

Roadmap 2017

— Fundamental Concepts for Promoting Large Scientific Research Projects —

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Working Group on Large Scientific Research Projects,
Council for Science and Technology,
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Introduction

Large Scientific Research Projects (hereinafter referred to as the “Large Projects”) yielded results that have taken the lead in scientific research worldwide, by aggregating cutting-edge technology and knowledge to tackle research issues that had yet to be explored by anyone and bringing about dramatic development of those fields. Such projects will continue to necessitate strategic, systematic promotion through a long-term outlook, while garnering the support and understanding of the general public and society overall.

Regarding these things, the “5th Science and Technology Basic Plan” (Cabinet decision on January 2016) indicated the necessity of striving to strategically and systematically promote the Large Projects, which will contribute to building a nationwide joint usage/research system in Japan with the aim of strengthening the fundamental abilities of science and technology innovation. In addition, “Aiming to strengthen fundamental science abilities – Overcoming three crises and turning science into culture” (Task Force on Strengthening Fundamental Scientific Abilities, the Ministry of Education, Culture, Sports, Science and Technology, April 2017) indicated the necessity of promoting the Large Projects with the aim of building an appealing research environment, and thereby aggregating cutting-edge technology and knowledge to tackle research issues that had yet to be explored by anyone, and striving to yield groundbreaking results that have taken the lead in scientific research worldwide. Such things clearly show the necessity of such projects.

On the other hand, the Large Projects require large amounts of expenses, and it is particularly important to promote them after conducting sufficient matching between the national science policies and projects in the scientist community based on scientific objectives and thorough preparations.

Based on such a viewpoint and in light of the “Master Plan 2017” (February 2017) formulated by the Science Council of Japan, the Working Group on Large Scientific Projects (hereinafter referred to as the “Working Group”) formulated a “Roadmap”^{*} as a

* The Working Group has formulated and publicly announced three “Roadmaps” thus far. In October 2010, it formulated and publicly announced a Roadmap based on the “Master Plan” (March 2010) formulated by the Science Council of Japan. Based on the fact that the Science Council of Japan made minor revisions to the Master Plan (September 2011), the Working Group formulated and publicly announced the “Roadmap 2012” in May 2012. In addition, in August 2014, it formulated and publicly announced the “Roadmap 2014,” based on the “Master Plan 2014” (February 2014) formulated by the Science Council of Japan.

fundamental concept for promoting the Large Projects, from the perspective of clarifying priorities for promoting the Large Projects.

Based on the Roadmap, etc., the government has been working to promote the Large Projects, and we continue to expect that the government will make the utmost efforts to secure the required budgets. At the same time, we will ask the scientists communities to organize the evaluation results and tasks indicated in the Roadmap and make efforts so that follow-up results for previous Roadmaps will contribute to lively discussions and information transmission aimed at promotion of scientific research, as well as individual Large Projects.

1. Large Scientific Research Projects

(1) The Significance of Promoting the Large Projects

- The aforementioned 5th Science and Technology Basic Plan pointed out that there is a delay in building an international research network, there is slow progress in preparing an environment in which young researchers can sufficiently utilize their abilities, and therefore the fundamental abilities of Japan's science and technology innovation are weakening. In addition, it is necessary to strengthen the knowledge base for such tasks, and it is expected that promotion of the Large Projects will play a role in building an appealing research environment that is open to the world.
- Amid this environment, Japan is promoting the Large Projects such as "Search for new physics by making more advanced B Factory accelerators," "Research for joint use of Subaru Telescope," "Promotion of neutrino research through 'Super-Kamiokande'," and "Demonstration of steady-state ultrahigh-performance plasmas." Such projects have yielded groundbreaking results that have taken the lead in scientific research worldwide, by aggregating cutting-edge technology and knowledge to tackle research issues that had yet to be explored by anyone and bringing about dramatic development of those fields. And further, such projects have expanded places for cutting-edge research in a broad scientist community that is centered on universities, and played a definitive role in development of Japan's scientific research.

In addition, the Kobayashi-Maskawa Theory, which explains the breaking of CP symmetry, was proven by B Factory experiments, and neutrino vibration, which proves that neutrinos have mass, was discovered in Super-Kamiokande, and these things led to the two men being awarded the Nobel Prize in physics. This shows that the

promotion of the Large Projects has an extremely important significance for Japan, in terms of attracting outstanding researchers from throughout the world by presenting Japan's scientific research to the world, increasing interest in science among the public, particularly children who will lead the next generation, providing the public with dreams, hope, and self-confidence, and contributing to cultivating human resources in the relevant fields through research.

