. For recommencing input of information from a “temporarily saved” status, please refer to “Saving and Reassessing your Application Information” above.

■ Confirmation of application information status

After clicking “Application / Selection Information Management” on the left-side menu (1) below), click “Application Information Management” (2) below).

If the proposal has been submitted correctly, status will appear as “Processing” (there may be a time lag for applications submitted via e-Rad).

Research Applications whose status does not appear as “Processing” by the Application Deadline are invalid. If a “Processing” message does not appear by the Application Deadline despite compliance with submission rules, please send an e-mail to the following contact address: kaikaku_mirai@jst.go.jp.

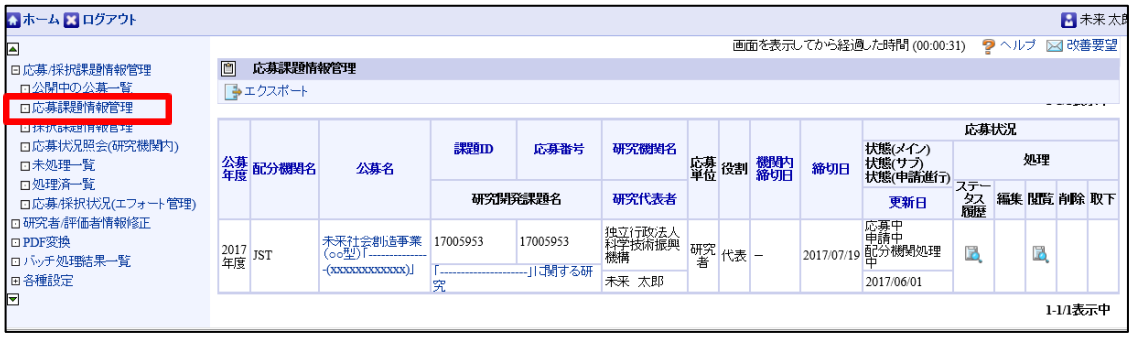



Figure Application information management (Processing)

■ Receipt by JST

When a research proposal has been received by JST after the Application Deadline, the application status is shown as “Application Complete” or “Received.” It should be noted that in some cases the change in application status may not be reflected until several days after submission.

Please make sure to visit our Invitation for R&D Proposals page for the latest updates and FAQs:

http://www.jst.go.jp/mirai/jp/application/research/

**【Contact for Inquiries】**

Please submit inquiries by email (except for urgent inquiries).

Japan Science and Technology Agency (JST)
Department of Research and Development Reform
K's Gobancho, 7 Gobancho, Chiyoda-ku, Tokyo 102-0076 Japan

E-mail： **kaikaku_mirai@jst.go.jp**

Tel： +81-3-6272-4004 (Mon.-Fri. 10:00-17:00*)

* Except Saturdays, Sundays, and National Holidays

[Communication by e-mail may be requested even when a question is asked by telephone.]