- Promotion of the Large Projects is an extremely effective initiative in order to strive to aggregate knowledge of researchers that goes beyond organizational frameworks and strengthen the joint usage/research system, which is an effective system that contributes to the development of Japan's scientific research. In that sense as well, formulating the Roadmap and thereby adding database-type and network-type large-scale research to the concept of the Large Projects, which conventionally emphasized building large facilities, and proceeding in a direction that covers a broad range of scientific fields, is an important development.
- On the other hand, because large investment amounts are required for the Large Projects, smooth promotion has been difficult in the austere financial situation of recent years. This is the same in other advanced nations throughout the world, and as a result of international cooperation the direction of promoting the Large Projects that have significance for human history is being strengthened. Amid such circumstances, it can be said that in various fields of fundamental science, which are Japan's strongpoints, paying sufficient attention to international competition and international cooperation while also promoting such Large Projects is essential from the perspectives of Japan's sustainable development and contributing to the world. For that reason, from now on, it will be necessary for Japan to clearly position as the basis of the nation's science policies the stable and continuous investment of fixed resources into the Large Projects, while obtaining support from all segments of society and the public.

(2) Fundamental Outlook about Large Projects

① Fundamental attributes

- Up to now, the Large Projects have generally been considered to have fundamental attributes listed below, and they have been promoted as important tasks for scientific policies. It will be necessary to maintain this outlook from now on as well.
 - ・ Projects that are carefully conceptualized and prepared for through independent evaluation based on intellectual curiosity and inquiring minds of researchers, and

through formation of agreement within the scientist community, with the objective of aiming for the pursuit of truth to contribute to the development of humanity

- Projects that are expected to produce groundbreaking results and that have taken the lead in scientific research worldwide, by aggregating cutting-edge technology and knowledge to tackle research issues that had yet to be explored by anyone
 - Projects that can support research and education at universities from a broad position and strengthen the foundation of science, while also increasing the public's interest in science, allowing Japan to exhibit leadership amid international competition and cooperation, and contributing to the world
 - Nationwide projects in which multiple research facilities form an organic network, many researchers participate under a clear promotion system, and all of the participants take on the challenges of large themes
- In light of the Science Council of Japan's Master Plan 2017, for the Large Projects that are handled under the Roadmap in Classification I [new application projects and projects stated in the Master Plan 2014 Classification I] of large scientific research projects [large facility projects or large-scale research projects that have long-term (5 to 10 years or longer) implementation periods and budget sizes that exceed billions of yen, and that are based on scientific vision and systems], things that are considered "important large research projects" serve as the foundation, and projects that are subject to hearings for important large research projects are also handled as things that are subject to selection. For things such as the scope of subject projects from now on, it is desirable to keep in mind the fundamental attributes of the Large Projects, while also considering as necessary in accordance with the circumstances.

② Implementing institutes

- In order to continue to contribute to the strengthening of the foundation for Japan's scientific research as a whole, it is appropriate for the Large Projects to be promoted by a joint usage/research system, and from such a perspective it is conceivable that interuniversity research institutes and joint usage/research center will become the main implementing institutes. It is also necessary for such institutes, etc. to broadly and actively support the promotion of the Large Projects while also fulfilling their responsibilities, through things such as bearing coordination functions aimed at consensus-building in scientist communities in each field.
- Meanwhile, even among the Large Projects carried out based on top-down decision-making with administrative agencies such as the National Research and

Development Agency as the implementing institution, for example, if consideration is given to the scientific attributes of the relevant projects and the expected results, some of them will be difficult to promote smoothly unless many researchers participate actively. Accordingly, for such projects as well, it is desirable to organize the bottom-up intentions of the scientist communities and position the projects as the Large Projects.

- Under the Roadmap, in order to make it possible to organize outstanding Large Projects that will contribute to Japan's scientific research and then obtain broad cooperation and coordination at various stages, it is expected that there will be active consideration in the Council for Science and Technology's other subcommittees, as a reference for consideration by the Working Group.

(3) About the Roadmap

① Significance of formulating the Roadmap

- For the Large Projects, it is necessary to take measures for large amounts of expenses over long periods, and it is necessary to keep in mind the overall circumstances of domestic and foreign scientific research, as well as things such as the current situation of and future prospects for public and government spending for scientific research, and conduct promotion strategically and systematically with a long-term outlook, while obtaining a lot of support of society and general public. In light of this, the Working Group is formulating and publicly disclosing the Roadmap.
- The Science Council of Japan's Master Plan 2017, which will serve as a base for the Roadmap, emphasized scientific judgment in its formulation, and states that, "in addition to including large research projects that are required by each scientific field, it is aimed at giving certain policies for the ways that Japan's large research projects should be, and is not directly involved in things such as budget allocation for resource allocation organizations." Meanwhile, although the Working Group's Roadmap does not guarantee budget measures, as a document that should be sufficiently considered for promotion of related policies, from the perspective of clarifying priority for promotion of the Large Projects, it summarizes the Working Group's evaluation results, main outstanding points, and tasks and points to keep in mind in large scientific research projects of the Master Plan 2017 that have been recognized as particularly having certain priority.
- The roles of the Roadmap are as follows:
 - By formulating a roadmap, it becomes possible to make strategic and systematic

policy decisions based on thorough scientific evaluation.

- It becomes possible to promote projects while obtaining the support of society and the general public.
 - It becomes possible to promptly and appropriately handle international competition and cooperation.
 - It becomes possible to provide the opportunity for scientist communities to voluntarily consider, from broad perspectives, future objectives and required conditions for the accomplishment of such objectives.
 - It becomes possible to promote interaction between different scientist communities and promote cross-sectoral efforts for complicated scientific challenges.
 - By having the opinions of scientist communities organized in advance in the form of the Roadmap, the following things become possible:
 - 1) Even for projects that follow top-down decision-making, it becomes easy to reflect bottom-up opinions in some ways.
 - 2) Even when new support scheme for the Large Projects are created through supplementary budget, etc., it becomes possible for scientist communities to promptly and effectively utilize it.
 - 3) For government agencies related to research and development other than the Ministry of Education, Culture, Sports, Science and Technology (MEXT), it becomes easy to ascertain the trends and specific needs of each field.
 - 4) Depending on the scientific field, in circumstances in which international cooperation is essential due to the increased scale of research, the Roadmap contributes to promotion of international cooperation, as something that indicates the outlook about promotion of the Large Projects in Japan.
 - In Europe and the United States, promotion plans (roadmaps) for the Large Projects are being formulated and promoted by things such as Europe's "European Strategy Forum on Research Infrastructure (ESFRI)," the UK's "Research Council," and the United States' "Department of Energy (DOE)." For the Large Projects, such Roadmaps are being utilized to promote the clarification of the division of roles with overseas research institutes and researchers and the building of a cooperation/collaboration system. From now on it will be necessary to further utilize the Roadmaps and promote the Large Projects with even greater awareness of international cooperation and coordination.
- ② Effects of formulating the Roadmap - Follow up -
- For deliberation about new Roadmap formulation, it is important to confirm the progress of projects that have been positioned in Roadmaps thus far, and for that

reason a follow-up investigation was conducted for 61 projects that were posted in previous Roadmaps. The following is a summary of that investigation.

(For an overview of the investigation results, please refer to the reference materials.)

- Of the 61 projects, there were 16 projects that secured financial resources (of those, 7 projects were started overall and 9 projects were partially started), 19 projects that did not secure financial resources, and 26 other projects (revision, abandonment, etc.). Of the 54 projects that were not started overall, 35 projects were re-applied for the Master Plan 2017.
 - In addition, for the 11 projects that were posted in the most recent Roadmap 2014, of the 7 projects that were given an overall evaluation of “a” for the three perspectives of “urgency,” “strategic value,” and “understanding/support of the general public and society,” three projects secured financial resources through things such as national university corporation operating expenses subsidies, and therefore it is conceivable that evaluation at the time of Roadmap formulation is playing an important role in budget creation.
 - In particular, for the Large Projects, since fiscal 2015 the Science Information Network (SINET) has been promoted as part of a “project to promote large scientific frontiers,” which aims for strategic and systematic promotion based on the Roadmaps.
- As stated above, it can be said that the execution of the projects that are stated in the Roadmaps is making steady progress. While expecting the further development in the future, it will be necessary to conduct regular follow-ups in order to continue to ascertain the circumstances for the projects for which progress was checked through this investigation.
 - From now on we would like to have expectations that lively debates will continue to be conducted in the scientist community concerning promotion and drafting of the Large Projects, and that through such debates there will be contributions to promotion of advanced and wide-ranging scientific research, including creation of new academic fields and ripple effects to different fields.

(4) Direction for Improving Promotion Policies for Large Scientific Research Projects

- Based on the state of promotion of the Large Projects thus far, in March 2017 the Working Group summarized, as “the direction for improving promotion policies for large scientific research projects” (hereinafter referred to as the “Direction for Improvements”), the direction for striving to make further improvements for the mechanisms for their implementation and evaluation. The Direction for Improvements

is organized mainly as stated below for the two matters of “(1) Roadmap formulation” and “(2) Management of the project to promote large scientific frontiers.”

① Roadmap formulation

- For projects that are subject to Roadmap selection, using the important large research projects of the Master Plan as a foundation, and also adding projects that are subject to hearings to subject to selection
- For perspectives for evaluation, creating detailed content related to “implementing institute of the project” and “legitimacy of the project”
- For evaluation procedures, adding document screening, adding standards related to the number of cases that are subject to hearings, and adding the possibility of excluding the important large research projects of the Master Plan from subject to hearings

② Management of projects to promote large scientific frontiers

- Clarifying that the support period under this work for the Large Projects will be up to the final fiscal year of the relevant annual plan (even if there is a successor plan, creating a requirement that it be posted separately in the Roadmap and receive advance evaluation in relation to this work)
- For the period of the annual plan, in principle making it ten years for large facility projects, and adding that it will be possible to add an initial operation period that also takes into consideration the number of operation years after facilities have been prepared
- For advance evaluations, creating detailed perspectives for evaluations
- For evaluation of progress, adding implementation of on-site inspections and hearings, and adding specific examples of times when evaluations should be conducted
- For end-of-period evaluations, clarifying their purpose (achieving accountability to society and the general public) and the method of implementation

- In addition, for summarization of the Direction for Improvements, in February 2017 we solicited opinions from the public (public comments), and we are using them as references for this summary and for consideration by the Working Group from now on. (For details of the Direction for Improvements and an overview of the public comments, please refer to the reference materials.)

2. Formulation of the Roadmap

(1) The Science Council of Japan’s Master Plan 2017

- In February 2017, the Science Council of Japan formulated the Master Plan 2017, which resulted from observing science as a whole, creating systems, and making 182 projects in the 24 fields that are necessary for each scientific field (including integrated fields that are related to two or more fields). The Master Plan 2017 placed importance on involvement by scientist communities, a method of soliciting proposals from committees in each field was adopted, and from among the proposed projects the important large research projects that should be implemented particularly promptly were formulated.
- The Master Plan 2017 was created from 166 new large scientific research projects (Classification I) and 16 large scientific research projects that are currently being implemented (Classification II). Of these, Classification I includes the 28 important large research projects stated above.

(2) Deliberation by the Working Group

① Policies for Roadmap formulation

- Based on this new formulation of the Master Plan 2017 by the Science Council of Japan, the Working Group conducted deliberation about formulation of a new Roadmap, and of the 166 projects that were stated in Classification I of the Master Plan 2017, it conducted document screening and hearings, as subject to selection, for important large research projects and projects that are subject to hearings for important large research projects, and positioned in this Roadmap projects that obtained a certain level of evaluation or higher.

② Deliberation for each research project

- Based on the aforementioned policies, the Working Group initially made the important large research projects of the Master Plan 2017 the foundation, made the 65 projects that are subject to hearings for important large research projects the subject to selection (of those, two cases declined to be posted in the Roadmap), and for the projects that wanted to be posted in the Roadmap it conducted document screening and deliberation, and decided on a total of 20 projects (19 from important large research projects and 1 from projects other than important large research projects) to be subject to hearings.
- Hearings was conducted over three days by seeking participation of proponents of

the 20 projects in the Working Group, and the Working Group subsequently conducted deliberation.

- The main outline of consideration is as follows:
 - The viewpoints for evaluation were based on the Direction for Improvements. In other words, evaluation was conducted from the following two aspects.
 - 1) As fundamental requirements that should be fulfilled for promoting projects: ① agreement within the scientist community, ② implementing institute of the project, ③ system for joint use, and ④ legitimacy of the project
 - 2) As viewpoints for clarifying priority for project promotion: ⑤ urgency, ⑥ strategic value, and ⑦ understanding/support of the general public and society
 - For each of the evaluation matters above, each member conducted evaluation in three stages based on screened documents or hearings for each research project, and outstanding points and tasks, etc. were organized.
 - However, members that are interested parties in the relevant project and that declared that, although they were not directly interested parties, they are in a similar situation, did not express opinions related to evaluations for document screening or hearings, and also did not participate in evaluation.
 - Based on the above, the 20 projects were organized as follows.
 - 1) Classification into “a,” “b,” or “c,” based on evaluations for the above viewpoints ① ~ ④, which are considered fundamental requirements centered on the scientific viewpoints that must be fulfilled to promote the projects.
 - 2) Classification into “a,” “b,” or “c,” based on evaluations for the above viewpoints ⑤ ~ ⑦, which clarify priority for project promotion.
 - From among the projects that respectively obtained certain levels of evaluation for items 1) and 2) above, matters that require more detailed confirmation under the Direction for Improvements, such as the system for taking responsibility for project promotion, the state of decisions for organizational intentions, the legitimacy of budget and manpower planning, the state of preparations for research and facilities, and international superiority that results from implementation at an early stage, were evaluated more rigorously and carefully considered from a comprehensive viewpoint that includes things such as the characteristics of the field, and then 7 projects that could be recognized as having particularly high levels of urgency and strategic value in order to start and materialize projects were carefully selected and a decision was made to state them in the Roadmap. We expect that these 7 projects will be realized.
 - These projects have fundamental attributes as the Large Projects, and there are additional points such as that the implementing institutes, basic designs related to

facilities, and agreement within the scientist community are clear, and sufficient consideration has been given to construction expenses, etc., and therefore they were positioned in the Roadmap.

- For all of the 20 projects, the evaluation results of items 1) and 2) above, outstanding points, and tasks and points to keep in mind were organized.
 - Those evaluation results were notified to proponents of the projects. (At the time of document screening, whether or not the project is subject to hearings, and outstanding points and tasks and points to keep in mind were organized, and notification was made.)
- It has been decided that the Science Council of Japan's Master Plan will continue to be regularly revised in the future, and this Roadmap will also appropriately respond to such revision and be regularly revised, and we will strive for organic and proactive collaboration among the scientist community, science, and the government.

3 . Aiming for promotion of the Large Projects

(1) Initiatives for Proactive Transmission of Information to Society and the General Public

- Obtaining the support of all segments of society and the general public is wholly reasonable because the research is promoted using the nation's limited financial resources. Furthermore, in order to reliably promote the Large Projects, which require large amounts of investment, it is now more important than ever to proceed by conducting consideration together with society and the general public. From now on, we expect that the implementing institutes of each research project will share with society and the general public the importance and appeal of projects, and conduct proactive and strategic initiatives such as transmitting information, in order to appropriately promote the Large Projects. For formulation of this Roadmap, from the evaluation viewpoint of "understanding/support of the general public and society," the initiatives of each implementing institute were proactively evaluated, but from now on even more proactive evaluations may be conducted.

(2) Strengthening of Communication with Society and the General Public

① Clear and easy-to-understand dissemination of objectives and content

- The Large Projects aggregate cutting-edge technology and knowledge to tackle research issues that have yet to be explored by anyone and require highly expertise knowledge. It is necessary to communicate their objectives and content clearly and in

an easy-to-understand way, so that members of the general public, from children to the elderly, will share dreams for the realization of such projects. For that reason as well, for each Large Project it is essential to set up and operate an appealing website that always transmits the progress and results of projects to society and the general public as well as researchers, in an easy-to-understand way.

- From this perspective, formulation and public announcement of the Roadmap itself is an important step in order to disclose to the general public the large direction of Japan's cutting-edge science and inspire public interest in it, and it is necessary to promote further communication about the Roadmap.

② Interactive communication between the Large Projects and society/the general public

- The following are examples of some characteristics found in fundamental science.
 - In order to obtain new knowledge in fundamental science, extremely long-term research is necessary.
 - Investment in fundamental science has a meaning of international contribution to humanity's shared "knowledge" base.
 - Although fundamental science itself does not aim for direct application, it has played a major role in opening new paths for humanity by obtaining new and deep understanding about nature.
- In order to steadily promote the Large Projects, it is important to clearly indicate the aforementioned characteristics of fundamental science, broadly communicate the fundamental significance of investing in fundamental science as well as the significance of projects, have sufficient discussions with society and the general public, and increase the sharing of awareness by researchers and society. In light of the fact that promotion of the Large Projects has a function of cultivating diverse human resources in science, it is also important to sufficiently aware of the fact that the state of that information transmission will lead to cultivation of future human resources. Because the Large Projects handle cutting-edge themes and have the possibility of stimulating broad public interest and intellectual curiosity, including researchers in other fields, the viewpoints of transmitting interesting information to researchers and faculty members in near fields and to university students and of cultivating a broad related scientist community are also important.
- For the above reasons, it is conceivable to promote efforts such as the following examples.
 - Researchers themselves communicating in an easy-to-understand way, the content

and results of projects and the appeal of science, by using various opportunities such as giving lectures at schools or public lectures

- Using the Internet, etc. to communicate not only the progress and results of projects, but also small details about activities, such as the state of facility's construction stages or reflections when results were not achieved, and striving to sufficiently receive opinions from the general public and society
- Institutes implementing projects work to improve support system, such as assigning full-time faculty members with expert knowledge about interactive communication, science communicators, and administrative staff members or creating specialized departments, etc.
- Encouraging researchers, etc. to proactively conduct communication activities and giving consideration so that their activities will lead to evaluation of individual researchers
- Providing chances for researchers to have dialogues with the general public during opportunities such as open houses, etc. held by institutes implementing projects
- Giving consideration to building a mutual trust relationship by putting in place a system to effectively provide information, etc. required by the media, and appealingly transmitting information through collaboration with journalism

③ Implementation of public comments

- In the same way as for past Roadmap formulation, for this Roadmap formulation we solicited opinions from the public (public comments), and many people actively provided their valuable opinions, which were excellent for reference. We are grateful for the cooperation of so many people. For formulation of the Master Plan and the Roadmap from now on, it is necessary to appropriately reflect such opinions.
(For an overview of the results of solicitation, please refer to the reference materials.)

(3) Aiming for Promotion of the Large Projects

- A major premise for conducting the Large Projects is that research activities themselves will be conducted appropriately. Particularly for the Large Projects, which handle large amounts of expenses and many people, it is wholly reasonable to cultivate a high level of research ethics in related individual researchers, groups, and research institutes, to promote fair research activities, and to make sufficient efforts to ensure safety for research, in order to receive support from society and the general public.
- In order to obtain new knowledge in fundamental science, extremely long-term

research is required, and it is expected that the national government will take a long-term perspective based on the Roadmap and, with the aim of steadily promoting the Large Projects, make maximum efforts to secure stable and continuous budgets for outstanding research projects that will lead the world's scientific research.

- In fiscal 2012 a “project to promote large scientific frontiers” was established, and for subsequent promotion of the Large Projects a policy of basing it on the Roadmap, etc. was clearly set forth. In the first place, it is expected that budgets related to the Large Projects are financed not only by the project to promote large scientific frontiers, but also by diverse projects such as Grants-in-Aid for Scientific Research and National Research and Development Agency operating expenses subsidies, and it is necessary for the national government to utilize various means to strategically and systematically promote the Large Projects.
- In addition, when promoting new Large Projects that are in line with the Roadmap under the project to promote large scientific frontiers, it is necessary to sufficiently reflect the opinions of the general public and related parties, based on the Direction for Improvements, and also to ensure objectivity and transparency based on viewpoints of experts of the Working Group, etc., conduct follow-ups on the state of handling the tasks and points to keep in mind indicated in the Roadmap, and then again conduct advance evaluations.
- At that time, for Large Projects that will be conducted over a long period, it is necessary to appropriately evaluate progress based on the Direction for Improvements and set a time limit for the Large Projects (in principle, up to 10 years; provided, however, that for the purpose of evaluation related to scientific results, large facility projects can add an initial operation period after facility preparation), conduct end-of-period evaluation at the stage when the time limit has arrived, and once again clarify the positioning of subsequent projects based on that evaluation.
In particular, it is necessary to make the period of support under the project to promote large scientific frontiers up to the final fiscal year of the annual plan for each project, and even if there is a successor plan, to post it separately in the Roadmap and conduct advance evaluation for implementation.
- For the Large Projects that are currently underway, it is important to set appropriate times for each project, conduct objective and highly transparent evaluations by experts, including evaluation of project operation, and give appropriate advice. It is necessary to stick to policy of selection and concentration of resources, by recommending improvements and setting policies for cancellation for projects that, as a result of

evaluations, are not expected to achieve their objectives.

In addition, with the aim of making such evaluation results stricter, we are striving for further refinement of each evaluation viewpoint, and improvement of evaluation methods through implementation of on-site investigations and hearings by members of the Working Group and cooperation by external experts serving as advisers. Because visiting research sites will particularly lead to understanding of the tasks and the motivation of researchers, including young researchers, and to evaluations that better conform to the actual situation, it is necessary to further promote such initiatives.

- For promotion of the Large Projects, it is necessary to strive for reduction of maintenance and management expenses by utilizing existing facilities and equipment and introducing new technologies and, depending on attributes and content of the project, it is also necessary for implementing institutes to continuously make further self-help efforts aimed at stable and continuous project promotion, such as promoting international cooperation that includes sharing expenses, and receiving support from third parties, including collaboration with the industrial sector.

(4) Aiming for Future Roadmap Formulation

- In order for Japan to strategically and systematically promote the Large Projects, on the premise of sufficient discussion by scientist communities in each field, it is essential to conduct objective evaluation for the Large Projects in all scientific fields. From such perspectives, in Europe and the United States several promotion projects (Roadmaps) for the Large Projects have already been formulated, and in Japan as well large scientific master plans have been formulated since 2010, mainly by the Science Council of Japan. The Roadmaps that were formulated as a result made strategic and systematic initiatives possible in scientific fields. This mechanism will be fundamentally maintained from now on as well and, as with this addition of projects other than important large research projects for the Master Plan to subject for selection as a result of the Direction for Improvements, further development is crucial.
- Based on the characteristics of scientific research that is based on independence and emergence, and in light of the Science Council of Japan's Master Plan, which was selected by focusing on scientific aspects that were proposed through efforts by the broad scientist community, the Working Group is formulating a Roadmap that has added the priority for promotion, and is aiming to making the Large Projects possible through those results and efforts from various aspects. In this scheme, collaboration with the Science Council of Japan and the Council for Science and Technology are functioning effectively, and the fact that many of the projects posted in previous

Roadmaps have been moved to some form of implementation is as stated in the previously discussed follow-up results for past Roadmaps.

- Specifically, as viewpoints that are fundamental requirements that should be fulfilled for promotion of projects, the Working Group set the following four things: ① agreement within the scientists community, ② implementing institute of the project, ③ system for joint use, and ④ legitimacy of the project. In addition, as viewpoints for clarifying the priority for promotion of the Large Projects, it set the following three things: ⑤ urgency, ⑥ strategic value, and ⑦ understanding/ support of the general public and society, and it conducted deliberation about formulation of this Roadmap in the same way as past Roadmaps. We expect that those results will be shared by the Science Council of Japan and the broad scientist community, attention will be paid to the results of follow-ups for the projects posted in this Roadmap and to formulation of a more advanced Roadmap for the next period, and that Japan's Large Projects will be effectively promoted.
- It is hoped that the scientist community will continue to draft outstanding Large Projects that are truly necessary for the development of Japan's scientific research and science and technology, that those projects will be reflected in the Master Plan to further enhance the mechanism for effective utilization in policy judgments.
- In addition, based on these things, parties related to science and technology, such as the Science Council of Japan, which formulates the Master Plan, the Council for Science and Technology, which formulates the Roadmap, and related government agencies, conducted even deeper and broader promotion of mutual information exchanges and collaboration about the ways of promoting the Large Projects, the Master Plan, and the Roadmap, and we expect that, through clear and effective functioning of the cycle of drafting, implementing, evaluating, and improving, stratified and strategic promotion of the Large Projects can be aimed for in Japan, and that this will result in expansion of an appealing research environment that is open to the world, and in strengthening of Japan's knowledge base.

“Roadmap” of the Fundamental Concepts for Promoting Large Scientific Research Projects

Organized according to the thinking explained below, based on the Science Council of Japan's Master Plan and the Working Group's evaluation results.

1. “Fields,” “category*,” “project names,” “project summary,” “implementing institutes,” “financial requirement,” and “project duration”: quoted from the Master Plan 2017.

* About category

“Large facility projects” have the purpose of carving out cutting-edge research, and they are large research projects in which things such as interuniversity joint research institutes serve as the main institutes for building, maintaining, and operating large facilities and their incidental equipment and facilities, based on the agreement of the scientist community.

“Large research projects” are large research projects that create new knowledge through development of large-scale systematic research, such as many researchers forming an organization over a long period and promoting observation and research for important tasks for which researchers in the field reached a consensus and acknowledged, or a large-scale data collection organization or database being built and its effective use being promoted.

• Projects and their order are based on the Master Plan 2017.

2. “Project duration”: ■...Term for building and initial investment, ■...Term for running and operation

3. Thinking concerning “evaluations”

• As fundamental requirements that should be fulfilled for promoting projects, “① agreement within the scientist community,” “② implementing institutes of the project,” “③ system for joint use,” and “④ legitimacy of the project” were set, and as viewpoints to clarify priority for project promotion, “⑤ urgency,” “⑥ strategic value,” and “⑦ understanding/support of the general public and society” were set, evaluation was conducted in three stages (◎, ○, or △) for each perspective for each research project, classification was made based on the policies below. Final decisions on evaluations were made through consultation about the legitimacy of those results.

【Main specific perspectives for each viewpoint】

① Agreement within the scientist community

• Whether the state of consensus-building in the scientist community is clear

② Implementing institutes of the project

• Whether a promotion system by the implementing institute for this project is clear

• If many organizations will participate, whether a responsibility system and division of roles are clear

③ System for joint use

• Whether a system for implementing joint use and joint research has been established; Whether a broad range of university researchers can participate

④ Legitimacy of the project

• Whether the project's preparation schedule and implementation schedule are clear

• Whether they are schedules that can be implemented

• Whether building expenses and operation expenses are appropriate; Whether sufficient consideration has been conducted

• Whether budget plans and manpower planning are appropriate; Whether sufficient consideration has been conducted

• Whether the state of preparation for the project (preparatory research, technical development, and system preparation) is being reliably conducted

• Whether the operation plan for after construction ends has been sufficiently considered

• Consideration of ripple effects and future prospects for the community after the project ends

⑤ Urgency

• The importance of implementation at an early stage, and what the merits and favorable positions that Japan can obtain through international competition and cooperation are

• What kinds of effects on Japan there are concerns about if implementation is delayed

⑥ Strategic value

• Whether global top-level results will be achieved in the relevant field and Japan's strengths will be further enhanced

• Consideration of things such as ripple effects on other fields

• Whether it will lead to international contributions and international mental circulation

• Whether it will lead to Japan's growth and development in the future

• Consideration of what Japan will lose if the project is not implemented

⑦ Understanding/support from the general public and society

• Whether it is possible to make explanations to society and the general public with persuasiveness about the project's significance and necessity

• Whether it is possible to gain support from society and the general public concerning investment of huge amounts of national expenses over a long period

• Whether a relationship of trust has been built with the local society

• 【Evaluation ①】

Classification into “a,” “b,” and “c” as stated below, based on the percentage of “△” in the total percentage (%) of evaluation results based on viewpoints ①~④, which are fundamental requirements that should be fulfilled for promotion of projects.

• Less than 20%: “a” • 20% or more but less than 40%: “b” • 40% or more: “c”

* If the percentage of “◎” (%) for evaluation results is 30% or more, it will be possible to make the evaluation results one level higher (“c” → “b” or “b” → “a”), based on consultations.

* If the percentage of “△” (%) for evaluation results is close to (within ±5%) the percentage that is the standard for the individual classification, confirmation will be made of whether the classification of “a,” “b,” or “c” is appropriate.

• 【Evaluation ②】

Creation of points for the total percentage (%) for evaluation results based on viewpoints ⑤~⑦, which clarify the priority for project promotion, and then classification, from highest points to lowest points, of “a” for the top 1/4, “b” for the middle 1/2, and “c” for the lowest 1/4

* If the result of creating points based on the percentage (%) for the relevant score is close to (within ±10 points) the points that are the standard for the individual classification, confirmation will be made of whether the classification “a,” “b,” or “c” is appropriate.

| Field | Category | Project name | Project overview | Implementing institute | Financial requirement (JPY 100 millions) | Project duration | | | | | | | | | | | | | | | Evaluation ① | Evaluation ② | Main outstanding points, etc. | Main tasks, points to keep in mind, etc. | Notes | |
|--------------------------------------|------------------------|---|--|--|--|------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|--------------|--------------|-------------------------------|--|--|--|
| | | | | | | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | | | | | | |
| relinquished world order more fields | Large facility project | Project of a low emittance synchrotron radiation facility for the coming world science and technology | Further development of materials and life sciences will be aimed for, and prompt construction and beginning of operation of a 3GeV-class high-brilliant synchrotron radiation facility based on low-cost construction and insertion devices, with low-cost construction and energy-conserving operation in the fundamental design concept. | Leading institutions in synchrotron radiation research such as RIKEN will organize a nationwide cooperation system for the construction and operation of a proposed facility. Beamline construction will be conducted by an organization formed by adding to the aforementioned organizations the organizations that apply from academic and industrial circles. | Total amount 300 Medium-energy synchrotron radiation facility construction 250, beamline construction 30, operation expenses 20 (*Land acquisition expenses not included) | 2016 | | | | | | | | | | | | | | | | a | a | <ul style="list-style-type: none"> While constructions are being made throughout the world, this project is to construct a high-brilliant synchrotron radiation light source unfulfilled by existing facilities in Japan, and utilization in a wide range of fields, such as chemistry, life science, physics, and materials science, is expected. It is also important in industrial technology development, and it is a project that is being promoted as a joint project by industry, universities, and the government. | <ul style="list-style-type: none"> It is necessary to promote further consideration aimed at starting projects, such as candidate locations for construction of facilities, cooperation with industrial sector for the purpose of stable operation, and ascertainment of the needs of a wide range of users. It is necessary to arrange the relationships with existing synchrotron radiation facilities (role sharing) and then consider comprehensive research projects. | <ul style="list-style-type: none"> It is planned that the National Institutes for Quantum and Radiological Science and Technology will be the implementing institute for this project, and by referring this Roadmap, further consideration by the related councils of the Council for Science and Technology is necessary. |
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